رؤية VISION 2030
المملكة العربية السعودية
KINGDOM OF SAUDI ARABIA

دليل المختبرات والتجهيزات العلمية
كلية العلوم - ١٤٤٣ هـ

Handbook of Laboratories and Scientific Equipment
College of Science - 1443

بسم الله الرحمن الرحيم

دليل بالمعامل والأجهزة المتاحة (طلابية وبحثية) بكلية العلوم - الجامعة الإسلامية بالمدينة المنورة

Handbook to Available Laboratories and Devices (for Students and Research) at Faculty of Science - Islamic University of Madinah

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مقدمة

بسم الله الرحمن الرحيم

والصلام والسلام على أشرف الخلق وسيد المرسلين سيدنا محمد وعلى اله وصحبه أجمعين.

في اطار حرص المملكة العربية السعودية، نحو الارتقاء بالبحث العلمي والتقدم التقني في شتى المجالات، وعلى ضوء رؤية 2030 وتناغماً مع طبيعة المرحلة فقد أولت الجامعة الإسلامية بالمدينة المنورة البحث العلمي اهتماما ورعاية بالغة ارتكز ذلك على ماورد في خطتها الاستراتيجية الثالثة ضمن أحد محاورها الأساسية وأحد أهدافها لاسيما الهدف الثامن حول تطوير منظومة البحث العلمي والابتكار وريادة الأعمال

ومن هذه المنطلقات الاستراتيجية تقدم كلية العلوم بالجامعة الإسلامية هذا الدليل بالمعامل والأجهزة العلمية الطلابية والبحثية المتاحة بالكلية حيث يحتوي هذا الدليل على البنية التحتية من الأجهزة والامكانيات المتاحة على مستوى معامل الطلاب التدريسية والمعامل البحثية لمختلف التخصصات العلمية، والذي روعي فيه عرض الأهداف المرجوة من الأجهزة المتاحة في المعامل وطرق تشغيلها موضحة بالصور المرفقة لكل جهاز.

تهدف لجنة الأجهزة والمعامل بالكلية من خلال اصدار هذا الدليل الى استعراض الامكانات والمقدرات المتوفرة من الأجهزة العلمية الطلابية والبحثية والتعريف بها للسادة أعضاء هيئة التدريس والطلاب بالكلية لتوفير بيئة علمية وبحثية محفزة للابداع والابتكار دافعة في اتجاه الاستغلال الأمثل لها في مختلف المجالات ضمن المحددات الخاصة بالأولويات البحثية لكل قسم ولتحريك عجلة البحث العلمي نحو التقدم ونقل المعرفة وصولا الى تحقيق الاستدامة البحثية من أجل رفعة الكلية في مؤشرات البحث العلمي والتصنيفات الدولية وللمساهمة في تحقيق رؤية ورسالة الجامعة الإسلامية بالمدينة المنورة.

ختاماً نتقدم بخالص الشكر والتقدير لكل من ساهم وشارك في اصدار هذا الدليل ليكون المرشد للطالب والباحث في مسيرة البحث العلمي المنشودة سائلين المولى التوفيق والسداد لكل خير.

والله ولي التوفيق

لجنة الأجهزة والمعامل بكلية العلوم

1443هـ-2022م

Controls and mechanisms for using scientific equipment in laboratories

1. Each laboratory supervisor shall train the technicians - who are authorized - to use the equipment and deal with it as needed, in a way that ensures the preservation of the equipment and adherence to the policies and regulations in force in the laboratory.
2. The technician makes sure that safety and security means are available inside the laboratory.
3. The supervisor and technician must make sure that there are models: (Operation - Maintenance - Work) on the devices for each device in the laboratory.
4. The person wishing to use the device must inform the laboratory supervisor in writing or orally of the date and time needed to do the measurements and whether he can use the device throigh filling out the form on the link: https://forms.gle/9n8jUFsR9JxAzkGh9
5. The time and date are recorded in the usage schedule of each device by the lab technician
6. The supervisor performs the measurement, or the supervisor directs the technician to accompany the beneficiary if he can use the device efficiently, or the technician performs the measurement.
7. If a box for the devices and a system for booking appointments for using the devices is created on the website of the Islamic University (Faculty of Science), the beneficiary should reserve the date and time and the supervisor or the technician (designated by the supervisor) confirms the reservation.
8. The beneficiary is obligated to apply the protocol for using the device according to the model in the device file
9. If any malfunction occurs on the device during operation, the user records the malfunction and informs the laboratory supervisor and technician immediately and stops using the device until the problem is resolved. If the supervisor or technician is not informed of the problem or causes a problem resulting from misuse, the supervisor submits a letter to the Equipment and Labor Committee to describe the incident, which in turn takes the necessary measures towards the event.
10. After the measurements are completed, the device is closed, and everything is returned to what it was before use in coordination with the technician.

11. The supervisor and technician are not responsible for drawing or interpreting the results. their role is limited to making the device available or making the measurement by supervisor or by the qualified user or by the technician.

12. If the supervisor is asked to interpret the results, perform some calculations, analyze, and write the results, he becomes a contributor to the research in which these measurements are used.

13. The lab supervisor and technician must ensure that the equipment is periodically maintained and calibrated until it is ready for use.

14. The supervisor, in coordination with the technician, introduces the annual operating requirements of the laboratory equipment at the beginning of each year to the department coordinator.

15. Each department should educate its employees about the necessity of obeying to all the rules and regulations related to the controls of the use of devices.

16. The user must abide by these controls, and the Devices and Laboratories Committee must follow up and take what is necessary to ensure their application to all its employees and students who are authorized to use the devices, without prejudice to the rules, regulations, controls and standards in force within the university.

أولا: أجهزة المختبرات في قسم الفيزياء

First: Laboratory Equipment in Department of Physics

المختبرات في قسم الفيزياء

Laboratories in Department of Physics

يحرص قسم الفيزياء بكلية العلوم في الجامعة الإسلامية منذ الإنشاء عام 1433هـ على الوصول إلى مصاف المراكز الأولى بين الأقسام المماثلة بالجامعات السعودية وتطبيق معايير الجودة العالمية. وقد كللت مجهودات القسم بالحصول على الاعتماد المشروط لبرنامج بكالوريوس العلوم في الفيزياء من هيئة تقويم التدريب والتعليم (NCAAA) بالمملكة العربية السعودية. والبرنامج هو ثالث برنامج فيزياء على مستوي المملكة يتم اعتماده، وهذا انجاز كبير وشهادة اعتراف بجودة البرنامج وجودة المخرجات التعليمية التي يحققها خريجو البرنامج. يهتم علم الفيزياء بدراسة الظواهر الطبيعية التي تحدث في العالم من حولنا ويحاول فهم وتفسير تلك الظواهر لإيجاد القوانين التي تحكمها, يدرس الطالب بالقسم عدداً من المقررات الدراسية، ويحتوي القسم على عدد من المختبرات التعليمية التي تستخدم في تدريس الطلاب ويستفيد منها طلاب القسم وطلاب الأقسام لآخري بالكلية وكذلك كلية الهندسية وهي:-

1. مختبر الفيزياء العامة (1)
2. مختبر الفيزياء العامة (2)
3. مختبر المواد
4. مختبر الإلكترونيات
5. مختبر الضوء الطبيعي
6. مختبر فيزياء الجوامد
7. مختبر الفيزياء النووية
8. مختبر الفيزياء الحديثة والذرية
9. معمل أبحاث الخلايا الشمسية
10. معمل أبحاث القياسات الفيزيائية
11. معمل أبحاث التحضيرات الفيزيائية

No.	Lab Name	Lab No.	Floor	Lab supervisor	Lab Technician
1	General Physics Lab (1)	008+204	GF + 2nd	Mr. Adel Alrehaily	Mr. Mohamad Najee Albokmy
2	General Physics Lab (2)	002	GF	Dr. Yasser Adbelrady Ismail Prof. Essam Elsayed Assem Prof. Mohd. Mudassir Husain	Mr. Mohamad Najee Albokmy
3	Materials Lab	303	3rd	Prof. Sedky Mohamed Hamed	Mr. Mohamed Elbadrany
4	Electronics lab	001	GF	Prof. Mohamed Ben Ghanem	Mr. Mohamed Elbadrany
5	Optics lab	001	GF	Dr. Mohamed Nazer Khan	Mr. Mohamed Elbadrany
6	Solid State Physics Lab	006	GF	Prof. Adel Ashour Mohamed	Mr. Khalid Alfahidi
7	Nuclear Physics Lab	003	GF	Prof. Khalaf Hammad Gad	Mr. Khaled Al-Fehedy
8	Modern and Atomic Physics Lab	006	GF	Dr. Mohd Tawqeer Khan	Mr. Abdelaziz Algohany
9	Physical Preparation methods	202	2nd	Prof. Mohamed Shaban Said Fadel	Mr. Abdelaziz Algohany
10	Solar Cell Research Lab	002	GF	Dr. Abdullah Almohammedi	Mr. Abd Allah Moala Alfazy
11	Equipment of Physics Measurement Lab (Research)	201	2nd	Dr. Mohd Tawqeer Khan	Mr. Abdelaziz Algohany

No.	Course Name	Number of Units
1	General Physics (1)	
2	General Physics (2)	
3	General Physics (3)	
4	Electronics	
5	Optics	
6	Modern and Atomic Physics	
7	Solid State Physics	
8	Nuclear Physics	

List of experiments for each of the practical courses in the Physics Department

No.	Name of Practical Course	List of Experiments
1	General Physics (1)	1. Measurement of Density
		2. Vectors Using The Force Table
		3. The Coefficient of friction
		4. Free Fall
		5. Hook's Law
		6. Simple Pendulum
		7. Newton's Second Law
2	General Physics (2)	1. Ohm's Law
		2. Combination of Resistance & Kirchhoff's Law
		3. Wheatstone Bridge
		4. RC-Circuit: Charging of a Capacitor
		5. RC Circuit: Discharging of a Capacitor
		6. Series Resistance - Capacitor AC Circuit
		7. Measurement of the Earth's Magnetic Field
		8. Determination of Specific Electron charge
3	Materials Lab	1. Determination of Young's modulus of a metal wire
		2. Determination of specific heat of solids
		3. Determination of the velocity of sound by using columns air
		4. Measurement of the buoyancy force

		5. Determination of the viscosity of viscous fluids
		6. Measurement of the surface tension
		7. Temperature measurement with a thermocouple
		8. Determining of the focal length of a concave mirror and convex mirror.
		9. Determining of the focal length of the converging and diverging lenses
4	Electronics	1. The rectifier diode
		2. Half-Wave Rectifier
		3. Full-Wave Rectifier
		4. The Zener diode 1 (The Volt-Ampere characteristic curve)
		5. The Zener diode 2 (Regulated Voltage Supply)
		6. The common emitter
		7. Transistor familiarization
		8. The Silicon Controller Rectifier
		9. The TRIAC
5	Optics	1. Determination of the refractive index (n) of the material of a prism using spectrometer
		2. Determination of the Wavelength of Sodium Light using Newton's Rings
		3. The Diffraction Grating: Measuring the Wavelengths of Light
		4. Determining the velocity of light in the air/liquid/solid from the path and transit time of a short light pulse (Velocity of light: Measuring with short light pulses)
		5. Irradiance and Inverse-square Law for Light
		6. Study of polarization by verification of Malu's law
		7. To study diffraction of light using a slit
		8. To determine the wavelength of light of the

		used laser with Michelson interferometer
		9. Stefan-Boltzmann law: measuring the radiant intensity of a “black body” as a function of temperature
6	Solid State Physics	1. The Photoconductivity
		2. The Elasticity (Stress – Strain)
		3. The Hysteresis Loop
		4. The Hall Effect
		5. The Four Point Probes
		6. The Dielectric Constant
		7. X-Ray
		8. The Magnetic Susceptibility
		9. The Solar Cell
7	Nuclear Physics	1. Characteristics of the Geiger counter
		2. Determining the Half-life of Ba-137
		3. Inverse Square Law
		4. Gamma Ray spectroscopy Using a Scintillation Detector Nal (Ti)
		5. Absorption of Gamma Rays
		6. Effect of Magnetic Field on Alpha Particles
		7. α Spectroscopy of Radioactive Samples
		8. Recording a β Spectrum with a Scintillation Counter
		9. Quantitative Observation of the Compton Effect
		10. Nuclear Magnetic Resonance in Polystyrene, Glycerin and Teflon
8	Modern and Atomic Physics	1. Alpha Particles Scattering
		2. Millikan's Experiment
		3. Frank-Hertz Experiment
		4. Electron Diffraction
		5. Determination of the Specific Charge of the Electron
		6. Photoelectric Effect
9	Physical Preparation	1. Liquid Nitrogen Maker

	Methods	2. Ultrasonic cleaner
		3. UV-Vis-IR spectophotometer
		4. Polishing Machine
		5. small Optical table
		6. Heating magnetic stirrer with timer
10	Equipment of Solar Cell Research Lab	1. Water Purification System (for Type I & II water)
		2. Analytical Balance
		3. Desiccator with Vacuum Bump for Chemical Storage
		4. ITO-Substrate and Glass Cutter
		5. Ultrasonic Cleaner, USC 500-TH
		6. Heating Magnetic Stirrer with Timer
		7. Lab TechLMS-2003D, Korea
		8. Vacuum Oven
		9. Oxygen-Plasma Cleaner
		10. Spin Coater for Preparing of Layers outside Glove Box
		11. Drying Oven
		12. Digitally Controlled Glove Box with Thermal Evaporation System
		13. Transparent Glove Box
11	Equipment of Physics Measurement Lab (Research)	1. Alpha particles scattering
		2. Millikan's experiment
		3. Frank-Hertz Experiment
		4. Electron diffraction
		5. Determination of the Specific Charge of the Electron
		6. Photoelectric Effect
12	Some of Solar Cell Applications (Research)	1. Smart Greenhouse Powered by Photovoltaic System
		2. Hybrid Solar Still-Solar Heater

أجهزة المختبرات في قسم الفيزياء

Laboratory Equipment in Department of Physics

1- محتويات مختبر الفيزياء العامة (1) من التجارب

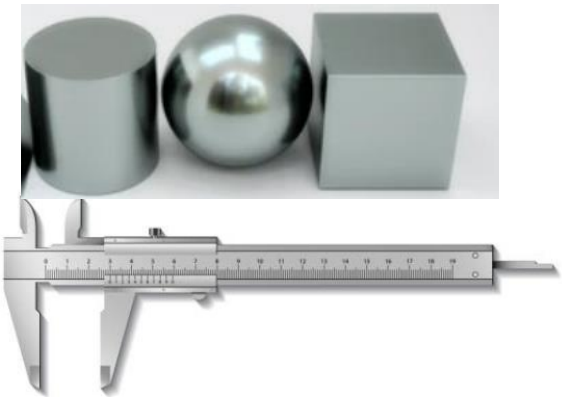
1- Experiments of General Physics Lab (1)

Experiment 1: Measurement of Density

Objectives:

- Determine the mass and volume of three different objects of different metals.
- Calculate the density of each object and compare with the accepted values of the density of the metals.
- Determine the uncertainty in the value of the calculated density caused by the uncertainties in the measured mass, length, and diameter.

Pictures



Procedure

1. Use the laboratory balance to determine the mass of each of the three objects.
2. Use the vernier calipers to measure the dimensions of the three objects
3. Calculate the density ρ of each of each object. Record the results in the Data Table
4. Calculate the uncertainty in the density
5. Calculate the percentage error in your results for the density of each of these metals
6. Assume that the density of aluminum is 2.70 gram/cm^3, the density of brass is 8.40 gram/cm^3, and the density of steel is 7.85 gram/cm^3

Experiment 2: Force Table

Objectives:

- In this experiment we will investigate the general properties of vectors noting their resolution into components and their additive properties

Pictures

Procedures

PART 1. COMPONENTS OF A FORCE

1. Arrange identical masses of 200 g at positions of 40˚ and 220˚. These masses should balance
2. Now, remove the mass at 40˚and by trial and error find the amounts of mass that can be hung at 0˚ and 90˚ to balance the mass at 220˚. These are the x- and y-components of the force of 200 g at 40º.
3. Calculate the x- and y-components of the vector with a magnitude of 200 g and direction of 40˚ as shown in Figure-3 and record them in Table-1
4.

PART 2. ADDITION OF TWO VECTORS

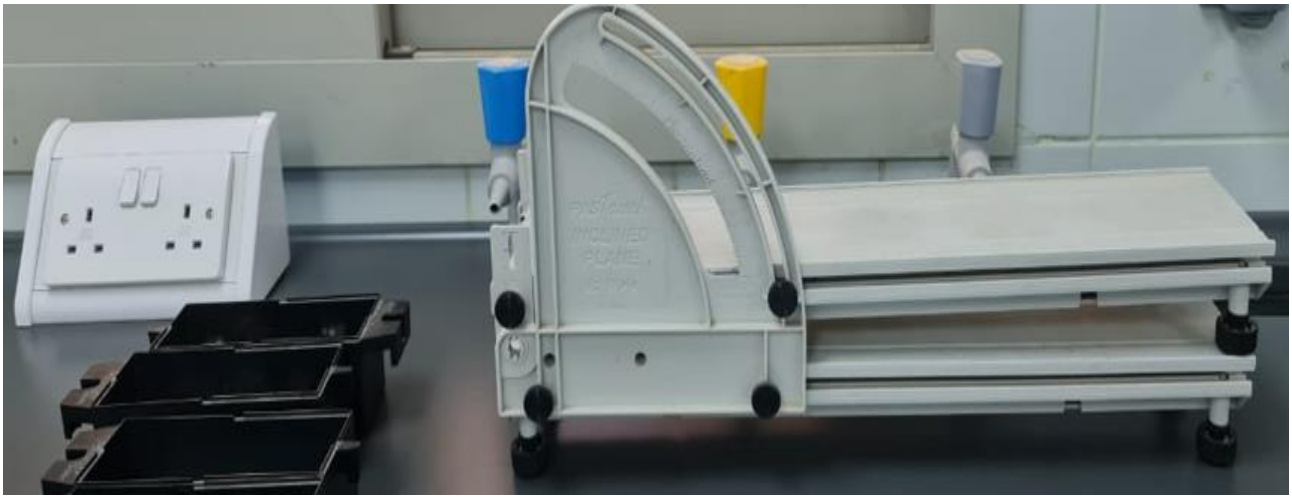
1. To find the resultant of two forces: a 200 g force at 30º and a 200 g force at 120º by the same method useTable-2

Experiment 3: The Coefficient of friction

Objectives:

- Measure the coefficient of static friction for contacting surfaces by measuring the angle of repose for a block on an inclined plane.
- Measure the coefficient of kinetic friction for contacting surfaces by the constant speed method

Pictures



Procedures

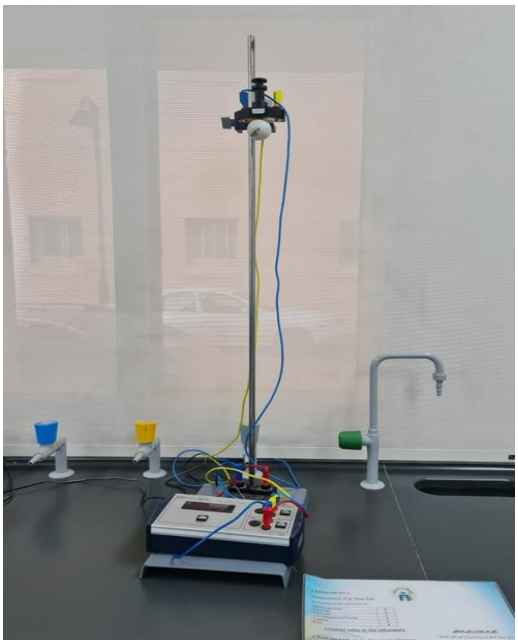
1. With the adjustable section horizontal, place the block near its upper end (farthest from the hinge)
2. Slowly and carefully raise the adjustable section, until the block just begins to slide. Read and record the angle of elevation θr of the adjustable section in Table-1
3. Repeat this four times, for a total of five trials, recording five different measurements of
4. θr For consistent results, use the same face of the block each time, and start the block from the same place on the board each time
5. Add 200 g to block and repeat the previous procedure to find μs
6. Add another 200g to the block for a total of 400 g added mas and repeat the previous procedure to find
7. Repeat the previous procedure for another block (you can call it Block #2)
8. Repeat the same procedure for Kinetic friction
9. Calculate the average angle r. Then use this average value to calculate the coefficient of static friction by using μs =tan θr .
10. Find the average value obtained for the coefficient of static friction s
11. Calculate the average angle r. Then use this average value to calculate the coefficient of static friction by using μs =tan θr . Record your data on Table-2 above.
12. Find the average value obtained for the coefficient of static friction s
13. Calculate the average angle k. Then use this average value to calculate the coefficient of static friction by using μk=tan θk. Record your data on Table-3 above.
14. Find the average value obtained for the coefficient of kinetic friction μk
15. Calculate the average angle k. Then use this average value to calculate the coefficient of static friction by using μk =tan θk . Record your data on Table-3 above.
16. Find the average value obtained for the coefficient of kinetic friction μk

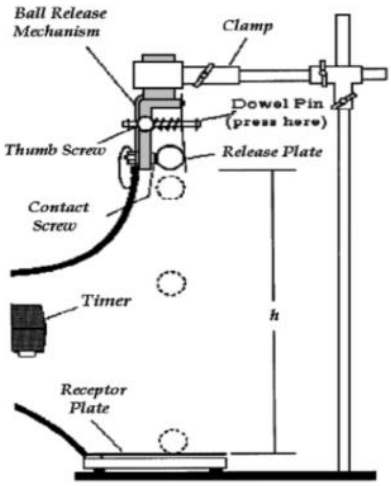
Experiment 4: Free Fall

Objectives:

- determine the value of g, the acceleration of an object in free fall near the surface of the Earth.

Pictures





Procedures

1. Set up the apparatus. The millisecond timer starts when the ball is released and stops when the ball hits the trapdoor. Use the first steel ball
2. Set the height h to 40 cm (using a meter stick). Press the reset button on the timer, and then push to release the ball which drops and falls on the receptor plate. Record the time of fall t in Table-1
3. Repeat the measurement three times for this height h and take the smallest time as the correct value for t
4. Increase the height h by about 10 cm and repeat the measurements made in the previous steps. Increase the height again by 10 cm and repeat the measurements until the height increases to approximately 100 cm
5. Repeat steps 1 through 5 for a different steel ball and record your data in Table-2
6. Calculate the value of g for each height using the Equation-1, $g=2h/t^2$ and record it in the appropriate column of your data table.

7. Calculate the average value of g
8. Compare your result with the accepted value of 9.8 m/s^2 by calculating the percent error (% error).
9. Plot a graph of height t^2 versus h. Draw the best straight line fit of the data and determine the acceleration due to gravity from the slope. With h on the x-axis and t^2 on the y-axis, the slope is 2/g.
10. Show your calculation of the slope on the graph.

Experiment 5: HOOK'S LAW

Objectives:

- Measure the spring constant of one particular spring by two methods:
- Directly determine the spring constant k of a spring by measuring the elongation versus applied force.
- Determine the spring constant k from measurements of the period T of oscillation

Pictures

Procedures

Part 1: The Static Method

1. Begin by measuring the position of the spring. This is your equilibrium position. Record this as y0 in your data sheet (Table-1)
2. Attach a 50-gram (0.050 kg) mass holder to the spring and measure the new position y1 to which the reference point on the spring is extended. Record mass and the position with the 50-gram mass holder in Table-1
3. Add additional 50-gram masses to the mass holder and record the position of extension yi each time the mass is increased by 50 grams until the total mass reaches 350 grams
4. Compute the applied force F that the masses exert on the spring by calculating the Calculate the displacement Δy of the spring, which is the amount the spring is stretched and is calculated by taking the difference between the extended position yi and the equilibrium position y0, ($\Delta y = yi - y0$). Record your results in Table-1

Part 2: Dynamic Method

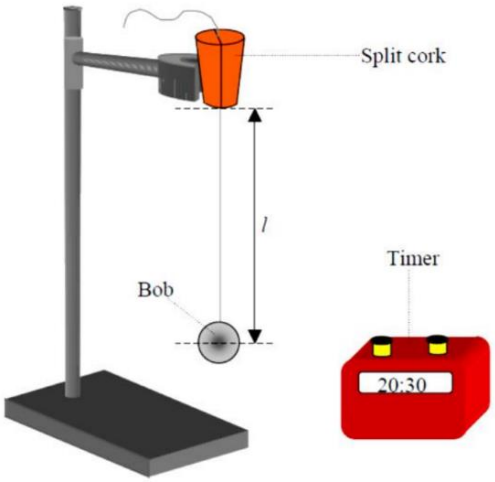
5. Attach the hanger to the spring (mass = 0.050 kg) and let it hang at rest.
6. With only the hanger attached to the spring, measure the period of vibration by first displacing the holder about 5 cm below the equilibrium. Release it, and let the system oscillate and then measuring the total time (t) for 30 complete oscillations Record your data in Table-2.
7. Add an additional 50 grams to the hanger and repeat step 2 until the total mass reaches 350 grams (including the hanger)
8. Calculate the period of oscillation T for each oscillating mass by dividing the total time t by 30.
9. Record the results in Table-2. Also record the values of T^2 in Table-2.
10. Graph the applied force F to the spring as a function of its displacement Δy.
11. Plot the displacement Δy on the horizontal axis (x-axis) and the applied force on the vertical axis (y- axis). Draw the best straight line fit of the data.
12. The spring constant k will be the slope of the straight line (slope =k). Calculate k from the slope.
13. 1. Plot T^2 (y-axis) vs. M (x-axis). Draw the best line fit of the data. The slope is equal to $42/k$.
14. Calculate the spring constant k from your value of the slope.

Experiment 6: Simple Pendulum

Objective

- Investigate the dependence of the period T of a pendulum on the length L and the mass M of the bob.
- Determine an experimental value of the acceleration due to gravity g by comparing

Pictures



Procedures:

1. Set up the pendulum as in the Figure 1, and Adjust the length L to about 20 cm. The length of the simple pendulum is the distance from the pivot point to the center of the ball
2. Displace the bob from its equilibrium position by a small angle (<10°) and then release the bob to swing back and forth
3. Measure the total time (t) it takes to make 10 oscillations. Record your data in Table-1.
4. Note: Greater accuracy can be obtained by timing for ten oscillations and dividing the result by 10 rather than to time just a single oscillation
5. Calculate T by dividing the total time t by 10 to get the periodic time T. Record your results in Table-1. Calculate also T^2 and record it in Table-1
6. Repeat the procedure for lengths near 40cm, 60cm, 70 cm, and 80cm. Be sure to record the length L for each pendulum

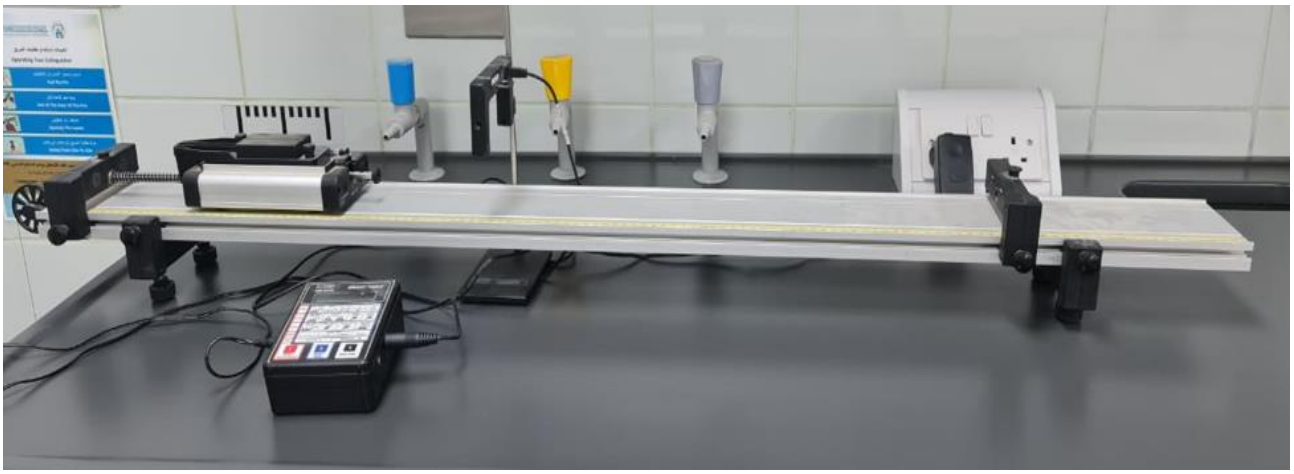
7. Calculate the value of g for each length and record it in the appropriate column of your data table using:
8. Calculate the average value of g and compare your result with the accepted value of 9.8 m/s^2 by calculating the percent error (%error).
9. Plot a graph of height T^2 versus L. Draw the best straight line fit of the data.
10. Determine the acceleration due to gravity from the slope. With L on the x-axis and T^2 on the y-axis, the slope is
11. Compare your result with the accepted value of 9.8 m/s^2 by calculating the percent error (%error).

Experiment 7: Newton's Second Law

Objectives:

- To investigate Newton's Second Law using a dynamics cart in order to find the relationship between force, mass, and acceleration.

Pictures



Procedures:

1. Keep the cart a distance of at least 5 cm from the front of the photogate before releasing it. Starting the cart a nearer distance than this, may cause the gate not to function properly
2. Put 500g on the cart and place the cart at the starting position. With no masses attached to the hanger, release the hanger and record the acceleration recorded by your timer Record the acceleration and the total mass of the hanger in Table-1
3. Repeat the previous step for a total of three trials and record the acceleration each time in Table-1

4. Add 20 g to the mass hanger and repeat steps 2 and 3. Keep adding 20g each time until the hanger has a total mass of 140 g. Make sure to be recording the acceleration for each trial in Table-1
5. Calculate the external force acting on the cart, which is the total weight of the hanger F=W= mg. Record these TABLE-1.
6. Calculate the average acceleration of the tree Trials and record this in TABLE-2
7. Plot the average acceleration (a) versus the external force (F). With (F) on the x-axis and (a) on the y-axis. Draw the best straight line fit of the data. From the slope calculate the mass of the empty cart.

تابع: أجهزة المختبرات في قسم الفيزياء

Laboratory Equipment in Department of Physics

2- محتويات مختبر الفيزياء العامة (2) من التجارب

(مختبر الكهرباء والمغناطيسية)

2- Experiments of General Physics Lab (2)

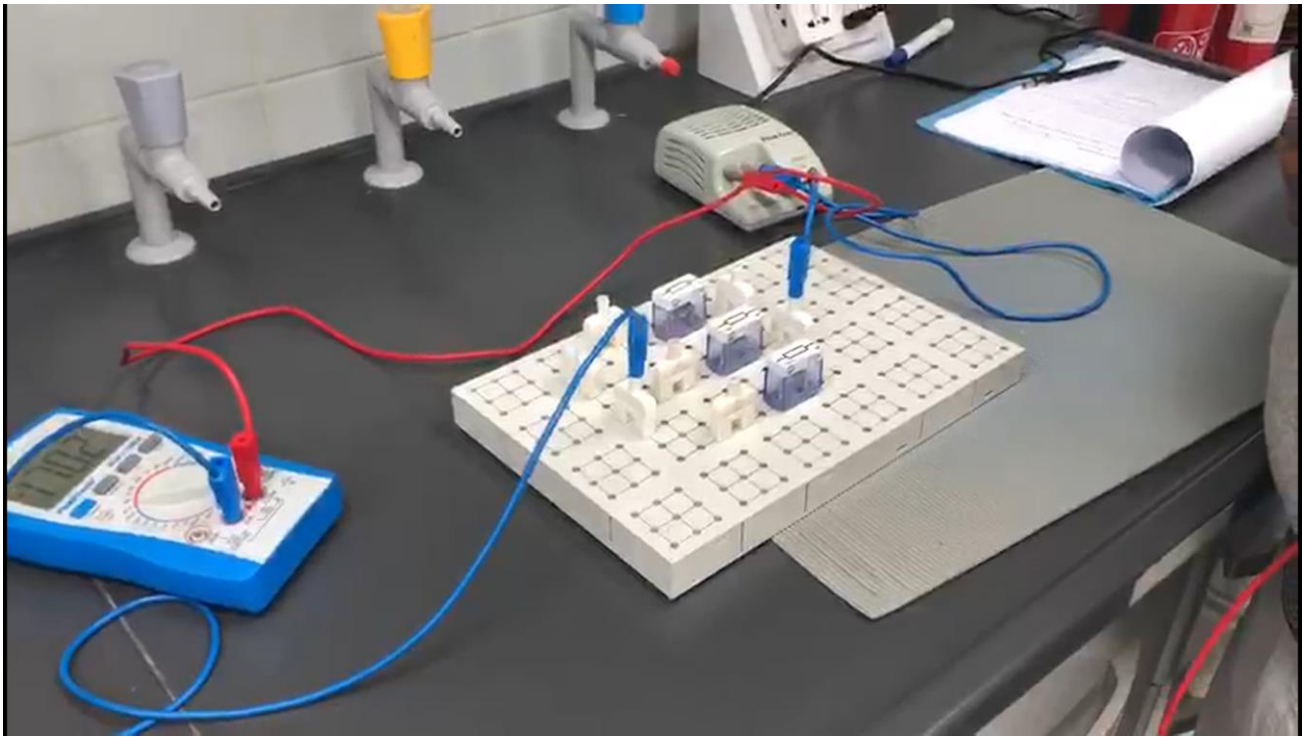
(Electricity and Magnetism Lab)

Experiment 1: Ohm's Law

Objectives:

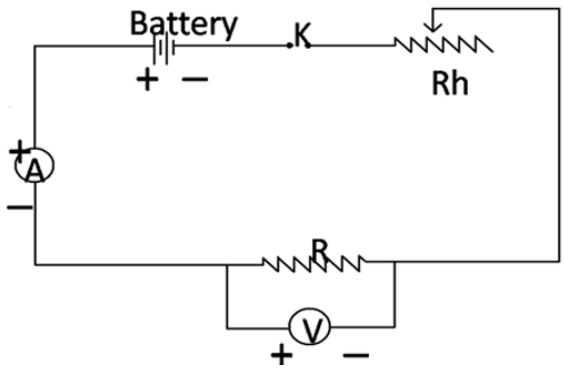
- To perform an experimental check of Ohm's Law
- To practice constructing electric circuits

Pictures:



Procedures:

1. Connect the circuit shown below using a fixed resistance R.



2. Set the value of electromotive force into certain voltage (electromotive force).
3. You can get different readings of the current and voltage by varying the rheostat position.

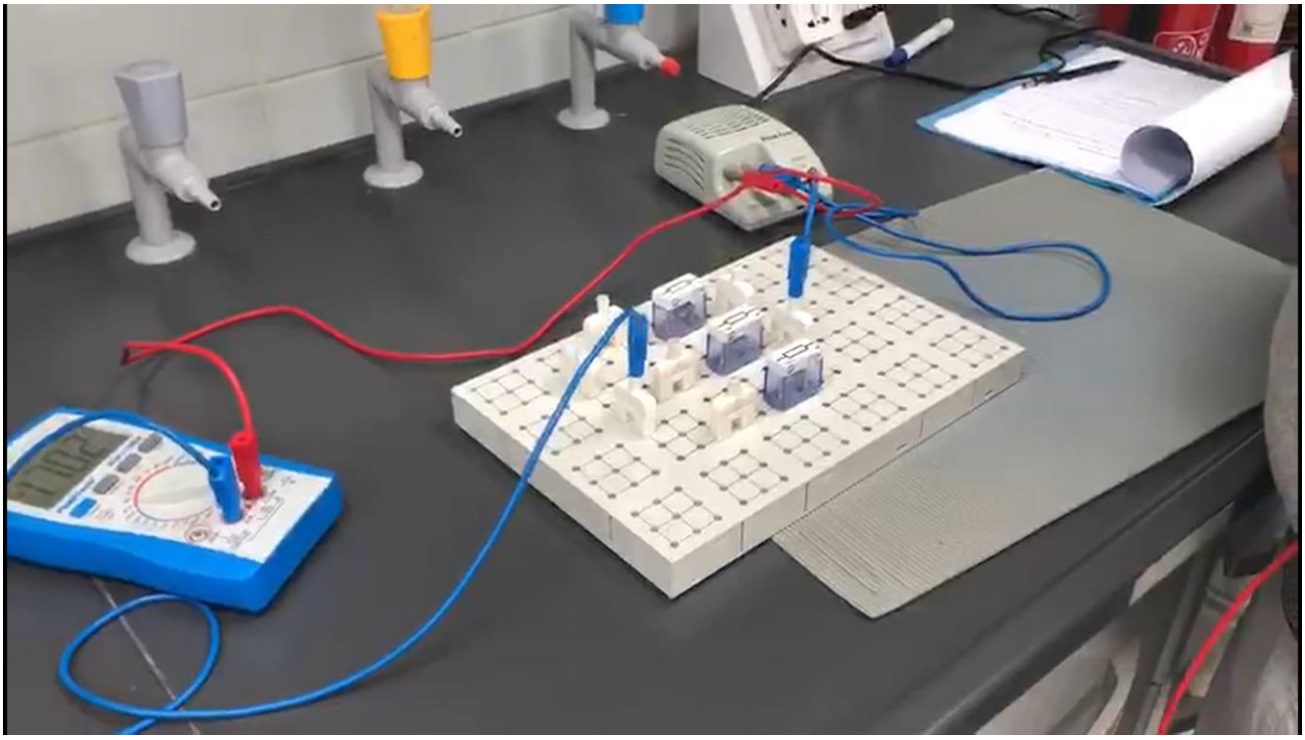
4. Record the value of the current through the resistance and the voltage across it.
5. Slide the bar on the rheostat to change the current flowing through the circuit and record the values of I and V.
6. Repeat step 5to get at least 5 different readings.
7. Record the data in Table
8. Repeat the previous steps for another value of the resistance. Record the data in Table2.
9. Plot a graph of the voltage (V) and the current (I), with V on vertical axis and (I) on horizontal axis. Draw the best straight line fit of the data.
10. Determine the slope of the straight line which is the resistance R in this case.
11. Plot a graph of the voltage (V) and the current (I), with V on vertical axis and (I) on horizontal axis. Draw the best straight line fit of the data.

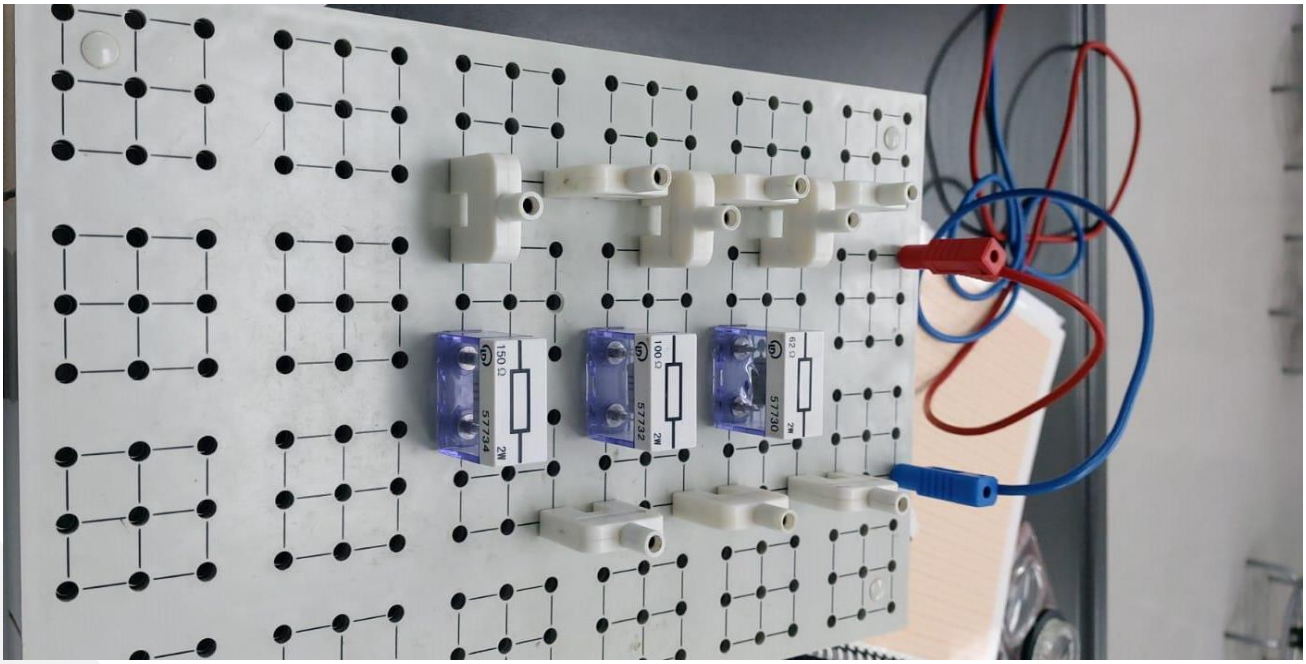
Experiment 2: Combination of Resistance & Kirchhoff's Law

Objectives:

- To find the equivalent resistance of series and parallel resistors.
- To verify the Kirchhoff's current Law and voltage Law.

Pictures:





Procedures:

Part 1: Kirchhoff's voltage Law and resistance in series

1. Connect the circuit as shown in Figure 5. Make sure to record the values of R_1, R_2, and R_3 in your data sheet.

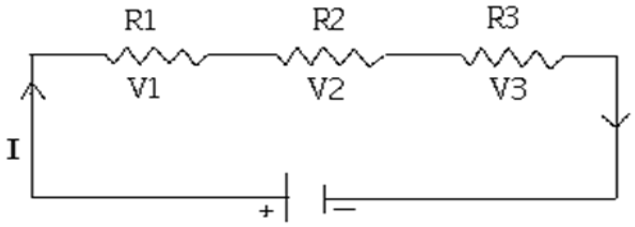


Figure 5

2. Set the power supply to the 6 V. Measure the voltage across the power source V_s, and across each resistor V_1, V_2, V_3. Record these values in your data.
   Note: The voltmeter must be connected in parallel with each resistance.
3. Measure the total resistance by digital multimeter and record in the table.
4. Calculate the % error in your measurement.
5. Repeat the above procedure for 12 V.
6. Add the three voltages (V1+V2+V3) and record your answer in the Table.
7. How the total voltage Vtotal compares to the Source voltage Vs. To answer this, calculate the percentage difference (% Diff) between the two and record the value in the Table.
8. Measure the total resistance by digital multimeter and record in the table.
9. Calculate the % error in your measurement.

Part 2: Kirchhoff's Current Law

1. Connect the circuit as shown in Figure 6. Make sure to record the values of R_1, R_2, and R_3 in your data sheet

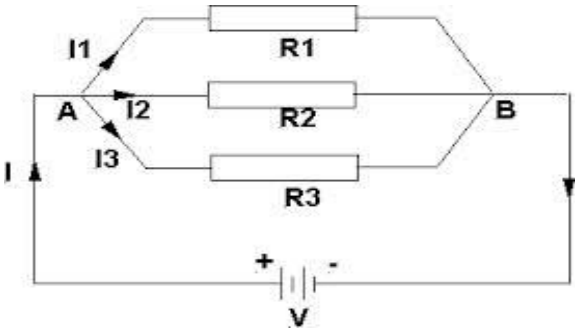


Figure 6

2. Set the power supply to the 6 V. Measure the current through the circuit I and through each resistor I_1, I_2, I_3. Record these values in your data.

Note: the ammeter must be connected in series with each resistance. Ask your instructor how you accomplish this on the board. This is not easily done as the voltage measurement.

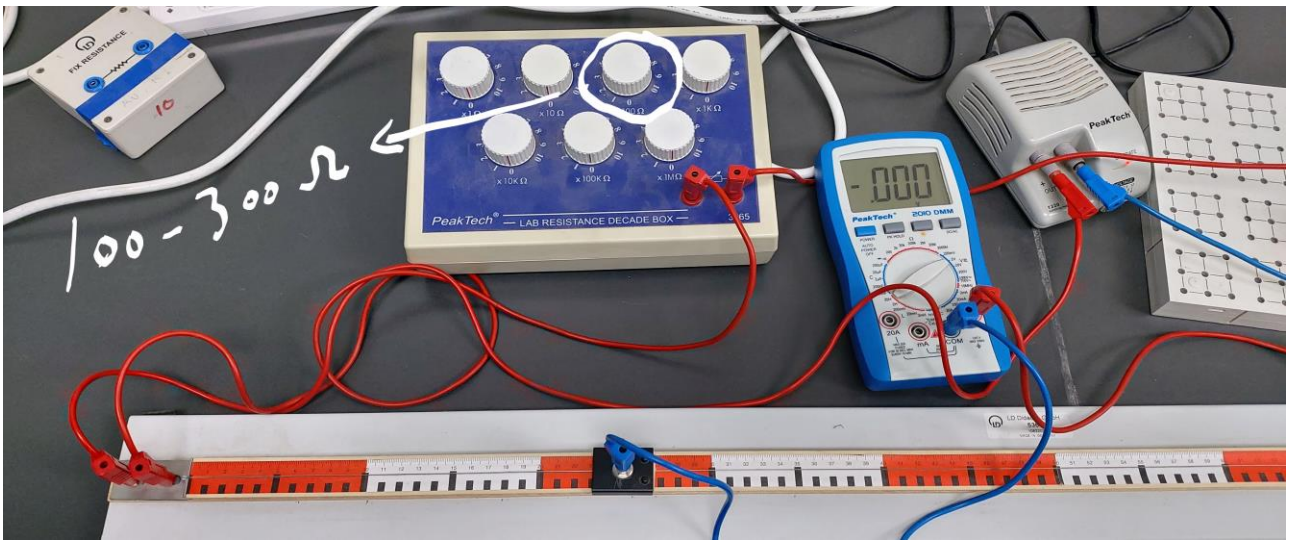
3. Measure the total resistance by digital multimeter and record in the table.
4. Calculate the % error in your measurement.
5. Repeat the above procedure for 12 V.
6. Add the three currents (I1+I2+I3) and record your answer in the Table.
7. How the total voltage Itotal compares to the output current I. To answer this, calculate the percentage difference (%Diff) between the two and record the value in the Table.
8. Measure the total resistance by digital multimeter and record in the table.
9. Calculate the % error in your measurement.

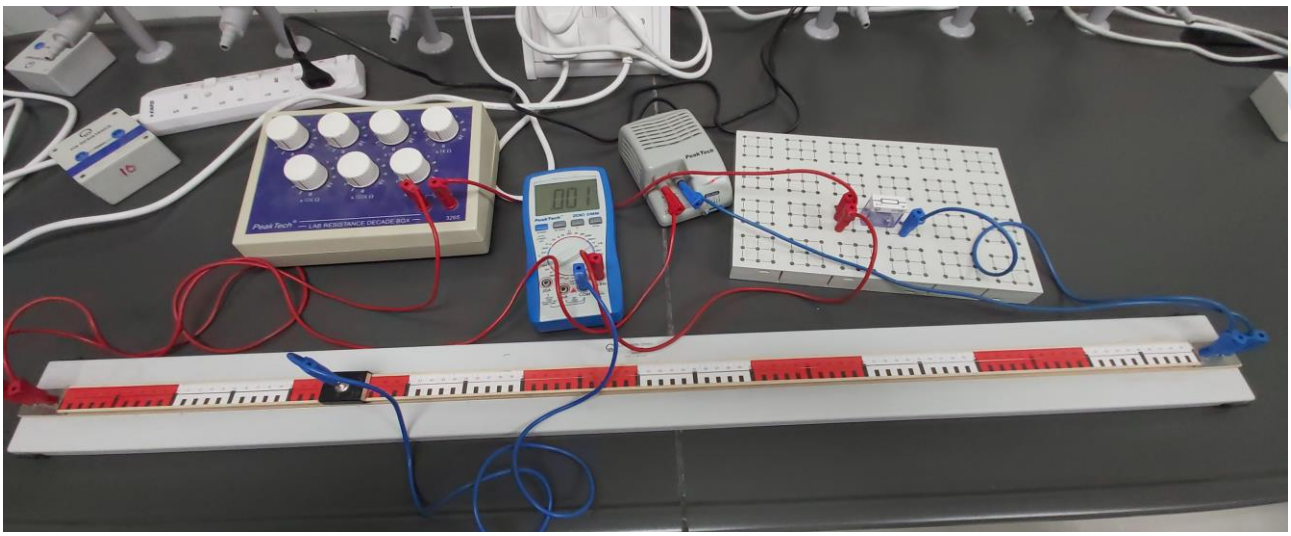
Experiment 3: Wheatstone Bridge

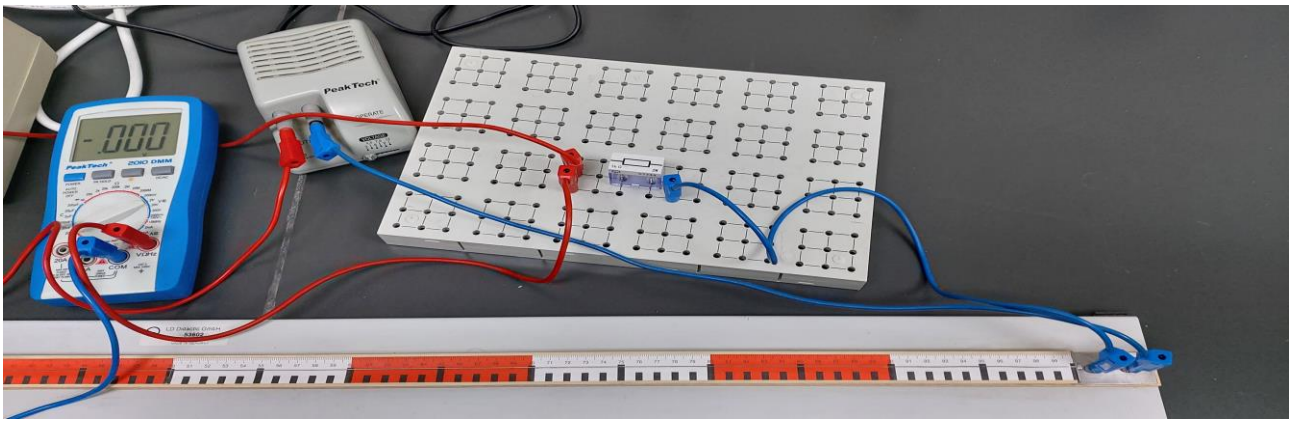
Objectives:

- To investigate the principles of operation of a slide-wire form Wheatstone bridge and determine the resistance of several unknown resistors.

Pictures:

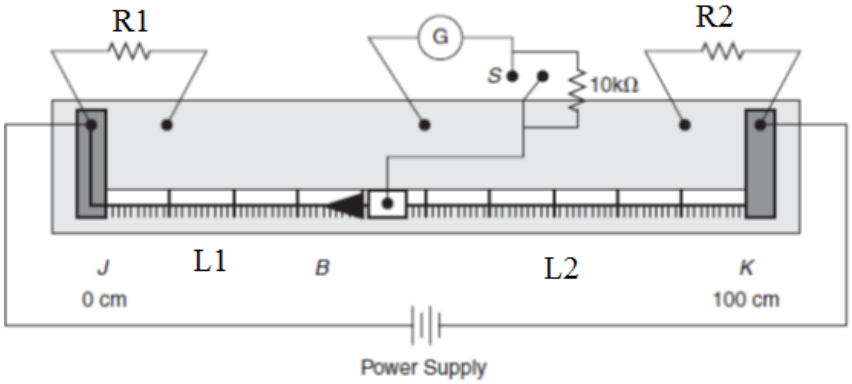






Procedures:

Part 1: Testing the Balance Condition



1. Connect the circuit as shown in the Figure 3.2. Use a fixed known resistance for R_1=100Ω. The resistance R_2 is a box resistance with variable resistances.
2. Set the resistance box to a given value (eg. 200Ω).
3. Close the switch and slide the wire until you reach equilibrium (current is zero). Read the value of the Lengths L_1 and L_2 and record them in Table-1.
4. Open the switch. Change the value of R_2 as indicated in the Table and repeat step 3.

Part 2: Finding Unknown resistors

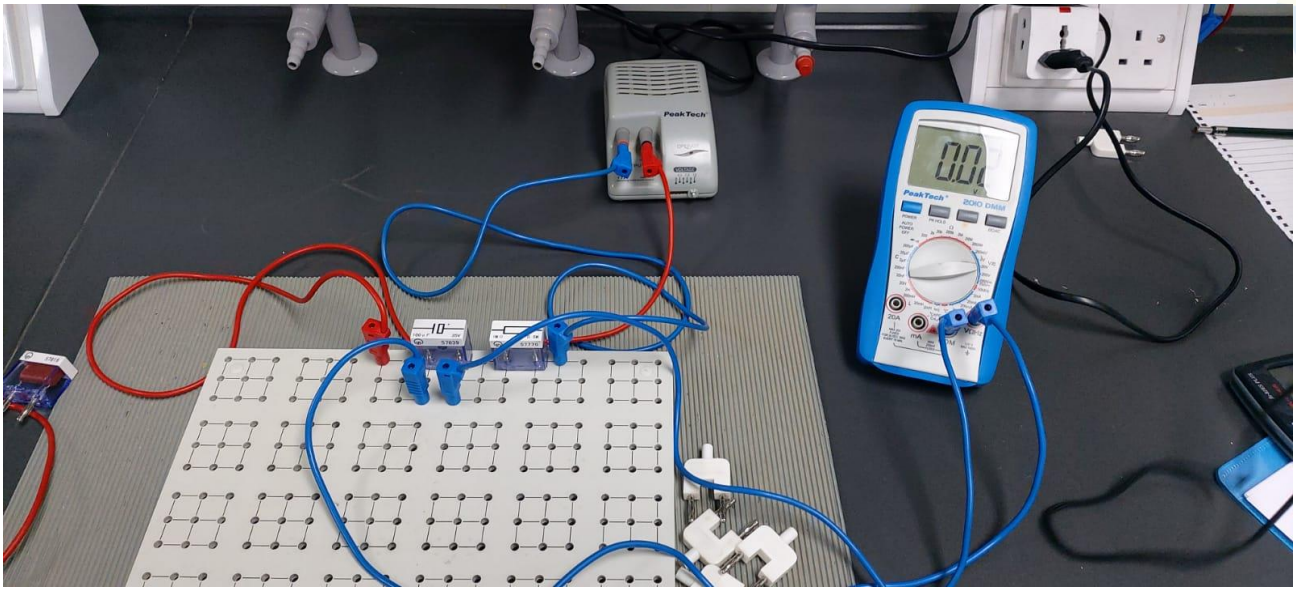
1. Adjust the power supply voltage to 3 V. Leave the power supply fixed at this value for all the measurements. All measurements should be made with this same voltage, which has been chosen so that the currents in all resistors of the circuit will be small. This ensures that there is no heating of the resistors. Any significant heating of the resistors could cause differential increases in resistance and would lead to errors.
2. Place the first unknown resistor in the Wheatstone bridge circuit in the position of R_1 in the circuit of Figure 3.2. Place the resistance box in the position of (R_K) R_2 in Figure 3.2 and choose a value for R_K approximately equal to the nominal value that you read from the resistor code for this unknown resistor. Record the value of R_K in Data Table 2.
3. The 10 kΩ resistor and switch S in series with the galvanometer are designed to protect the galvanometer from excessive current. Be sure that each attempt to find a balance condition starts with switch S open. This places the resistor in series with the galvanometer and limits the current.
4. With switch S open, move the sliding contact at B until a balance is achieved—i.e., zero current in the galvanometer. This is a rough balance.
5. With the system at rough balance, close switch S to achieve maximum sensitivity at the final balance condition. Balance is the point where there is no deflection of the meter, which may not be at zero of the meter if the galvanometer has a zero offset.
6. Record the values of L_1 and L_2, the length of the two sections of wire at balance. The Wheatstone bridge has 1mm as the smallest marked division. Therefore, measurements of L_1 and L_2 should be made to the nearest 1mm.
7. Using the same unknown resistor, repeat Steps 3 through 6 above with two other values of R_K, one value approximately 10% greater than the original R_K, and one value approximately 10% less than the original R_K.

Experiment 4: RC-Circuit: Charging of a Capacitor

Objectives:

- Investigate the time needed to charge a capacitor in an RC circuit.
- Measure the voltage across a capacitor and the current in the circuit as a function of time in an RC circuit as a means to determine the RC time constant.
- Determine the value of an unknown capacitor and resistor from the measurements.

Pictures:



Procedures:

1. Construct a circuit such as the one in the Figure 4.3 using the capacitor supplied, the voltmeter, the microammeter and the power supply. Have the circuit approved by your instructor before turning on any power.
2. Connect the Voltmeter across the capacitor and the microammeter in series with the resistance. Use C = 100μF, R= 600 KΩ, ε= 12V and record them in Table 1.
3. Choose a predetermined values of the potential and current as illustrated in the Tables and close the circuit, start the timer, and record the times at which these values are reached.
4. <**Note**: If you can't measure the voltage and current simultaneously, you can do first measure the time required for the specified voltage to be reached. After you are done, you can repeat the experiment to measure the time required for the current to be reached>
5. Plot Vc versus time. Comment on the shape of the plot.

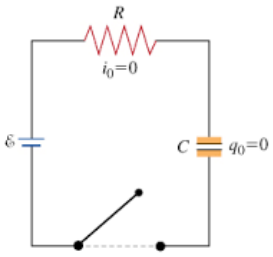


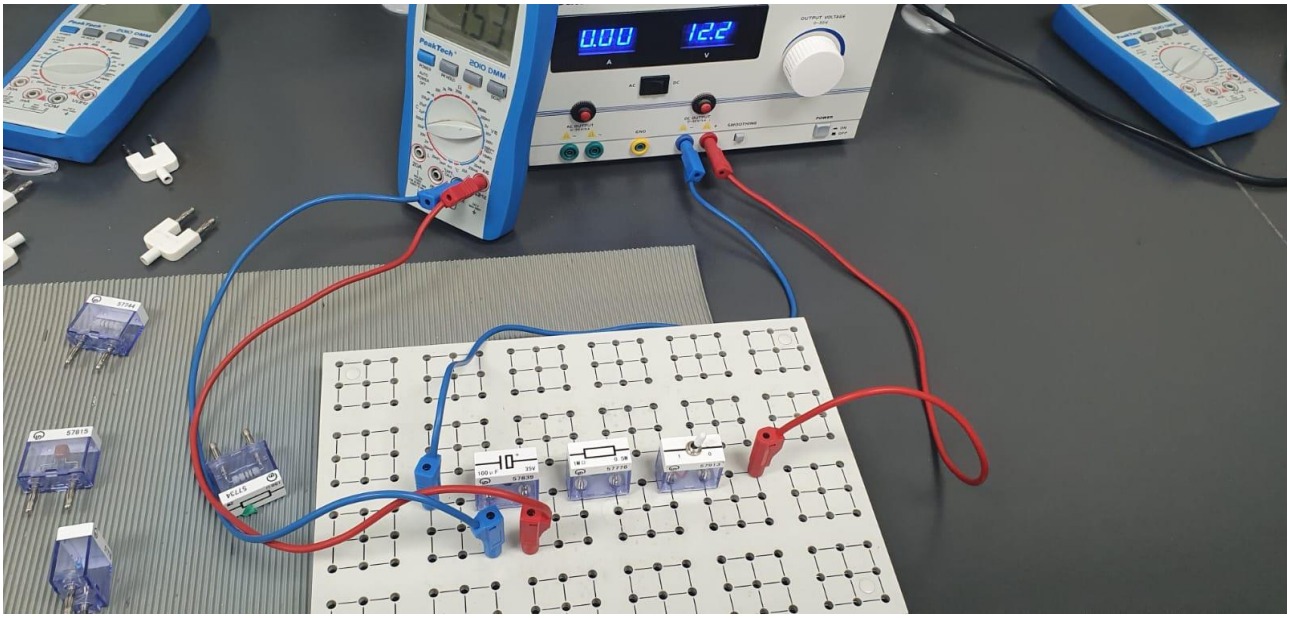
Figure 4.3: Circuit for charging of a capacitor

Experiment 5: RC-Circuit: Discharging of a Capacitor

Objectives:

- Investigate the time needed to discharge a capacitor in an RC circuit.
- Measure the voltage across a capacitor and the current in the circuit as a function of time in an RC circuit as a means to determine the RC time constant.
- Determine the value of an unknown capacitor and resistor from the measurements.

Pictures:



Procedures:

1. Charge a capacitor using a power supply and a resistance as shown Figure 5.4.
2. After the capacitor is fully charged, discharge the capacitor through the resistance R only (Remove the power supply) as shown in Figure 5.4.

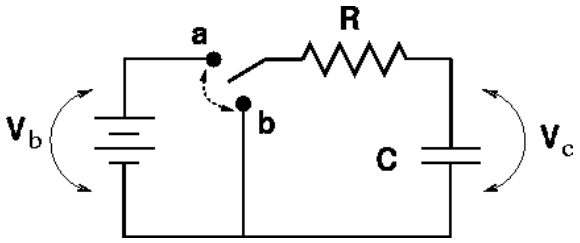


Figure 5.4

3. Start the timer and record the voltmeter reading and the ammeter reading for 10 s time intervals. Record the voltage V and current I in Data Sheet.
4. Calculate the values of ln (Vo/V) and record them in the Table

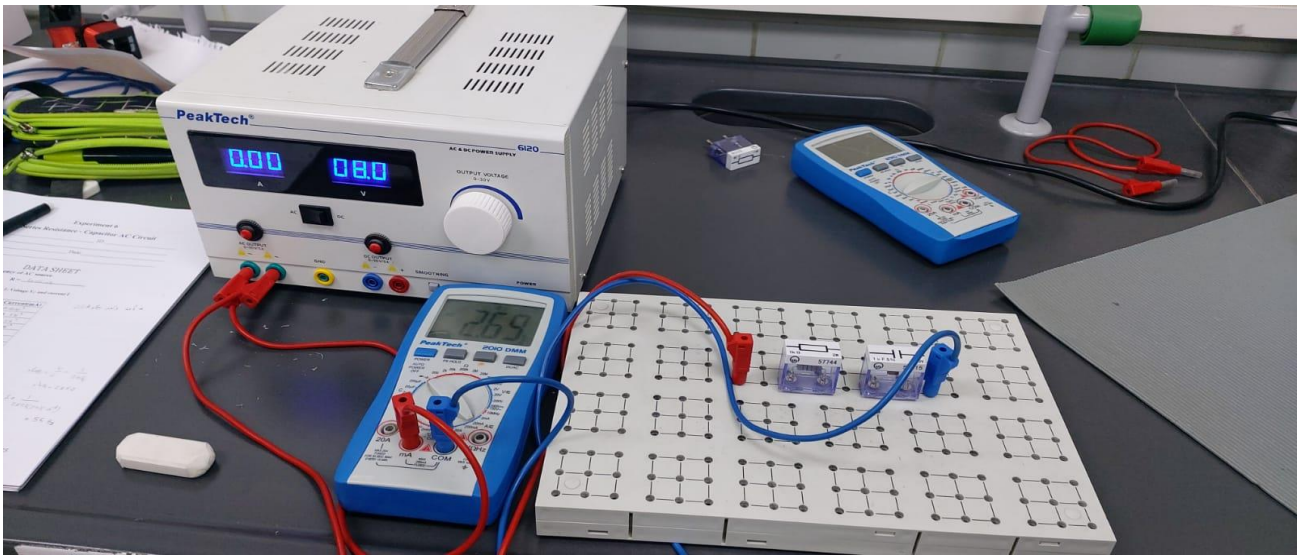
5. Plot ln (Vo/V) as the vertical axis and t as the horizontal axis. Draw the best line fit and calculate the slope.
6. Calculate RC as the reciprocal of the slope.

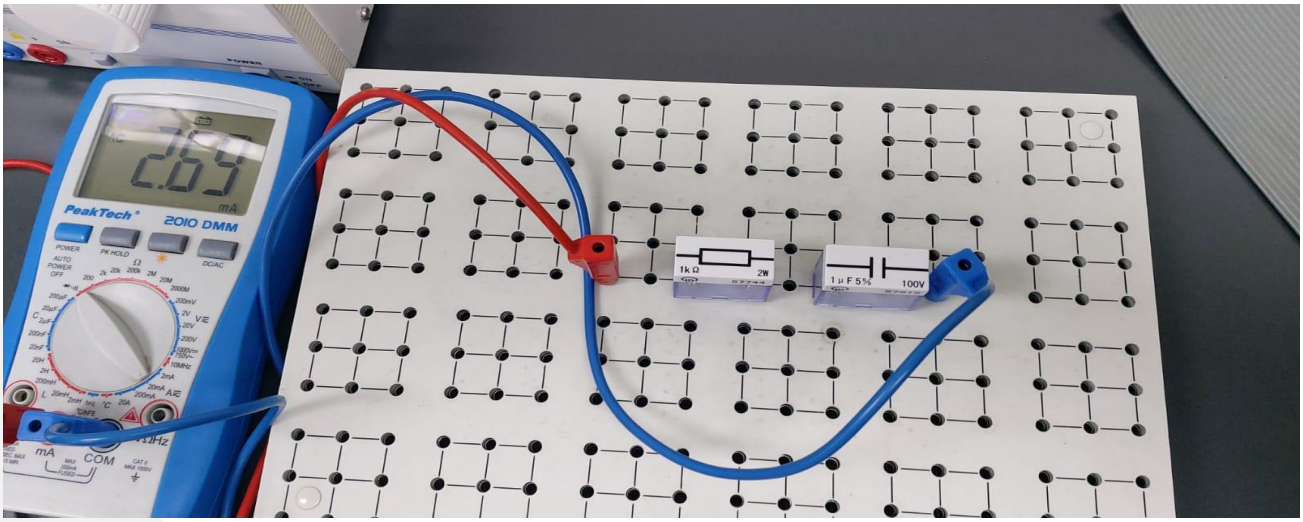
Experiment 6: Series Resistance - Capacitor AC Circuit

Objectives:

- To understand the relationship between alternating voltage (V), current (I) and phase angle (θ).
- To find the frequency of AC source
- To find the unknown capacitor
- To calculate the phase angle (θ).

Pictures:





Procedures

Part I: To Find the frequency of AC source

1. The circuit was connected as in Figure (8)
2. Record voltage drop across capacitor (V_C) and current (I) passing through it
3. Plot (V_C) in (Y-axis) and (I) in (X-axis), you will get a linear relation
4. The Slope is equal ($1/\omega C$), so $\omega = 2\pi f$ (f is the frequency of the current), then you can get (f)

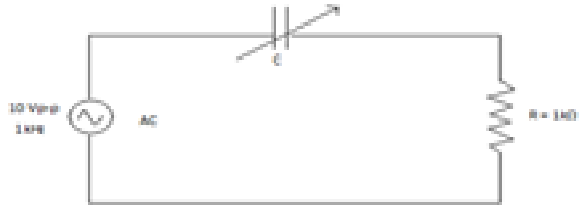
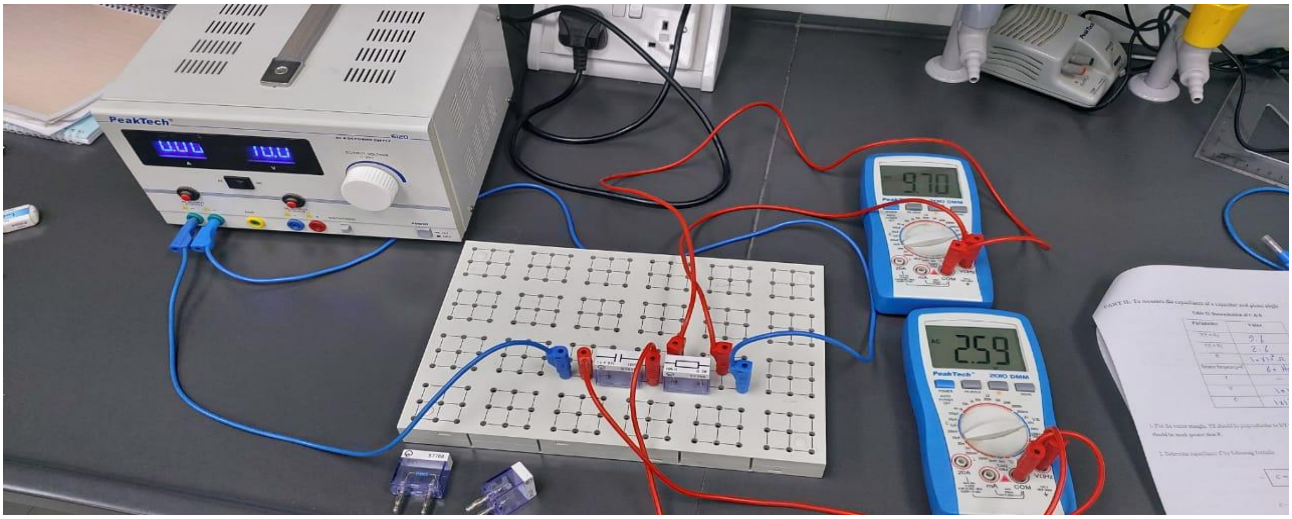


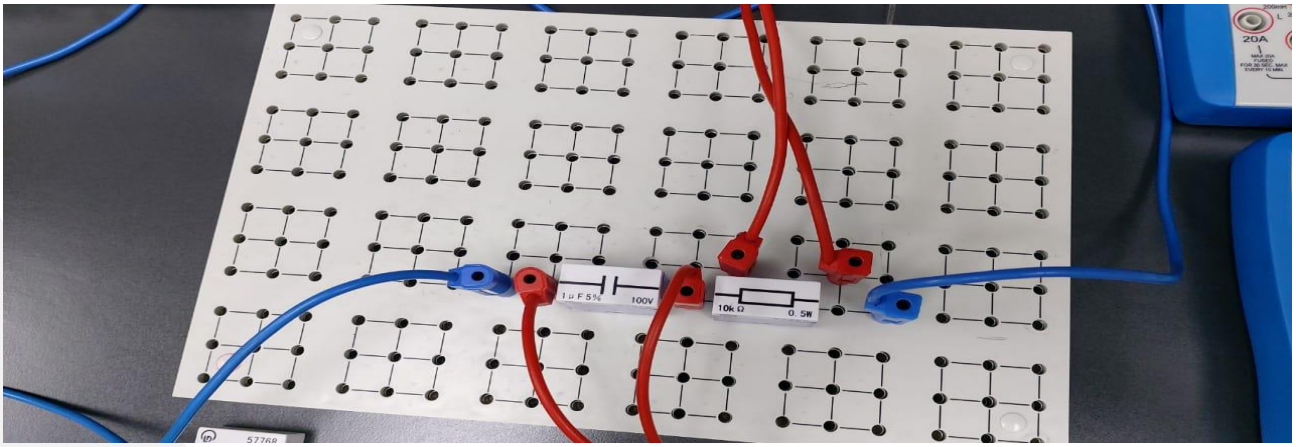
Figure (8)

5. Plot (V_C) in (Y-axis) and (I) in (X-axis), you will get a linear relation
6. Find the slope

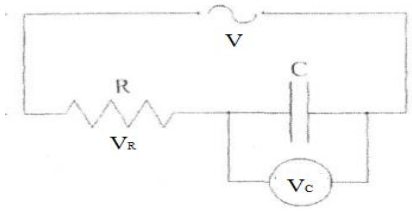
PART II: To measure the capacitance of a capacitor and phase angle

Pictures:





1. Set up the apparatus as shown in Figure 9 .
2. Choose R so that VR≈ VC and measure V, VR and VC



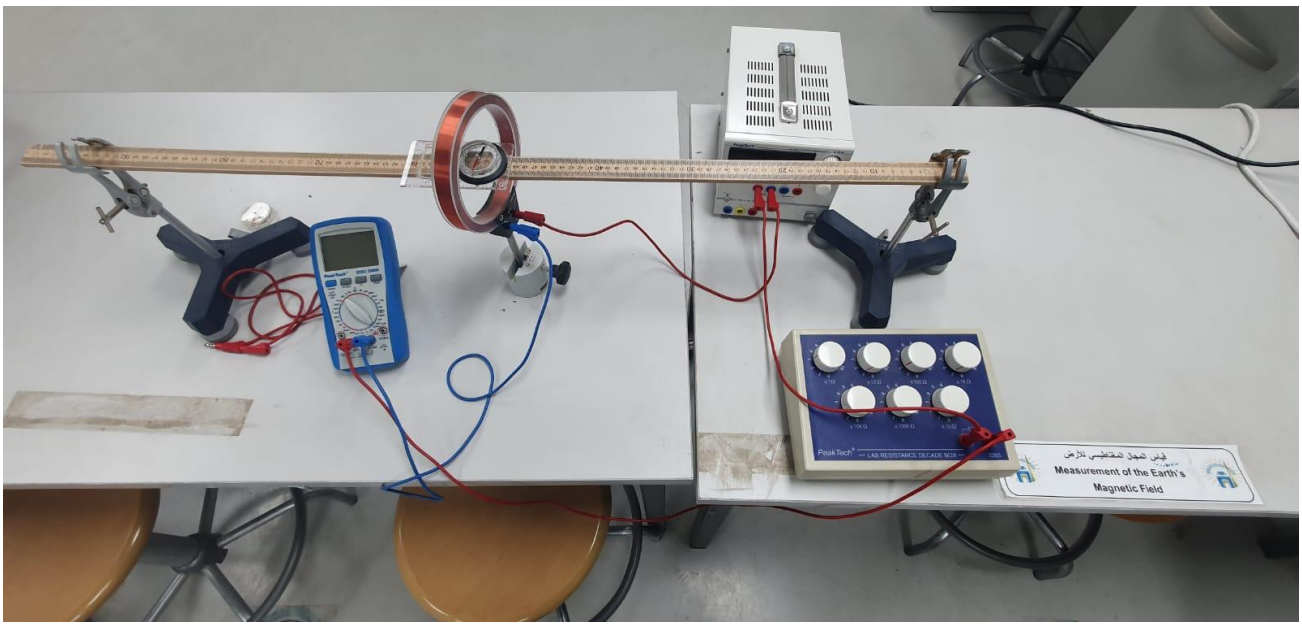
3. Find the phase angle θ

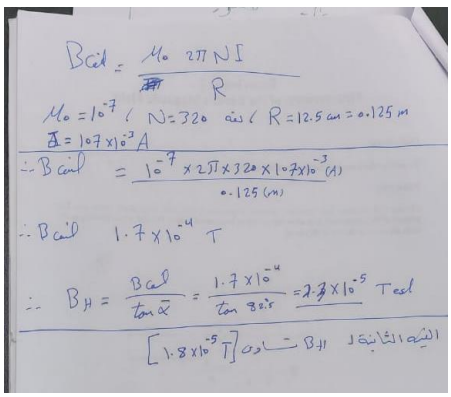
Experiment 7: Measurement of the Earth's Magnetic Field

Objectives:

- To measure the horizontal component of the earth's magnetic field.

Pictures:





Procedure

1. Measure the radius, *R*, of the coil, and record the value on the data sheet.
2. Record the number of turns of wire *N* on the data sheet.
3. Place the compass at the center of the coil, let the needle settle, and align the plane of the coil parallel to the North-South direction.
4. Carefully rotate the compass until the ends of the compass needle are aligned with 0 ◦and 180 ◦on the compass scale.
5. Connect the circuit as described below. IMPORTANT: do NOT turn on the power until your instructor has checked your circuit (or you can blow a fuse in the meter).
6. Connect the '+' socket in the power supply to the left-most socket in the coils. Connect the right-most socket in the coils to the 'Com' socket in the meter, and the 'mA' socket in the meter to the '-' socket in the supply.
7. Turn the dial on the meter to the milliamps setting.
8. HAVE YOUR INSTRUCTOR CHECK YOUR CIRCUIT. If OK, turn on the power supply, and adjust the current to a value around 15 mA. Record the current for trial 1 in Table 1 on the data sheet.
9. Read the deflection (in degrees) of each end of the compass needle. (Tap on the compass box lightly to make sure that the compass needle is not binding and moves freely.) Record the deflection of the north pole of the compass needle as $\alpha N\text{–}left$ and the deflection of the south pole as $\alpha S\text{–}left$ in Table Include an estimated uncertainty in these values.
10. Repeat for four other values for the current between 5 and 25 mA.
11. For each value of the current, average the two measured deflection angles and record the result as α in Table 1.
12. Calculate and record the horizontal component of the earth's magnetic field B_H for each trial as described in the theory.

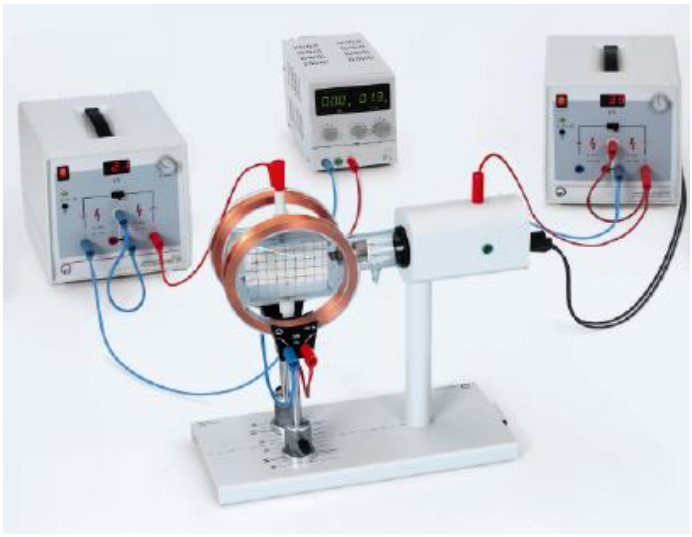
13. Calculate the average of the values you obtained for B_H from the five.
14. Compare your value for B_H with accepted values and comment on the agreement.

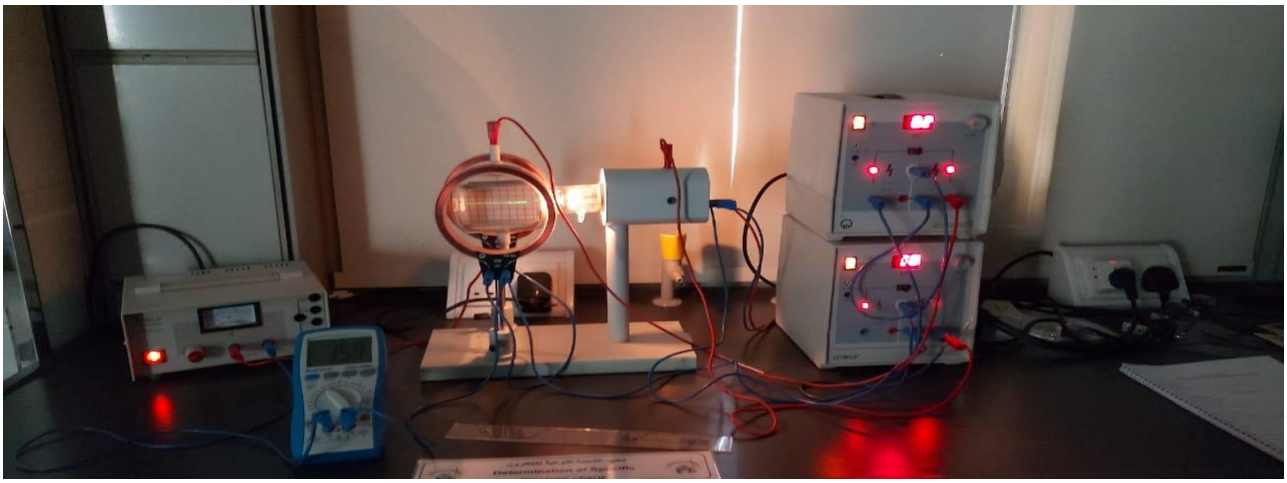
Experiment 8: Determination of Specific Electron charge

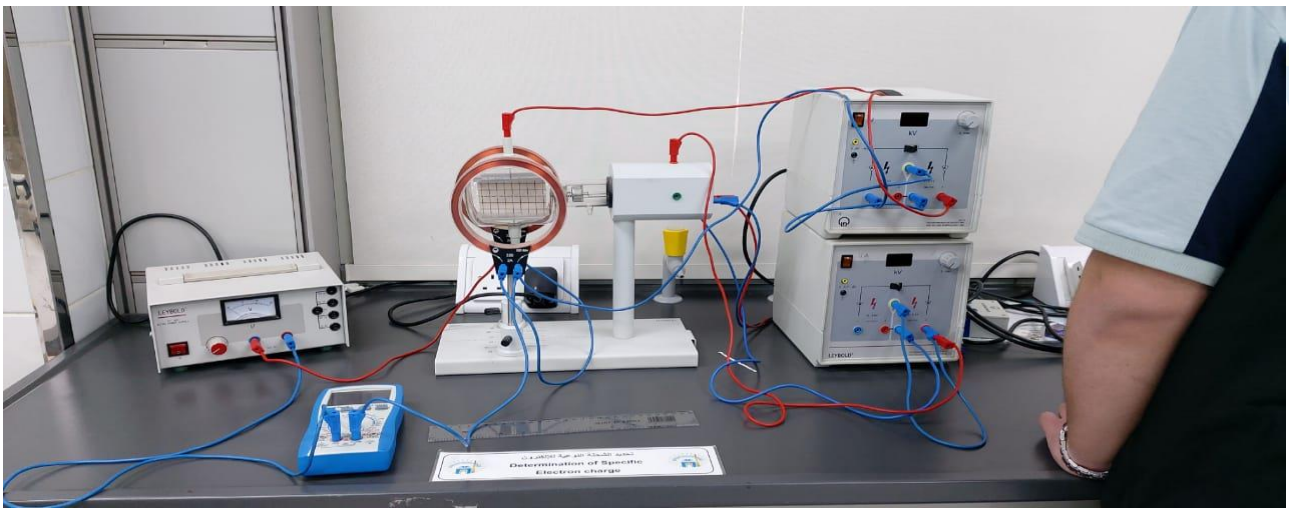
Objectives:

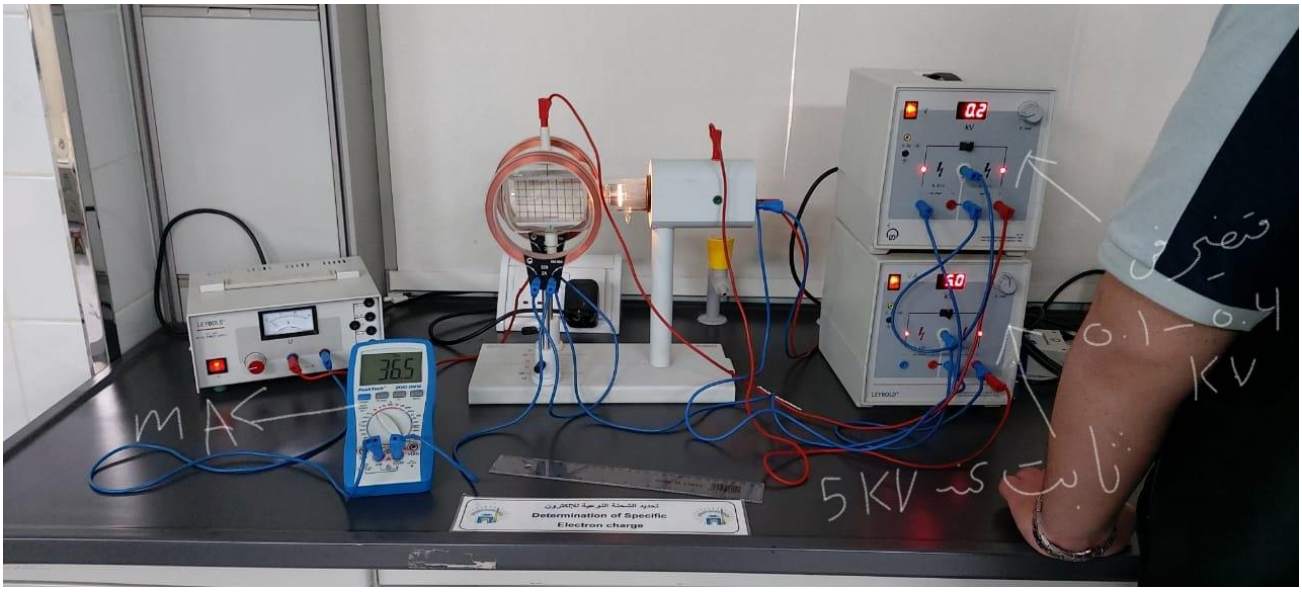
- To determine specific electron charge

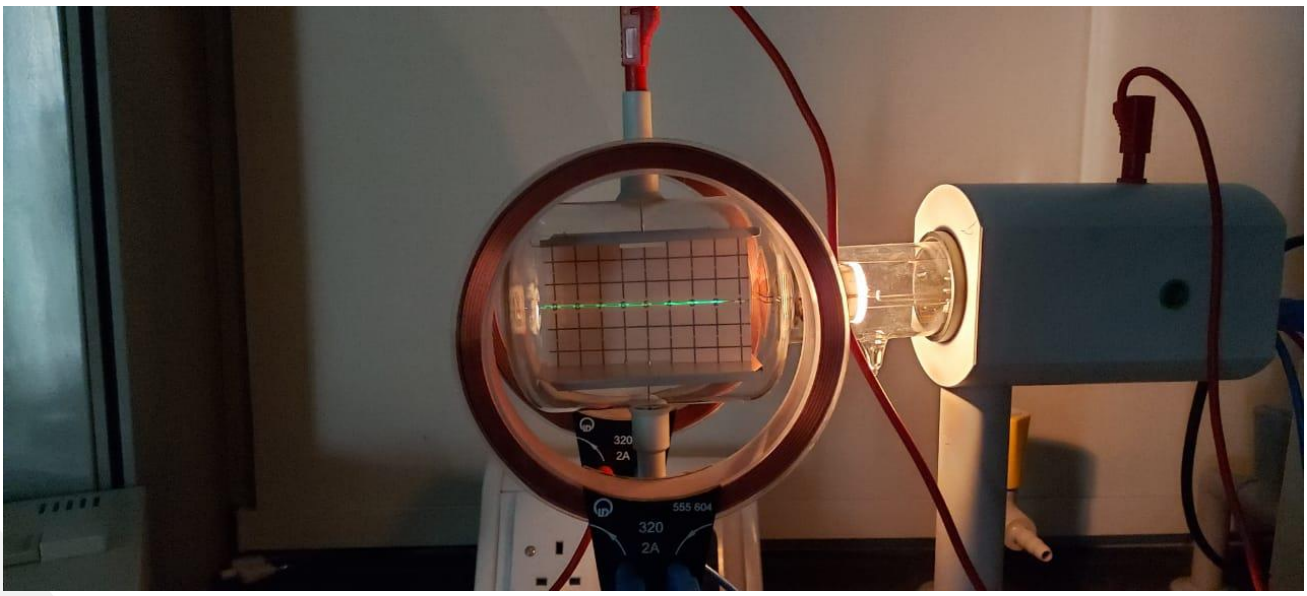
Pictures:






Determination of Specific
Electron charge


MA
365
5 KV
Determination of Specific
Electron charge


320
2A
555 604
320
2A

Procedures:

Setup

The experimental setup is shown in Figure 1. For setting up, the steps described below are required:

1. Carefully insert the Thomson tube into the tube stand.
2. Connect sockets F1 and F2 on the tube stand for the cathode heater to the 6.3 V output at the rear of the high voltage power supply 10 kV.
3. Connect socket C on the tube stand (cathode cap of the Thomson tube) to the negative pole and socket A (anode) to the positive pole of the 10 kV high voltage power supply and in addition earth the positive pole.
4. Place the Helmholtz pair of coils in the positions marked with H (Helmholtz geometry) on the tube stand.
5. Adjust the height of the coils in such a way that the centers of the coils are aligned to the level of the beam axis.
6. Connect the coils in series to the direct current power supply so that the current flows through the coils in the same direction. Ensure that the current flows in the same direction through the coils.
7. Connect one capacitor plate to the positive pole at the right-hand output, the other to the negative pole of the left hand output of the second 10 kV high voltage power supply and earth the middle socket of the high voltage power supply.

Carrying out the experiment

1. Measure the distance d between the capacitor plates.
2. Switch on the high voltage power supply. Now the cathode is being heated.
3. Slowly increase the anode voltage V_A and observe the beam slowly increasing in brightness at the center of the luminous screen.
4. While $V_A < 5\ kV$ is kept at a fixed value slowly increase the voltage at the capacitor plates V and observe the change to the beam.
5. Increase the current through the Helmholtz pair of coils I just enough that the deflection on account of the electric field at the capacitor output is just compensated for.
6. Maintain V and I at fixed values and vary V_A and observe the changes to the beam.
7. For various values of V_A select V and I in such a way that the deflection on account of the electric and the magnetic fields just compensate, and enter the values in a table.

تابع: أجهزة المختبرات في قسم الفيزياء

Laboratory Equipment in Department of Physics

3- محتويات مختبر المواد من التجارب

(خواص المادة والحرارة و الضوء الهندسي)

3- Experiments of Materials Lab

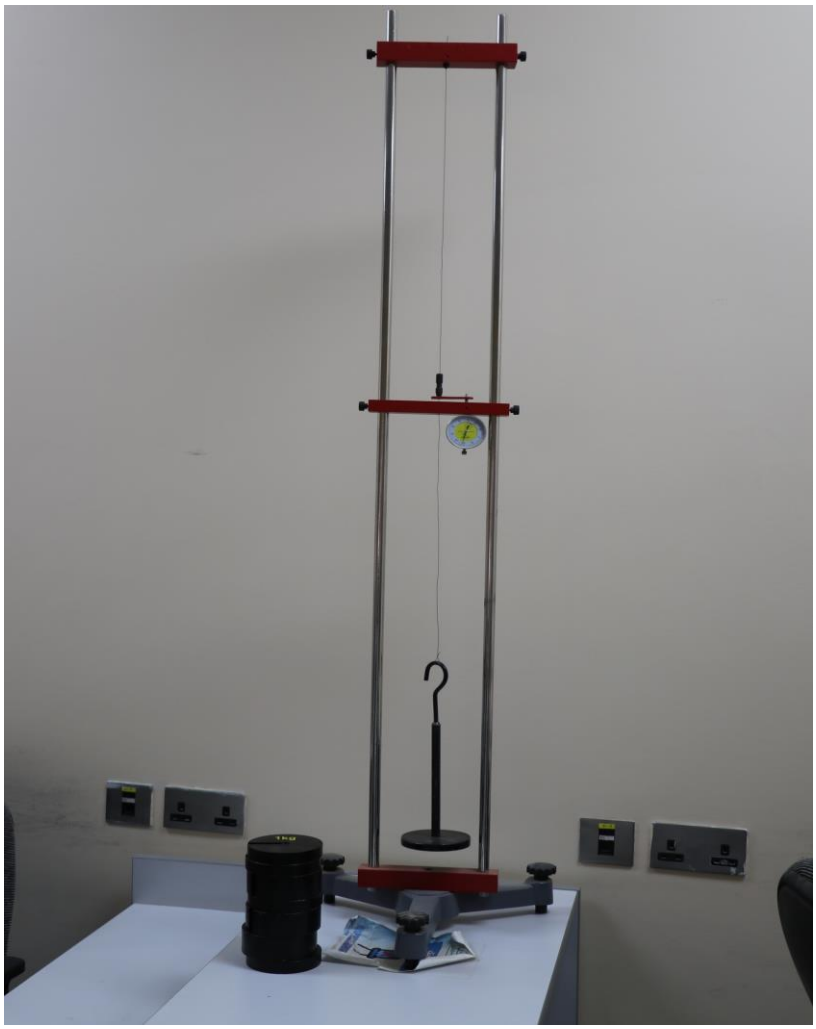
(Properties of matter, heat and geometric optics)

Experiment 1: Determination of Young Modulus of Wire

Objectives:

- To investigate the elasticity of materials by showing that the stress is proportional to the strain.
- To find Young's modulus for given materials

Picture



Procedures:

1. You are given a piece of wire hanging vertically in a sturdy frame, a kilogram mass hanger attached to the end of the wire and a stack of kilogram masses.
2. The wire is connected to a bubble level and balancing micrometer, which allows you to determine small changes in the length of the wire.
3. You record the initial length and initial diameter of the wire.
4. You then place different amounts of mass on the mass hanger and for each amount, you determine the cumulative change in length of the wire.
5. In the analysis you calculate and plot stress vs. strain.

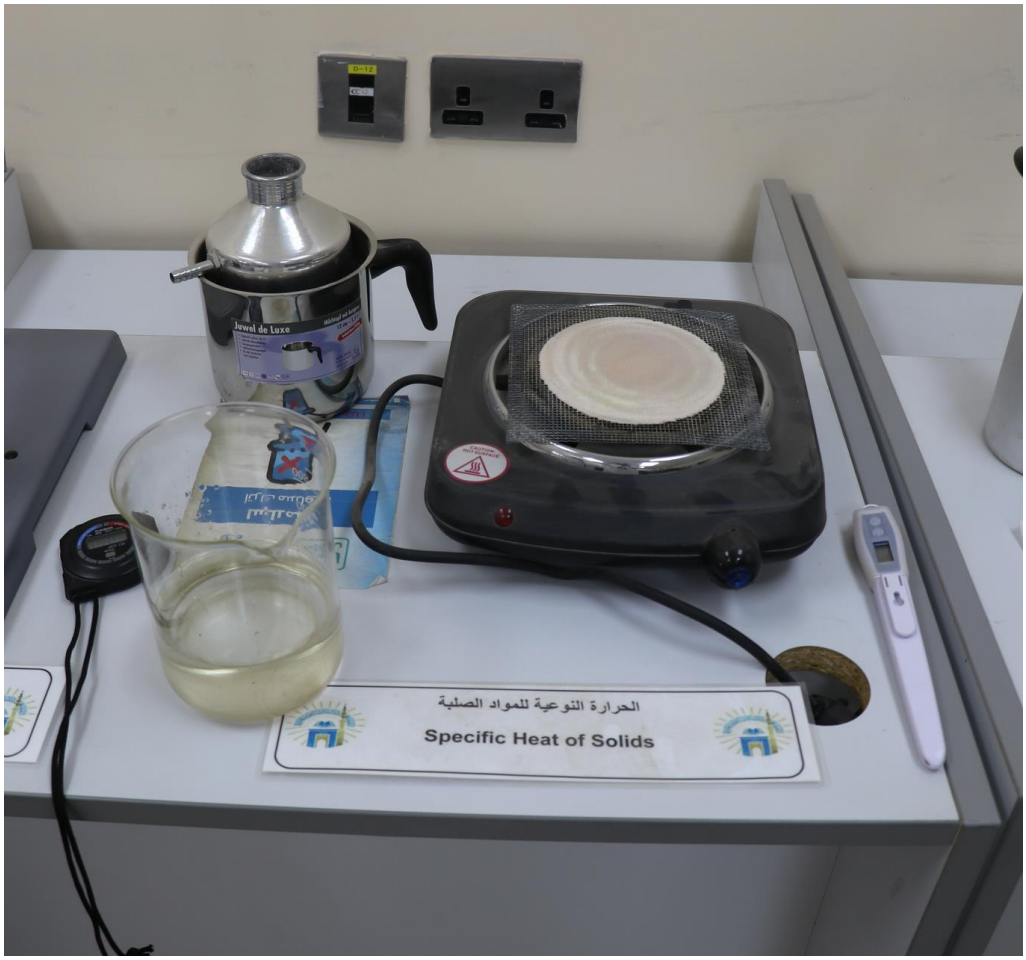
6. From this graph you determine whether the stress on the wire remains in the linear region.
7. You find a numerical value of Young's modulus for the wire, and you determine the material that composes the wire by comparing this experimental value to a table of accepted values.

Experiment 2: Specific Heat of Solids

Objectives:

- Mixing cold water with heated copper, lead or glass shot and measuring the mixture temperature.
- Determining the specific heat of copper, lead and glass.

Picture:



Experimental setup:

1. The experimental setup is illustrated in the figure.
2. Mount the heating apparatus in the stand material.
3. Fill water into the steam generator, close the device cautiously, and connect it to the top hose

4. connection of the heating apparatus (steam inlet) with silicone tubing.
5. Attach silicone tubing to the bottom hose connection of the heating apparatus (steam outlet), and hang the other end in the beaker. See to it that the silicone tubings are securely seated at all connections.
6. Fill the sample chamber of the heating apparatus as completely as possible with lead shot, and seal it with the stopper.
7. Connect the steam generator to the mains, and heat the shot for about 20–25 minutes in the
8. heating apparatus flowed through by steam.

Experiment 3: Determination of the Velocity of Sound by Using Columns Air

Objectives:

- The aim of this experiment is to determine the velocity of sound by using columns air.

Pictures:

Procedures:

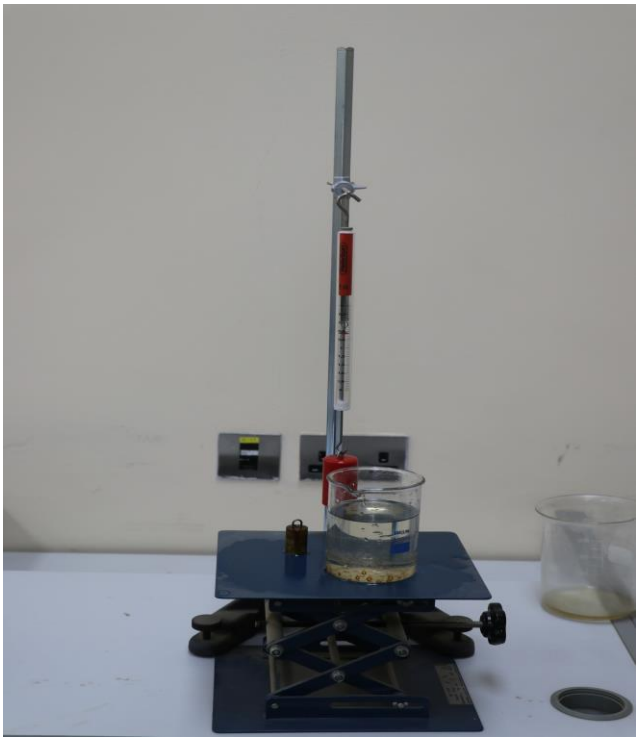
1. Strike a tuning fork of frequency 512 Hz with a rubber mallet and hold it at about an inch above the open end of the resonance tube with its prongs horizontal. Adjust the water level starting from its highest level.
2. Gradually increase the length of the air column by lowering the can to find the first position of resonance, where the sound coming out of the air column is loudest. You may have to strike 19 the fork several times and move the water column up and down to precisely locate the resonance position.
3. Continue this procedure to find second (and if possible, the third) position of resonance.
4. Record these lengths as $l1$ and $l2$.
5. Repeat the experiment with a tuning fork of different frequency.

Experiment 4: Measuring the Buoyancy Force

Objectives:

- Measuring the force F acting on a cylinder immersed in a liquid and determining the buoyancy force.
- Confirming the proportionality between the buoyancy force FG and the immersion depth h.
- Determining the densities ρ of three different liquids.

Pictures:



Procedures:

The experimental setup is illustrated in the figure.

1. Determine the dimensions of the solid cylinder.
2. Hold the dynamometer suspended vertically and adjust the zero position.
3. Suspend the solid cylinder from the dynamometer and determine its weight F_0.
4. To make determination of the immersion depth easier,make equidistant marks on the solid cylinder with a waterand ethanol proof pen.
5. Fill about 200 ml of distilled water into the beaker.
6. Immerse the solid cylinder up to the first mark and measurethe force F.
7. Immerse the solid cylinder further and measure the force Fas a function of the immersion depth h.
8. Pour out the distilled water and dry the beaker and the solidcylinder using, for example, absorbent tissue.
9. Repeat the experiment with ethanol and then with glycerine.

Experiment 5: Determination of the Viscosity of Viscous Fluids

Objectives:

- Assembling a falling-ball viscosimeter.
- Determining the viscosity of glycerine.

Pictures:

Procedures:

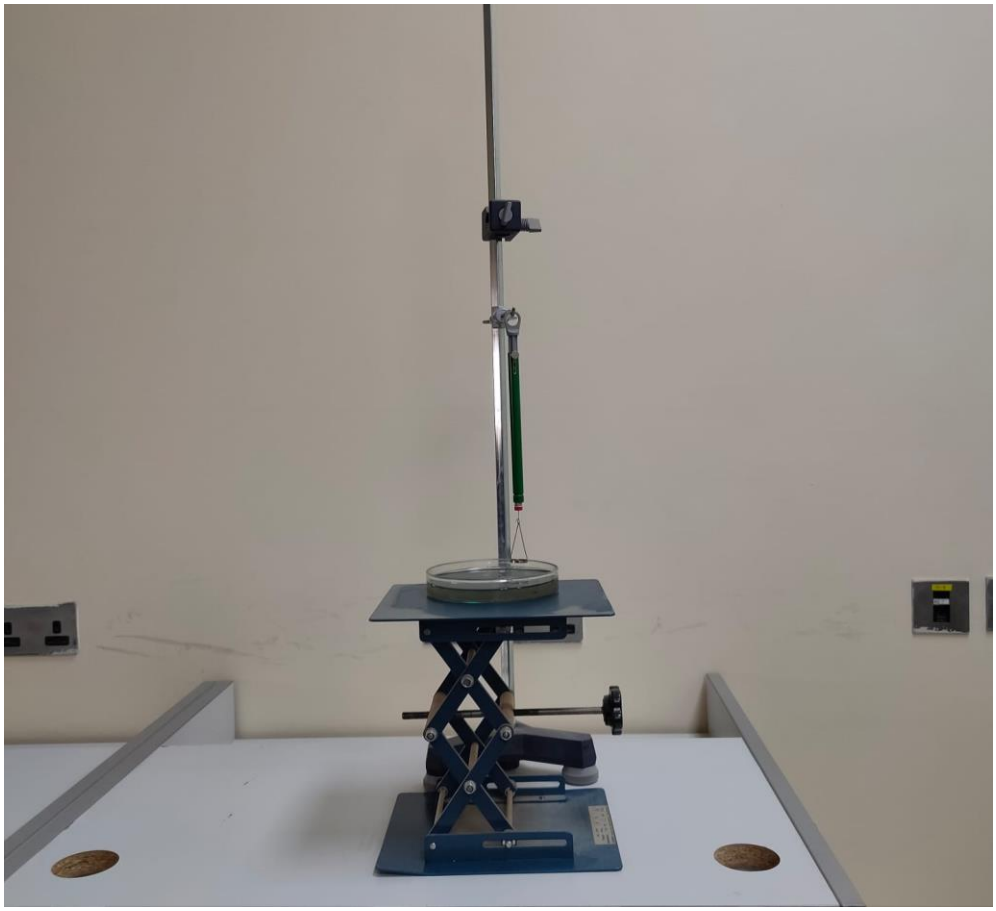
1. Set the counter P to zero by pressing the key “0”.
2. Trigger off the morse key, and observe the falling ball.
3. As soon as the ball has reached the mark (c), release the morse key.
4. Read the time of fall t from the counter P and record it.
5. If the ball does not fall at all or if it falls with a delay:
6. If the ball falls without the morse key‘s being triggered: Turn the iron core a bit downward.
7. Repeating the measurement:
8. Turn the voltage for the holding magnet to 12 V and turn the knurled screw (a) to stop.
9. Get grip of the steel ball from outside on the bottom of the vessel with the pair of magnets sticking together (red mark outward), and move the ball slowly upward along the wall of the vessel until it reaches the holding magnet. Using a bent piece of wire, for example, push the ball exactly below the iron core (see Fig. 2).
10. Turn the knurled screw upward again, set the counter P to zero, and repeat the measurement of the time of fall.
11. If the devices recommended in addition are available (seeabove), determine the inner diameter D of the guinea-and-feather apparatus, and the diameter d and the mass m2 of the steel ball.
12. Put the measuring cylinder on the electronic balance, and counterbalance.
13. Fill 100 ml of glycerin from the storage bottle into the measuring cylinder, and determine its mass.

Experiment 6: Measuring the Surface Tension

Objectives:

- Creating a liquid layer between the edge of a metal ring and the surface of the liquid.
- Measuring the tensile force acting on the metal ring just before the liquid layer breaks away.
- Determining the surface tension from the measured tensile force.

Picture:



Procedures:

1. Determine the diameter of the metal ring.
2. Make the zero adjustment at the dynamometer using the movable tube.
3. Fill distilled water into the crystallization dish.
4. Lower the clamp with hook until the metal ring is completely immersed.
5. Cautiously lower the laboratory stand, always observing the tensile force at the dynamometer.
6. As soon as the edge of the metal ring emerges from the liquid, the liquid layer is formed.
7. When the tensile force does no longer increase although the laboratory stand is further lowered, the layer is just before breaking away.
8. Read the tensile force just before the layer breaks away, and take it down.
9. Pour the distilled water out, and dry the crystallization dish and the metal ring.
10. Repeat the measurement with ethanol.

Experiment 7: Temperature Measurement with a Thermocouple

Objects:

- To introduce the basic principles of several common methods of temperature measurement (liquid-in-glass thermometers, thermocouples and thermistors). Also, to familiarize the students with the static calibration procedure and the dynamic characteristics of a first order system.

Procedures:

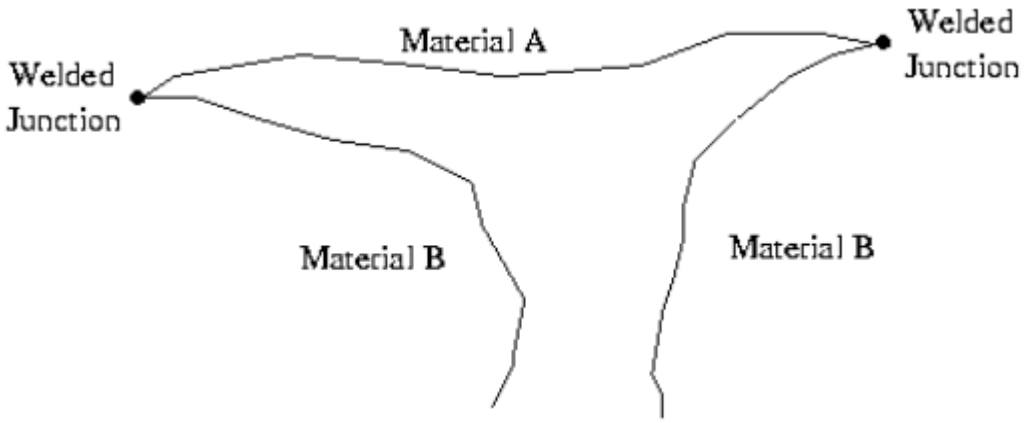


Fig. Thermocouple arrangement

1. Constant temperature bath

Examine the components of the bath which include the fluid chamber, heater, coolant, thermo-regulator, stirring and circulation pumps. Several different temperature settings will be used. Note how the settings are made and set the bath for a low temperature.

2. Liquid-in-glass thermometers

Note the difference between full immersion and partial immersion thermometers and note how each is to be used. The teaching assistant will demonstrate the difference between the full and the partial immersion thermometer.

3. Thermocouples

The thermocouple used in this experiment is made by welding a long piece of wire of material A and two shorter pieces of wire of material B, thus forming two dissimilar junctions as shown

in Figure shown above. Connect the free ends to a digital voltmeter (set to read mV), and perform the following experiments:

1. With both junctions in air, observe and record the output.
2. Hold one junction of the thermocouple between your fingers and the other junction in the ice bath. Observe and record the voltmeter reading.

Experiment 8: Determining of the Focal Length of a Concave Mirror and Convex Mirror

Objectives:

The objective of the experiment is to find the focal length of a concave mirror, convex mirrc
Student should be able to draw a ray diagram showing how a concave mirror forms an imag
object which is placed
(i) outside the focus – resulting in a real image
(ii) inside the focus – resulting in a virtual image

Picture:

Procedures:

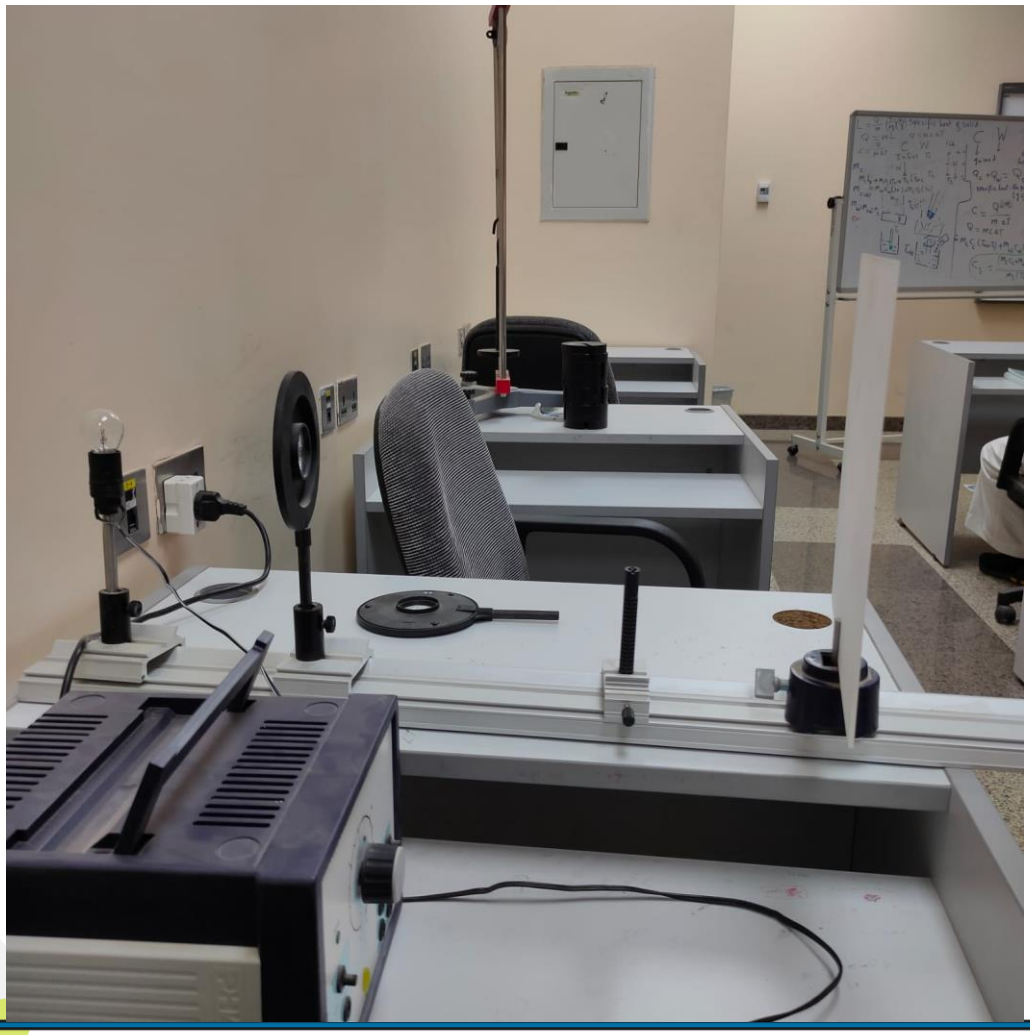
1. Place the ray-box well outside the approximate focal length.
2. Move the screen until a clear inverted image of the crosswire is obtained.
3. Measure the distance u from the crosswire to the mirror, using the metre stick.
4. Measure the distance v from the screen to the mirror.
5. Repeat this procedure for different values of u.
6. Calculate the focal length of the mirror using the formula $\frac{1}{f}=\frac{1}{u}+\frac{1}{v}$ and get an average.
7. Plot a graph of 1/u against 1/v and use the intercepts to get two values for f. Then get the average of these two.

Experiment 9: Determining of the Focal Length of the Converging and Diverging Lenses

Objectives:

- To measure the focal length of a converging lens using various methods and to study how a converging lens forms a real image.

Picture



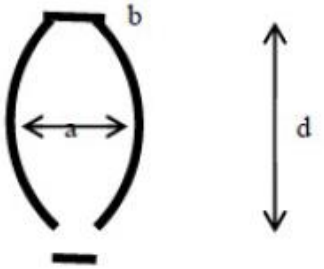
Procedures:

This experiment consists of two distinct parts. In the first part you will use a light source which creates light rays to investigate the reflecting/refracting properties of a plane mirror, a spherical mirror, a converging lens and a diverging lens. You will measure the focal length of the converging and diverging lenses and use the lensmakers formula (1) to estimate the refractive index of the material the lenses. The second part of the experiment uses an optical bench to measure the object and image distances for a converging lens from which the focal length and magnification are determined by equations (2) and (3).

Part I

1. Plug in the light source and rotate the front of the box so that several parallel light rays leave the source. Place the plane mirror in front of the box and sketch the behavior of the rays before and after reflection.
2. Sketch the behavior of the light rays before and after reflection by the spherical mirror.
3. Sketch the behavior of the light rays before and after refraction by the converging lens. Measure the focal length of the converging lens, f.
4. Sketch the behavior of the light rays before and after refraction by the diverging lens. By extrapolating the diverging rays onto the source side of the lens estimate the focal length of the lens.

5. Using the ruler provided, measure the thickness of the converging lens at its centre, a, and the thickness at either of the ends, b. Measure the length of the lens, d.



6. Assuming the curved surfaces of the converging lens have the same curvature, R, using simple geometry, it is possible to obtain the following expression for R,

$$R = \frac{(a-b)^2 + d^2}{4\,(a-b)}. \qquad (5)$$

Calculate the radius of curvature of the surfaces of the converging lens.

7. Using the lensmakers formula (1), with $R_1 = R_2 = R$ and your value of f for the converging lens, evaluate the refractive index of the lens.

تابع: أجهزة المختبرات في قسم الفيزياء

Laboratory Equipment in Department of Physics

4- محتويات مختبر الإلكترونيات (1) من التجارب

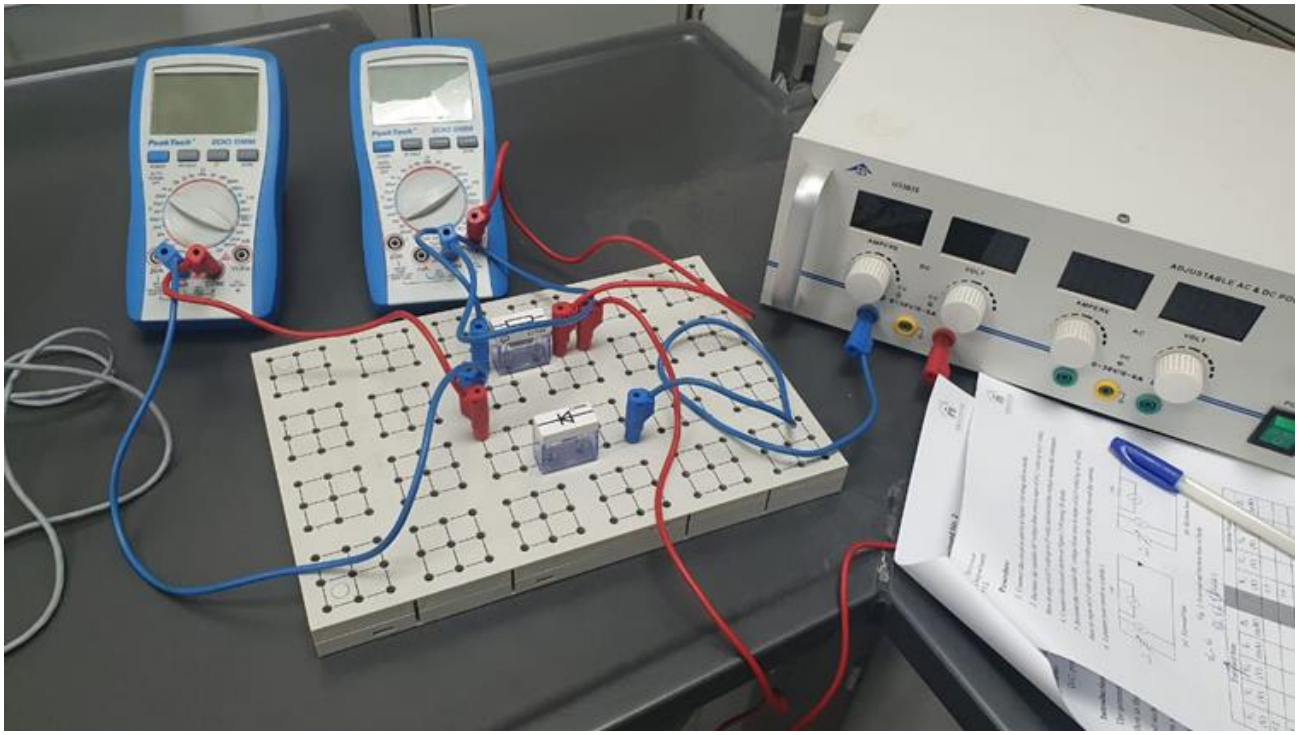
4- Experiments of Electronics Lab (1)

Experiment 1: The rectifier diode

Objectives

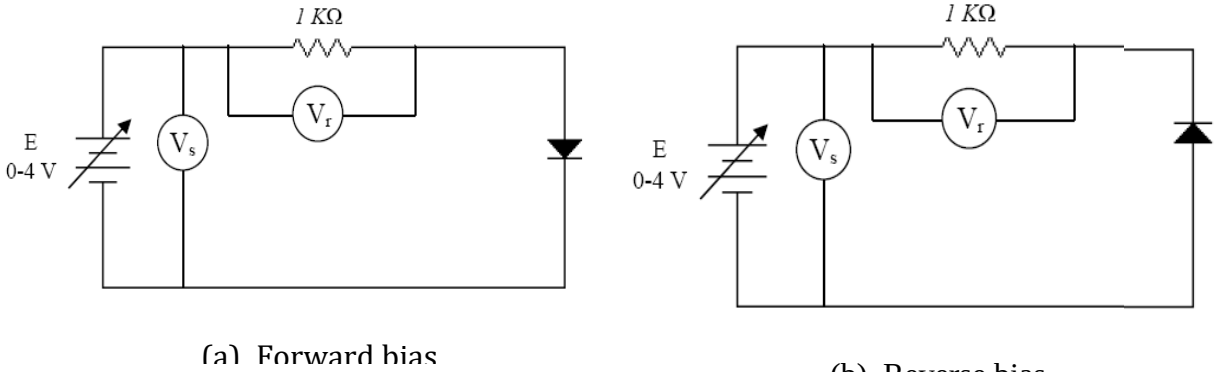
- Ability to recognize diodes in various physical forms.
- Ability to determine the diode polarity and to understand the need for correct connection.
- To obtain knowledge of the forward voltage/current characteristic and the conduction voltage for diodes.

Photos



Procedure

1. Connect the circuit as shown in Figure 2 (a) using silicon diode.
2. Increase the variable DC voltage from zero in steps of (0.2 volts) up to (1 volts), then in step of (0.5 volt) up to (5 volt), and record the voltage across the resistance.
3. Connect the circuit shown in Figure 2 (b) using Si diode.
4. Increase the variable DC voltage from zero in steps of (0.5 volts) up to (2 volt), then in steps of (1 volt) up to (10 volts) and for each step record the current.
5. Tabulate your result in a table 1.



(a) Forward bias

(b) Reverse bias

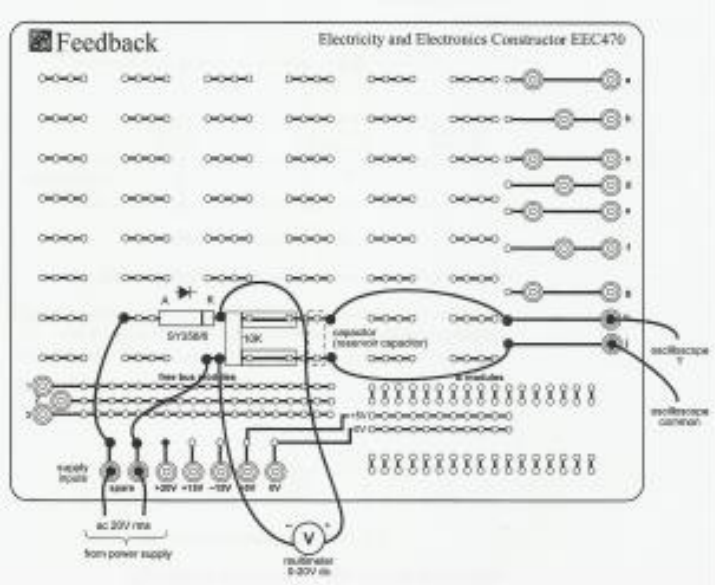
Fig. 2 Forward and reverse bias of diode

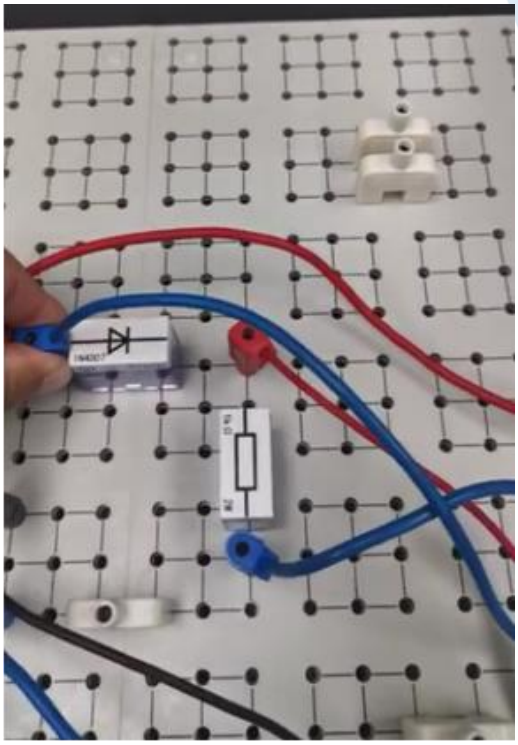
Experiment 2: Half-Wave Rectifier

Objectives

- To learn a half-wave rectified sinusoidal voltage.
- To understand the terms, mean value and rout mean square for input and output (rectified) voltage.
- To understand the effect of reservoir capacitor upon the rectified waveform.

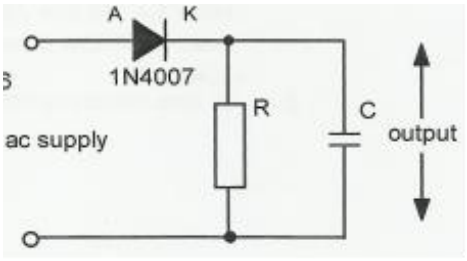
Pictures

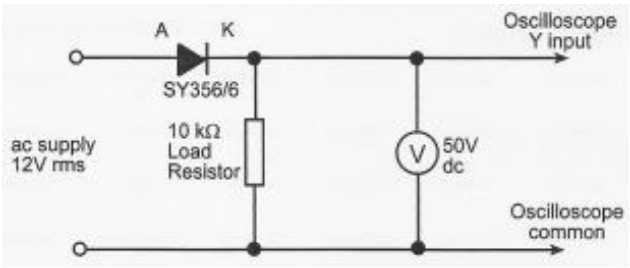




Procedures:

1. Connect the circuit shown in Fig.1
2. For input signal take the reading of voltmeter Vdc= V (by using dc-voltmeter) and the reading of Vrms= V (by using ac-voltmeter).
3. Use the oscilloscope to fill the Table 1 and to draw the input signal.
4. For output signal take the reading of voltmeter Vdc= V (by using dc-voltmeter) and the reading of Vrms= V (by using ac-voltmeter).
5. Use the oscilloscope to fill the Table 2 and to draw the output signal.
6. Connect the capacitor in parallel with load resistor and draw the output signal.



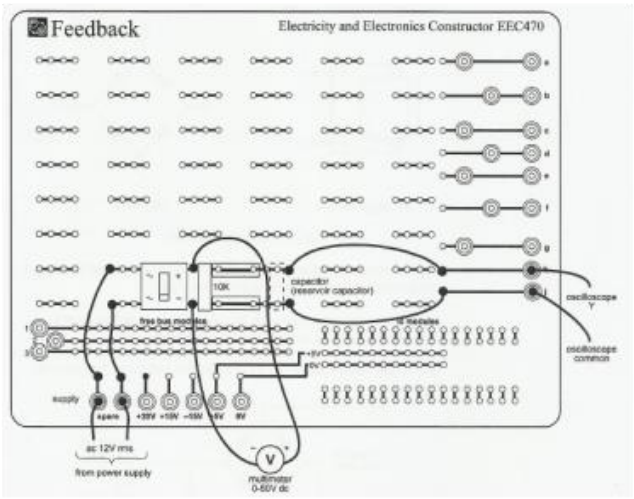


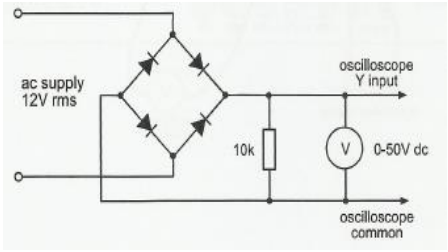
Experiment 3: Full-Wave Rectifier

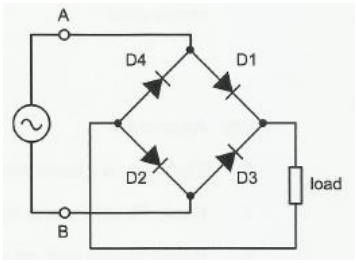
Objectives

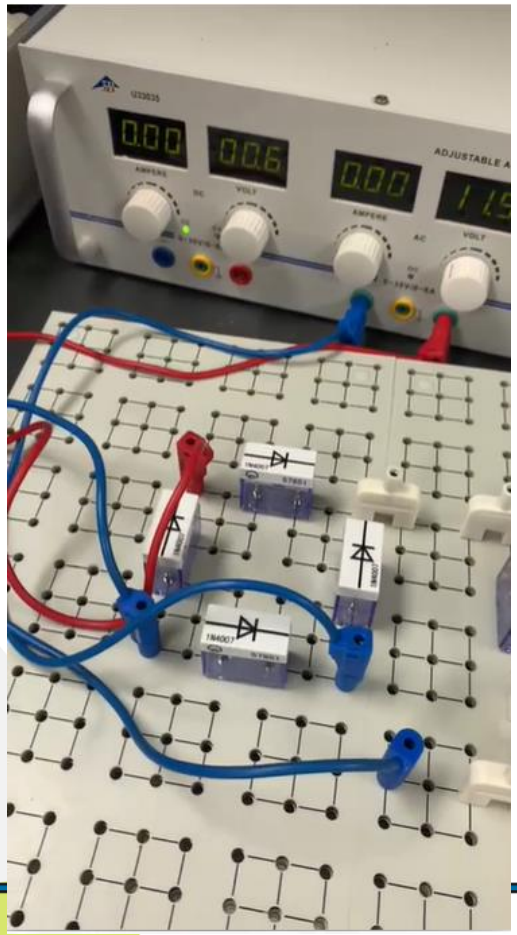
- To learn a full-wave rectified sinusoidal voltage.
- To understand the terms, mean value and rout mean square for input and output (rectified) voltage.
- To understand the effect of reservoir capacitor upon the rectified waveform.

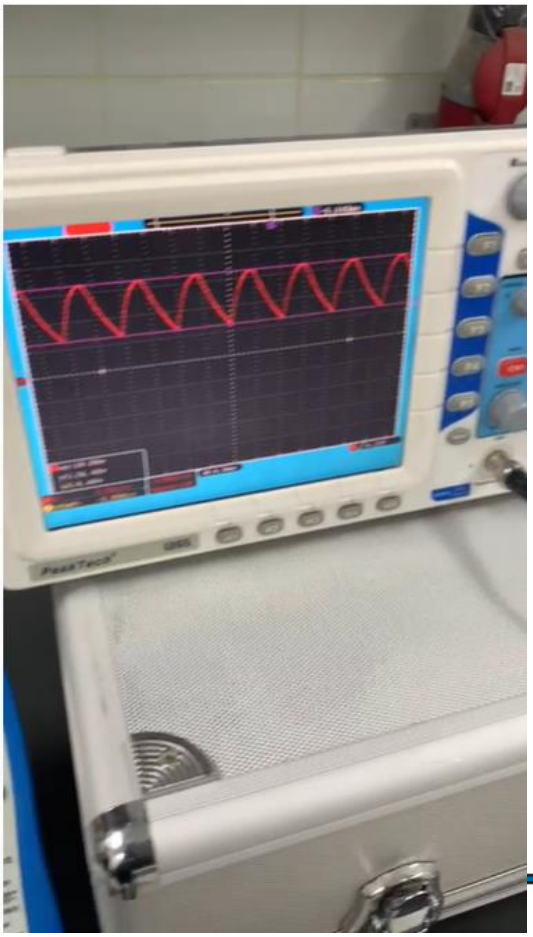
Pictures











Procedure

1. Connect the circuit shown in Fig.1
2. For input signal take the reading of voltmeter Vdc= V (by using dc-voltmeter) and the reading of Vrms= V (by using ac-voltmeter).
3. Use the oscilloscope to fill the Table 1 and to draw the input signal.
4. For output signal take the reading of voltmeter Vdc= V (by using dc-voltmeter) and the reading of Vrms= V (by using ac-voltmeter).
5. Use the oscilloscope to fill the Table 2 and to draw the output signal.
6. Connect the capacitor in parallel with load resistor and draw the output signal.

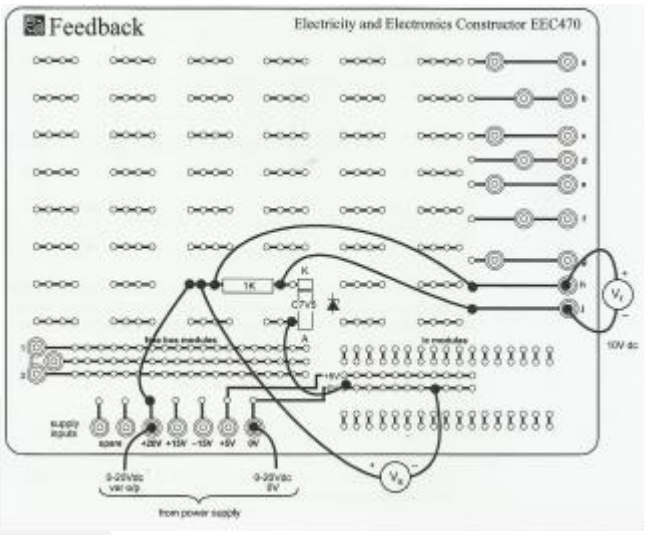
Experiment 4: The Zener diode 1

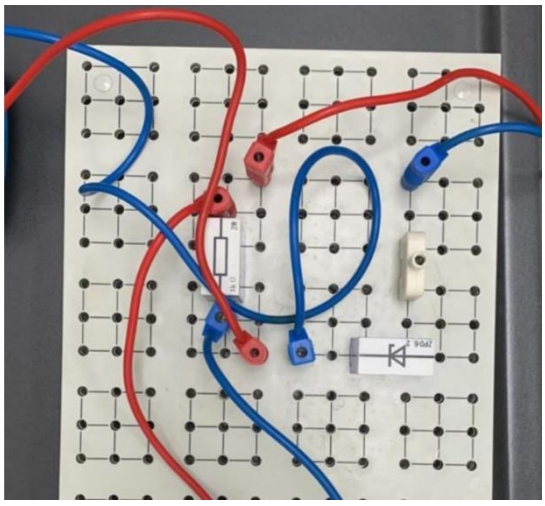
The Volt-Ampere characteristic curve

Objectives

- Investigate the relationship between current and voltage for a Zener diode in forward and reverse direction.
- Find the range of zener voltage.
- Find the resistance of zener diode at zener voltage.

Photos





Procedure

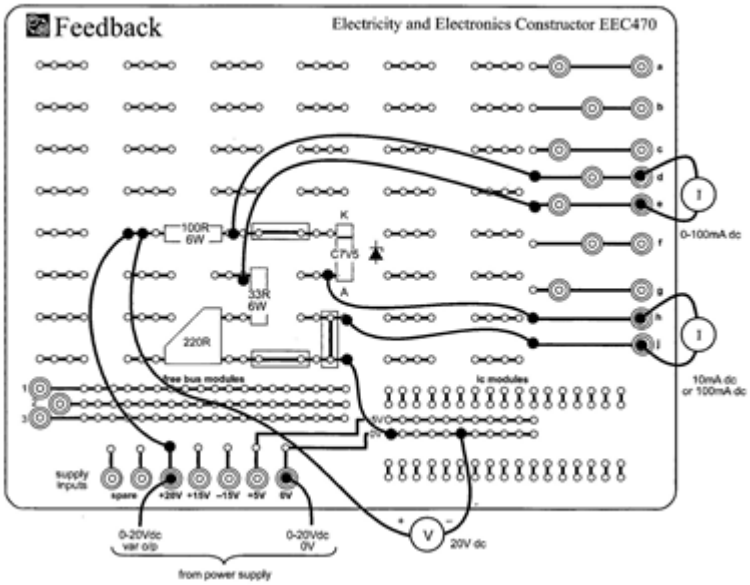
1. Set up circuit as shown in Fig. 2 . Connect Z diode in forward direction.
2. Select measurement range of 1 V- and 100 mA-. Make sure polarity on the meter is correct and that the meters are connected properly.
3. Switch on power supply unit. Increase voltage on the power supply unit to 20 V. Measure both Vs, Vr. Enter measurements in Table (1).
4. Change the polarity of the Zener diode .
5. Measure both voltage Vs , Vr . Enter measurements in Table 1
6. Calculate the potential difference across the diode by equation Vd=Vs-Vr , and the current passes through the diode Id=Vd/R= Vd/Rd or (Id= Vr/R= Vr/1000 Ω).
7. Enter your data in Table 1.
8. Graph the diode current as a function of diode voltage.

Experiment 5: The Zener diode 2 -Regulated Voltage Supply

Objectives

- To find the variation of voltage of unregulated voltage supply Vs which can be tolerated?
- To find the variation of load current IL which can be tolerated.

Photos



Procedures:

Set up circuit as shown in Fig. 5.1 (Fig.5.2 b). Select measurement range of 20 V- and 100 mA-. Make sure polarity on the meter is correct and that the meters are connected properly.

A. Regulation for maximum load current and minimum supply voltage

1. Switch on power supply unit and remove the potentiometer to make IL=0 .
2. Increase slowly the voltage on the power supply unit VS until the diode just begins to conduct current (1 mA). Record Vs for IL=0 in Table (1).
3. Set the potentiometer to maximum (clockwise) and replace it in the circuit. The extra current drawn by RL will reduce the diode current bellow 1 mA.
4. Increase the voltage of source VS to 12 V, the diode current will increase above 1 mA. Then adjust RL until the diode current just returns to 1 mA. Record VS and IL .
5. Repeat step 3 for VS =14, 16, 18, 20 V recording the results in Table 1.

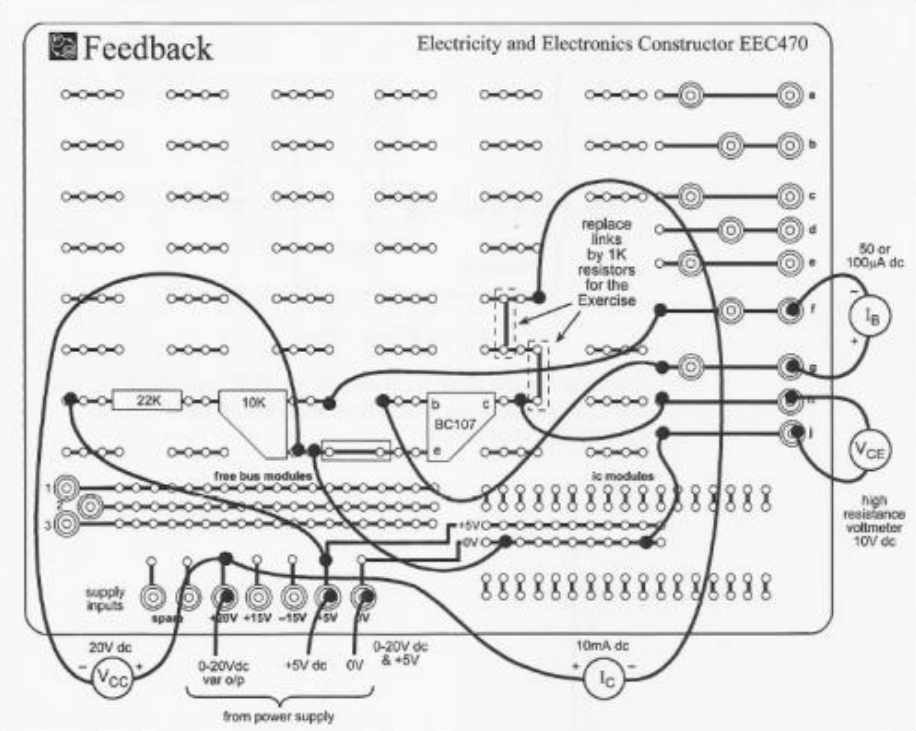
B. Regulation for minimum load current and maximum supply voltage

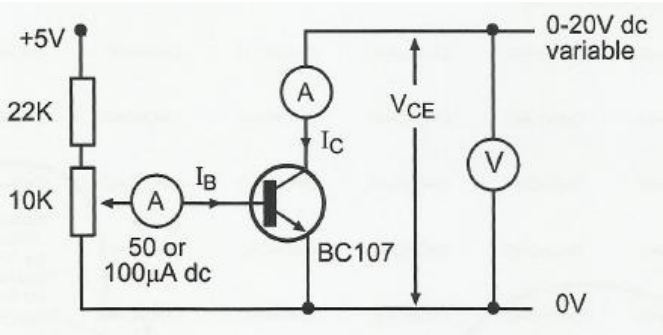
1. Reduce the load resistance RL to minimum (anticlockwise) and then set voltage supply VS to 20 V and increase RL until the diode current Id reads 70 mA.
2. Record the Load current IL against VS=20 V in table 1.
3. Reduce the voltage supply Vs to 19, 18, 17 .... V, each time resetting RL to give the diode current 70 mA and recording IL . Continue until it is no longer possible to set the diode current to 70 mA.

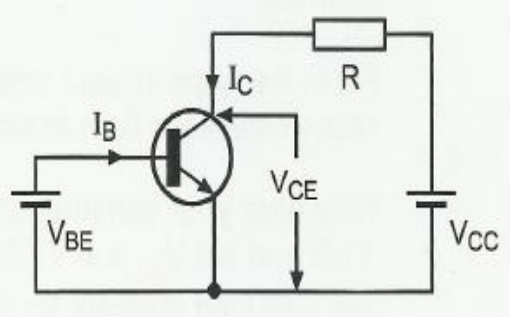
Experiment 6: The common emitter

Objectives

- To learn the common-emitter output (collector) characteristics.
- To understand the meaning and the importance of operating point and load line.


Feedback
Electricity and Electronics Constructor EEC470
replace links by 1K resistors for the Exercise
50 or 100µA dc
22K
10K
BC107
free bus modules
ic modules
high resistance voltmeter 10V dc
supply inputs
20V dc
0-20Vdc var o/p
+5V dc
0V
0-20V dc & +5V
10mA dc
from power supply


+5V
22K
10K
A
I_B
50 or 100µA dc
A
I_C
BC107
V_{CE}
V
0-20V dc variable
0V


I_C
R
I_B
V_{CE}
V_{BE}
V_{CC}

Procedure

1. Fill the Table 1
2. Plot the collector current IC versus the collector emitter voltage VCE .
3. From table for IB=45 μA find β for this transistor (use a suitable value of Ic for this purpose).
4. From figure for , find the slope of linear part of the curve.

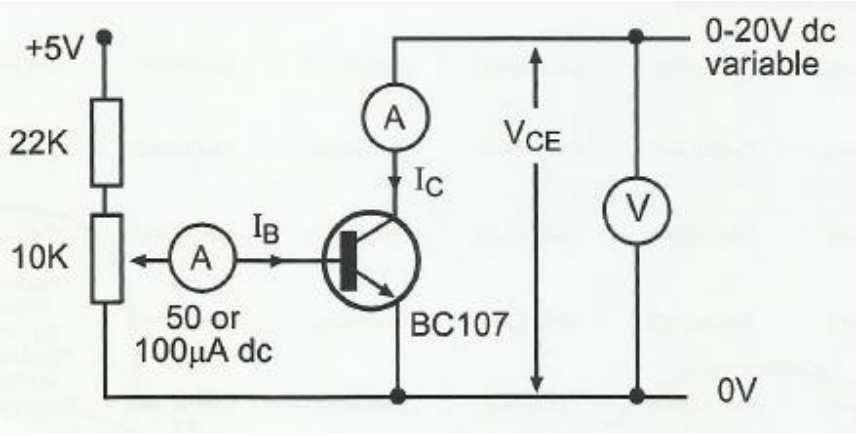
I_B (μA)	0.4	0.6	1.0	1.8	4.4	6.3	V_{CE} (V)
0							I_C (mA)
10							I_C (mA)
45							I_C (mA)

Experiment 7: Transistor familiarization

Objectives

- To familiarize with the transistor.
- To determine experimentally the parameters of the transistor.

Pictures



Procedure

1. Fill the Table 1
2. Plot the collector current IC versus the base current IB.
3. Find the slope of the curve.
4. What does the slope mean?

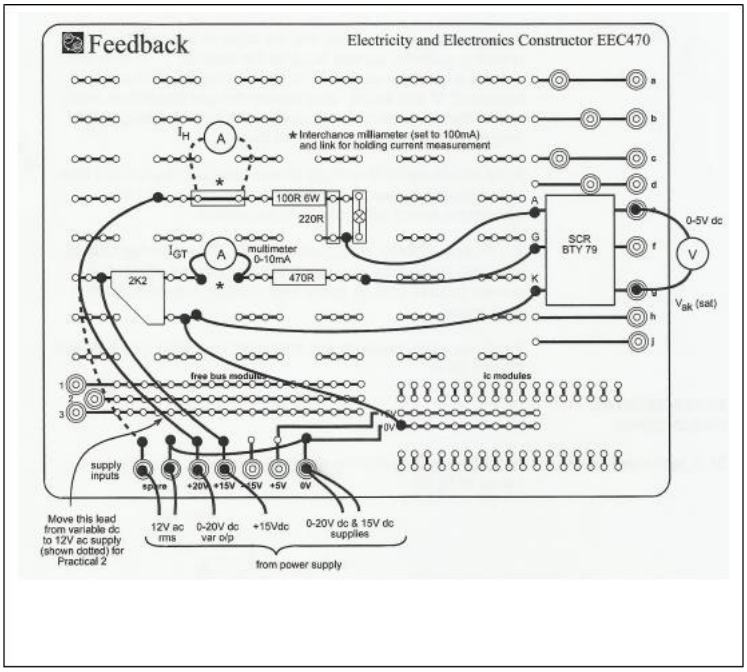
I_C (mA)	V_{EB} ( )	I_B ( )	$I_E=I_C+I_B$ ( )	$h_{fe}=\frac{I_C}{I_B}$	$h_{fb}=\frac{I_C}{I_E}$
1					
5					
10					
17					
23					
34					
Average value					

Experiment 8: The Silicon Controller Rectifier

Objectives:

- The silicon-controlled rectifier (SCR) can be used to rectify a waveform, but it passes a current in one direction. The SCR can work as half-wave rectifier and it can be used in a bridge to achieve controlled full-wave rectification.
- To perform an experimental check of silicon controller rectifier
- To practice constructing electric circuits

Pictures



Procedures:

A. Switch on the SCR

1. At first, we will apply a voltage across the anode cathode of SCR and increase this voltage, but this is not enough to switch on the SCR. For this purpose, fill the table 1
2. Now for Vvariable=12 V change the gate current and fill the table 2 and note when the lamp lights.
3. Plot the trigger current IG versus the anode cathode voltage VAK .
4. From graph find the saturation voltage VAK(sat).
5. Fill the table 3.

B. Switch off the SCR

1. At first, we will apply a voltage across the anode cathode of SCR Vvariable=12 V and decrease the current IG, but this is not enough to switch off the SCR. For this purpose fill the table 4
2. Now for IG=0 change the voltage Vvariable and fill the table 5 and note when the lamp switches off.

C. Half-wave rectification for AC-Voltage

1. Apply the AC-Voltage with IG=0 (the SCR is switched off, IAK= 0) and then connect the oscilloscope across anode and cathode. Draw the signal illustrated by oscilloscope.
2. Apply the AC-Voltage with IG=6 mA (the SCR is switched on, IAK= 30 mA) and then connect the oscilloscope across anode and cathode. Draw the signal illustrated by oscilloscope.

Experiment 9: The TRIAC

Objectives:

- Study the TRIAC device.
- Understanding of the bi-directional nature of the TRIAC and its applications.
- To understand the work of the TRIAC in the four operating quadrants.
- To use the TRIAC as half-wave and full-wave controlled rectifier and to see the rectified waveforms.

Picture:

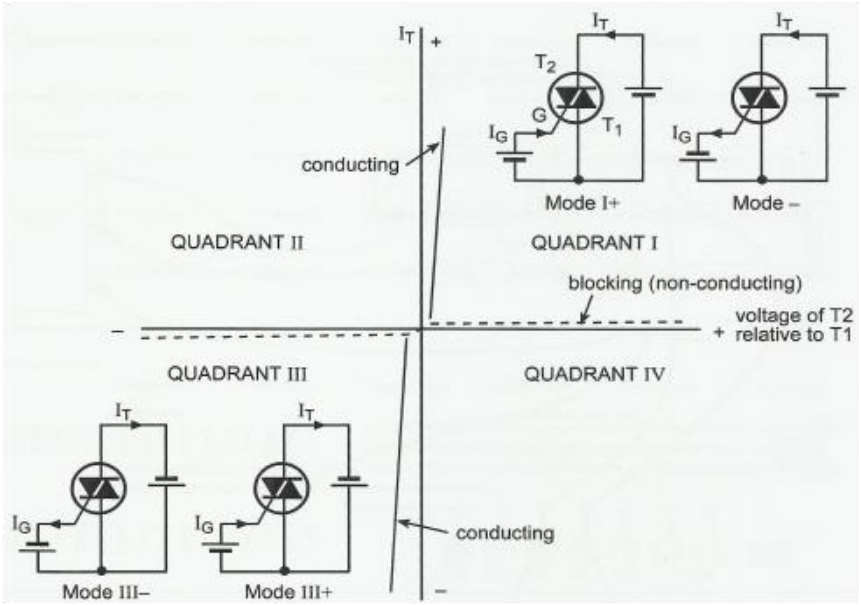


Fig. 1 TRIAC triggering modes

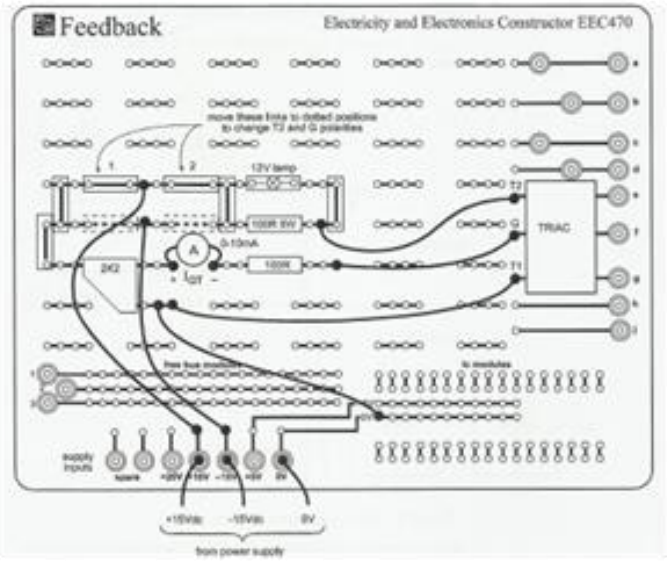
Procedure

Four modes of the TRIAC

Connect the circuit shown in Fig. 2 for four modes.

A. Mode I+ (positive gate current, and VT2> VT1)

1. Connect the two links 1, 2 as shown in Fig.2 to have positive IG and VT2> VT1.
2. Connect the Ammeter with polarity as shown in Fig. 2 to have a positive reading of gate current.
3. Add to this circuit other ammeter with polarity to have positive reading of IT2 .
4. Watch the lamp when it will be lighted, to determine IGT and VT2T1(sat).
5. Fill the table
6. From table 1 find: IGT = mA , and (VT2 –VT1)sat = V , IT2(H)= mA.
7. Decrease the gate current and note that the TRIAC stays switching on.



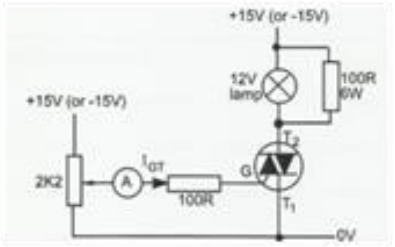


Fig. 2 Setup for TRIAC modes

B. Mode I- (negative gate current, and VT2> VT1)

1. Connect the two links 1(down), 2(up) in Fig.2 to have negative IG and VT2> VT1.
2. Watch the lamp when it will be lighted, to determine IGT and VT2T1(sat).
3. Fill the table 2
4. From table 1 find: IGT = mA , and (VT2 –VT1)sat = V , IT2(H)= mA.
5. Decrease the gate current and note that the TRIAC stays switching on.

C. Mode III+ (positive gate current, and VT2< VT1)

1. Connect the two links 1(up), 2(down) in Fig.2 to have positive IG and VT2< VT1.
2. Watch the lamp when it will be lighted, to determine IGT and VT2T1(sat).
3. Fill the table 3
4. From table 1 find: IGT = mA , and (VT2 –VT1)sat = V , IT2(H)= mA.
5. Decrease the gate current and note that the TRIAC stays switching on.

D. Mode III- (negative gate current, and VT2< VT1)

1. Connect the two links 1, 2(down) in Fig.2 to have negative IG and VT2< VT1.
2. Watch the lamp when it will be lighted, to determine IGT and VT2T1(sat).
3. Fill the table 4
4. From table 1 find: IGT = mA , and (VT2 –VT1)sat = V , IT2(H)= mA.
5. Decrease the gate current and note that the TRIAC stays switching on.

E. The TRIAC as half-wave and full-wave rectifier.

1. Connect the circuit as shown in Fig.3.
2. Add an ammeter (dc) to measure IG.
3. Connect the oscilloscope to the two ends T1 & T2 of TRIAC.
4. Connect an ammeter (ac) to measure the current IT2.
5. Watch the lamp and note three different stages (no light, small and big brightness).
6. Increase the current IG and fill the table 5 and watch the lamp and oscilloscope
7. Sketch the shape of signal for three causes of TRIAC:
   - switched off,
   - switched on with mode I+ (or mode III+) (half-wave rectifier)
   - and switched on with two modes I+ & III+ (full-wave rectifier).

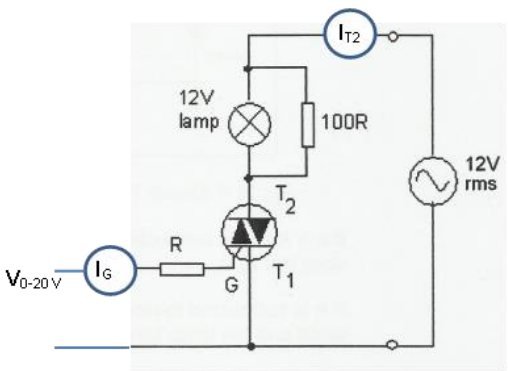


Fig.3 Half-wave and full-wave rectification

تابع: أجهزة المختبرات في قسم الفيزياء

Laboratory Equipment in Department of Physics

5- محتويات مختبر الضوء من التجارب

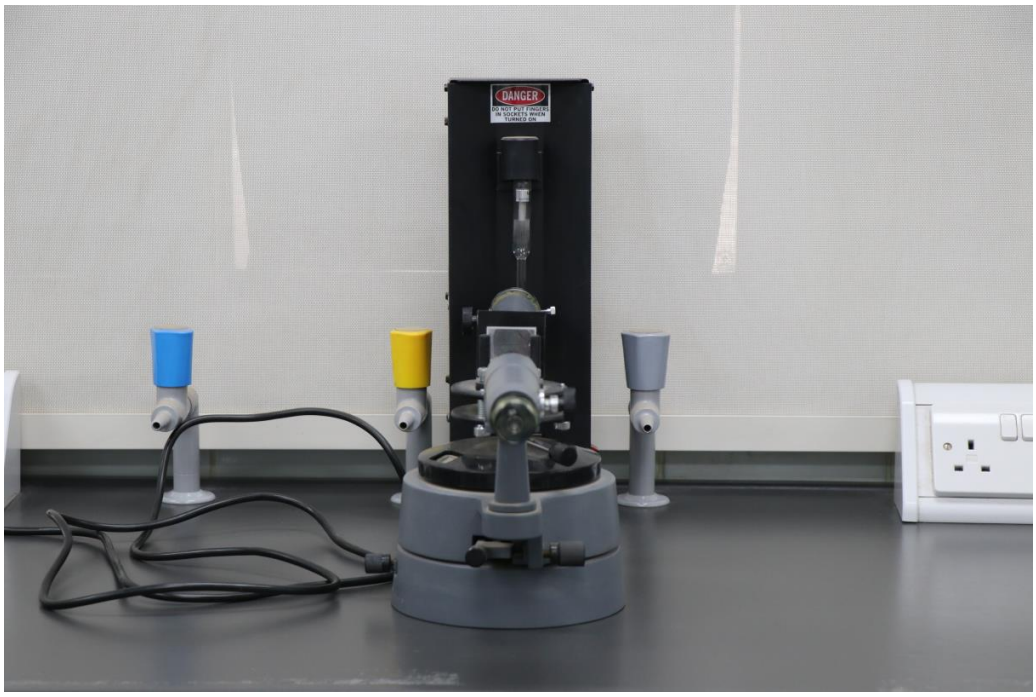
5- Experiments of Optics Lab

Experiment 1: Determination of the refractive index (n) of the material of a prism using spectrometer

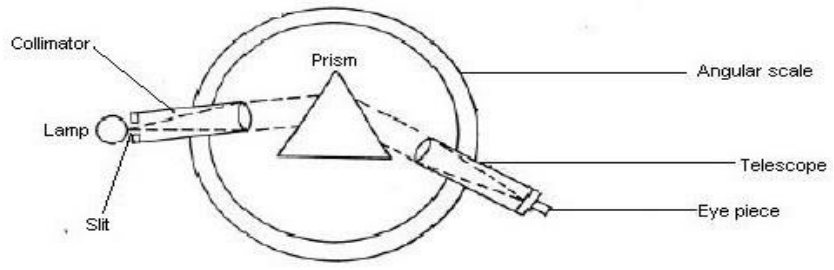
Objectives:

- To calculate the Refractive Index (n) of the Prism for various wavelengths of the Mercury Spectrum
- To plot the Dispersion and Calibration Curves using a Prism Spectrometer.

Pictures:



Procedure



Spectrometer

Set UP

A. Measuring the Apex Angle of the Prism (A):

1. Place the prism on the Prism Table and lock the prism table in the position so the incident beam falls on one of the edges of the prism.
2. Now, move the telescope and locate the images of the slit and note down the angles. The difference between both the angles is (2A).
3. Hence, half of the difference will give us (A).

B. Measuring the Angle of Minimum Deviation (δm):

1. Now, choose an angle of incidence other than the previous chosen one and with eye locate approximately the angle at which the spectrum starts to move in the opposite direction as the prism table is rotated, and lock the prism table.
2. Now, using the telescope, fix the telescope on one of the spectrum lines, and then use the fine adjustment for the movement of prism table to move the table so that we get the precise location of the angle where the line starts to move in the opposite direction, and note the angle for this.
3. Without disturbing anything, remove the prism and get the measure of the angle of the direct image of the slit in the telescope.
4. The difference between these two angles is the Angle of Minimum Deviation (δm) for this spectral line (λ).
5. Repeat the same for all the spectral lines that are given by the mercury lamp.

C. Measuring the Refractive index (n):

1. From the above data (A, δm) we can calculate the Refractive index (n) of the prism for various wavelengths (λ).
2. For the Calibration Curve, plot a graph of (δm) versus (λ).
3. For the Dispersion Curve, plot a graph of (n) versus (λ).
4. Calculate A and n using the following formula

$$A = \frac{A_1 + A_2}{2}$$

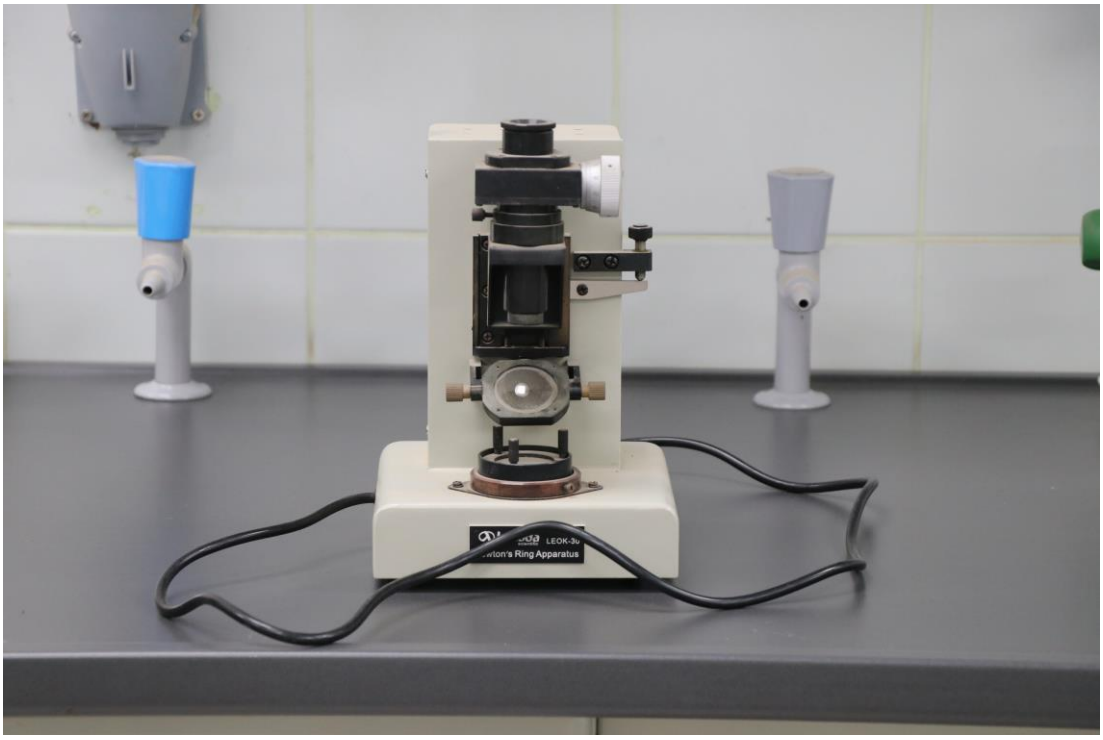
$$n = \frac{sin(\frac{A+\delta_m}{2})}{sin\frac{A}{2}}$$

Experiment 2: Determination of the Wavelength of Sodium Light using Newton's Rings

Objectives:

- To form Newton's Rings and then find the radius of curvature of a given plano-convex lens

Pictures:



Procedures:

A. Observation of Newton's Rings

1. Open the metal cover and install the Sodium lamp bulb to the lamp housing.
2. Turn on the Sodium lamp and warm up for about 5 minutes.
3. Insert the Newton's ring in the holder on the base with three screws up. Secure the Direct Measurement Microscope in focusing device.
4. Rotate beam splitter to let Sodium light illuminate the Newton's Ring. When the beam splitter is oriented 45□ to the optical axis of the DMM, fine rings can be seen through the eyepiece. Lock the beam splitter. If the interference pattern is not clear, rotate the focusing knob to focus the microscope.

5. Carefully turn eyepiece until cross hair is seen clearly. Carefully adjust the focusing knob until a clear image of the equal- thickness rings is observed.
6. Adjust the three screws on frame of Newton's ring to let center ring move to the
7. center of the viewing field. Tighten any two of the three crews on Newton's ring, distorted rings should be observed.

B. Determination of Radius of Curvature of Lens

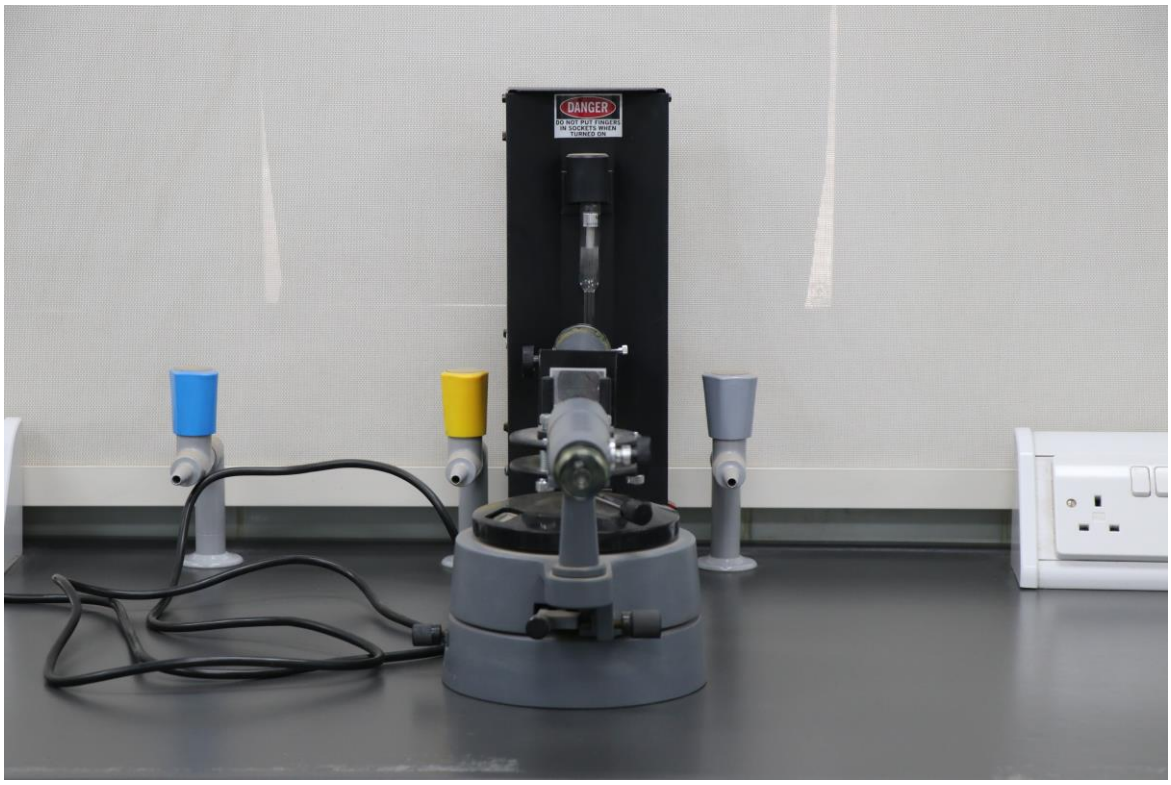
1. Turn on the sodium lamp and get Newton's rings. For details, please refer to 1.
2. Rotate the drum and set the cross hairs on the 5th ring on the left hand side of the interference pattern and record the reading of the drum. Similarly, go to the 14th ring on the same side of the pattern and record the drum reading. Repeat these steps for several rings and record the data in the following table. Repeat these steps on the right hand side of the interference pattern.
3. Determine d5, d6, ..., d14 from measured data and calculate (d14)2-(d9)2, (d13)2-(d8)2, (d12)2-(d7)2, (d11)2-(d6)2, (d10)2-(d5)2 and their average (m-n=5). Then calculate the radius of curvature of the lens by using the mean wavelength, 589.3 nm, of Sodium D-lines in equation (4).

Experiment 3: The Diffraction Grating: Measuring the Wavelengths of Light

Objectives:

- In this experiment the properties of a transmission grating will be investigated and the wavelengths of several spectral lines will be determined.

Pictures:



Procedures:

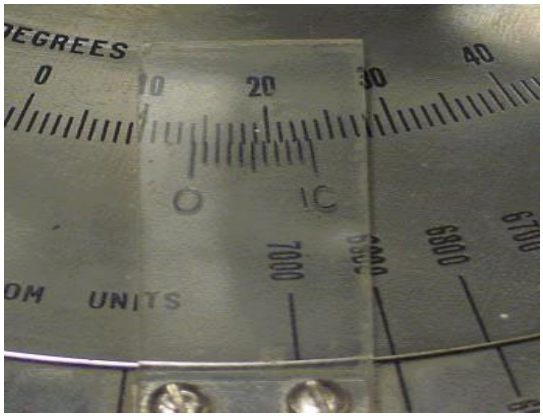
4. Review the operation of a spectrometer if necessary. The diffraction grating used for this experiment has 6000 lines per cm.
5. Record the number of lines per unit length of your diffraction grating in the Laboratory Report.
6. Mount the grating on the spectrometer table with the grating ruling parallel to the collimator slit and the plane of the grating perpendicular to the collimator axis.
7. Mount the light source in front of the collimator slit.
8. Move the spectrometer telescope into the line of the slit of the collimator and focus the cross-hairs on the central slit image.
9. Make sure the angle (θ) scale is set to zero when the telescope crosshair is centered on the slit image.
10. Notice that this central maximum or "zeroth"-order image does not depend on the wavelength of light, so that a white image is observed. Then move the telescope to the left side of the incident beam and observe the first- and second-order spectra.
11. (a) Focus the cross-hairs on the blue (violet) end of the first-order spectrum at the position where you judge the spectrum just becomes visible. Record the divided circle

reading (to the nearest tenth of of a degree) in Data Table 1. (Note – example degree scale on the right shows 14.2°)

(b) Move the telescope to the other (red) end of the spectrum and record the divided circle reading of its visible limit.

12. Compute the grating constant (d), and with the experimentally measured (□'s), compute the range of the wavelengths of the visible spectrum in centimeters and angstrom units (1 Å = 10^{-8} cm).
13. Record the grating constant of your telescope:

    N = 6,000 cm^{-1} (N is the number of grooves per centimeter) d = (1/N) = 1.67 □ 10^{-4} cm = 1.67 □ 10^{4} Angstroms

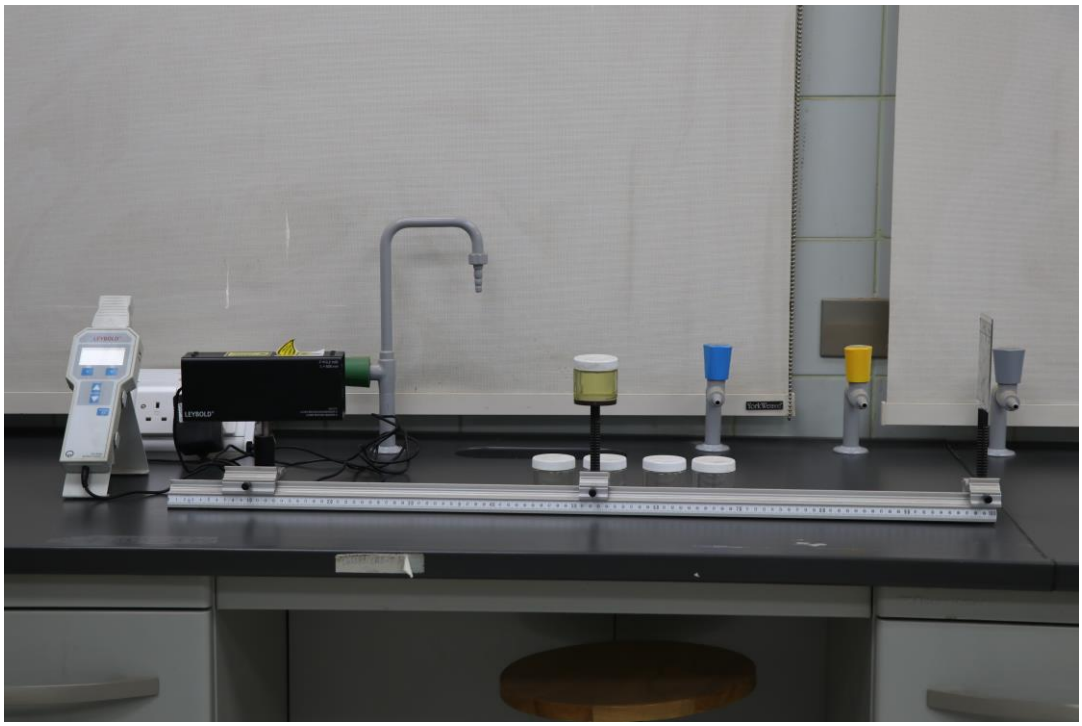


Experiment 4: Determining the velocity of light in the air/liquid/solid from the path and transit time of a short light pulse (Velocity of light: Measuring with short light pulses)

Objectives:

- Determining the velocity of light in the air from the slope of the graph s = f(t).
- Determining the velocity of light in the air as the quotient of the path and the transit time.
- Absolutely measuring the transit time t of a short light pulse for a given path 2s by marking the zero point with a reference mirror.
- Determining the velocity of light in the air as the quotient of the path and the calibrated transit time.

Pictures:



Procedures:

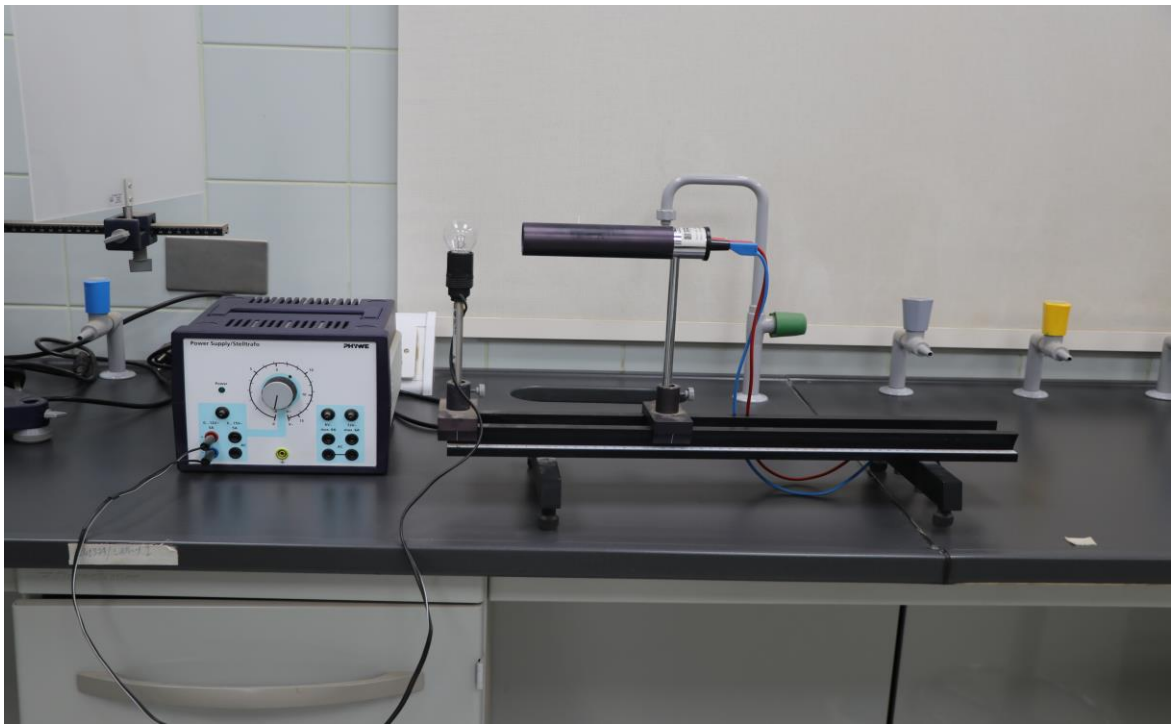
1. Measuring the transit time as a function of the position of the mirror or liquid sample.
2. Put the sample on the sample stand. Change in distance s of the large mirror or liquid sample and the transit time t of the light pulse.
3. Note the distance S in meter and transit time in nanosecond. Repeat and take the reading at different distance of different sample.
4. Plot the graph between the S, distance and transit time 't' of different samples.
5. The graph of the measured values for s as a function of t. From the slope a of the straight line through the measuring points, To obtain the following value for the velocity of light 'C' = 2 S/t, through air or sample

Experiment 5: Irradiance and Inverse-square Law for Light

Objectives:

- To observe the inverse-square law relationship between the intensity of a light bulb and the distance away from the light bulb

Pictures:



Procedures:

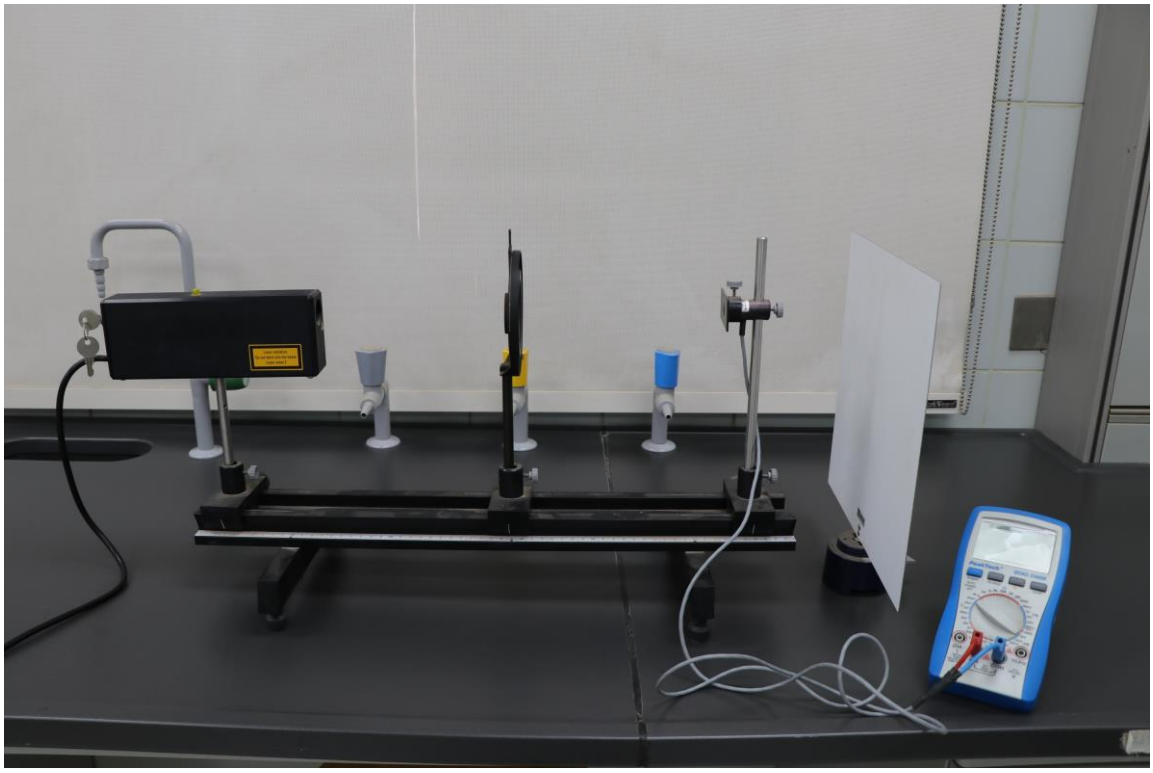
1. Fixed the light source at the end of the bench
2. Switch on the light bulb (The power source not exceeds 5 Volt)
3. Place the sensor towards the light bulb at a certain distance for example (20 cm).
4. Record the readings of both distance (d, 20 cm) and the sensor (I, mA) on a Table.
5. Repeat the steps (3) and (4) for different values of distance, 30, 40, 50, 60, 70 cm
6. and measure the readings of the sensor for each distance.
7. Record all results on the Table.
8. Draw the relation between the Intensity (sensor reading, Y-axis) and the distance (d, cm) on (X-axis)
9. The relation will investigate the Inverse square law (the slope will be 2).

Experiment 6: Study of polarization by verification of Malu's law.

Objectives:

- To determine the plane of polarization of a linear polarized laser beam.
- To determine the intensity of light transmitted by the polarization filter as a function of the angular position of the filter

Pictures:



Procedure

1. It must be made sure that the photocell is totally illuminated.
2. Using a digital multimeter the disturbing background currents Io must be determined with laser switch off.
3. Switch ON the laser. It should be allowed warm up for about 30 minutes to prevent disturbing intensity fluctuations.
4. The polarization filter is then rotated in steps of 50 between the filter positions +/- 900 and the corresponding photo cell current is determined.
5. Make the table required for angle and corrected photo current. Identify the intensity peak the show the polarization plane of the emitted laser beam has already been rotated by the angle against vertical.
6. Show that the corrected and normalized photo cell current as a function of the angular position of the analyzer. Malus's law is verified from the slope of line.

Experiment 7: To study diffraction of light using a slit

Objectives:

- To study diffraction of light using a slit
- To measure the wavelengths of laser source

Pictures:

Procedures:

1. Measure the distance between the slits (front of Slit Disk) and the screen. You can use the scale on the track, but it is easier and more accurate to use a meter stick. Record the wavelength of the laser (printed on its back).
2. Turn out the room lights.
3. Observe the pattern on the screen as you rotate the Single Slit to each of its four positions (0.16, 0.08, 0.04, 0.02 mm). How does the pattern change as you decrease the slit width? Answer Question 1 in the Conclusions section. Set the disk to the 0.02 mm slit.
4. Move the Light Sensor so the Rotary Motion Sensor (RMS) is against the black stop block on the linear translator arm. If the positions are all negative when you start taking data, click on the Hardware Setup and click on the properties gear for the Rotary Motion Sensor and check "Change Sign".
5. Click on the RECORD button. Then slowly turn the RMS pulley to scan the pattern. Hold the rear of the RMS down against the linear translator bracket so it does not wobble up

and down as it moves. Click on STOP when you have finished the scan. If you make a mistake, simply delete the run using the Delete Last Run button at bottom of screen and do the scan again. If the intensity maxes out (100%), change the gain setting on the light sensor and repeat the run. Click on Data

6. Repeat for the 0.04 mm slit. Press the 0-100 button on the Light Sensor. Label the run "0.04 mm".

Experiment 8: To determine the wavelength of light of the used laser with Michelson interferometer

Objectives:

- In the Michelson arrangement interference will occur by the use of 2 mirrors. The wavelength is determined by displacing one mirror using the micrometer screw.

Pictures:

Procedures:

1. The experimental set up is as shown in Fig. 1. In order to obtain the largest possible number of interference fringes, the two mirrors of the interferometer are first of all adjusted; to do this, the lens is first of all removed.

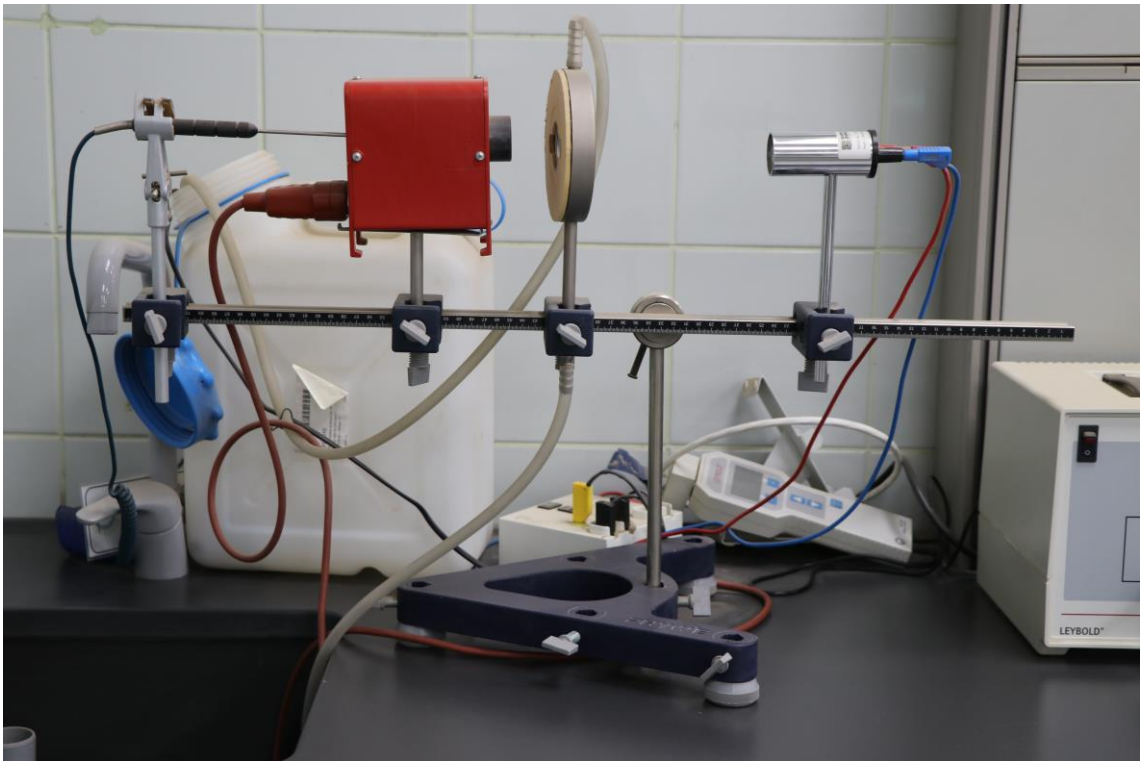
2. The laser beam strikes the half-silvered mirror at an angle of 45° splitting the beam. The resulting two beams are reflected by the mirror and impinge on the screen. By means of the two adjusting screws fitted to one of the mirrors, both points of light are made to coincide.
3. If the lens is placed in the light beam, the points of light are enlarged and the interference patterns are observed on the screen (bands, circles). By careful readjustment, an inter-ference image of concentric circles will be obtained.
4. To measure the wavelength, the micrometer screw is turned to any initial position at which the centre of the circles is dark.
5. The micrometer screws is now further turned in the same direction and the light-dark periods thus produced are count-ed.
6. The distance travelled by the mirror must be read off on the micrometer screw and divided by ten (lever reduction 1:10).
7. Should the central point of the circles move outside the light spot area a readjustment has to be performed?

Experiment 9: Stefan-Boltzmann law: measuring the radiant intensity of a “black body” as a function of temperature

Objectives:

- Conducting relative measurements of the radiant intensity of an electric oven with the black body accessory in the temperature range from 300 750 K using a Moll’s thermopile.
- Graphing the relationship between the radiant intensity and the absolute temperature to confirm the Stefan-Boltzmann law

Pictures:



Procedures:

1. Set up the electric oven, the screen of the black body accessory and the thermopile as shown in Fig. so that the rod of the thermopile is about 15 cm in front of the opening of the electric oven. The screen of the black body acces- sory should be positioned about 5 – 10 mm in front of the electric oven, with the metal side facing the thermopile.
2. Remove the glass window of the thermopile.
3. Connect the Ni Cr- Ni temperature sensor to the digital thermometer and insert it in the small central hole in the burnished brass cylinder as far as it will go.
4. Mount the temperature sensor in place with the universal clamp S and switch on the digital thermometer (measuring range > 200 °C).
5. Align the openings of the electric oven, the screen of the black body accessory and the thermopile so that the radi- ant heat is directly incident on the opening of the ther- mopile.
6. If you are using water cooling, switch on the immersion pump now.
7. Connect the thermopile to the microvoltmeter as shown in Fig. 1 (measuring range 10–4 V); make sure the red socket on the thermopile is connected to the red socket on the microvoltmeter.
8. Compensate the offset by pressing the key “auto comp”; if necessary, carry out the fine adjustment using the poten- tiometer to set the digital display to zero (see Instruction Sheet for the microvoltmeter).

تابع: أجهزة المختبرات في قسم الفيزياء

Laboratory Equipment in Department of Physics

6- محتويات مختبر فيزياء نووية من التجارب

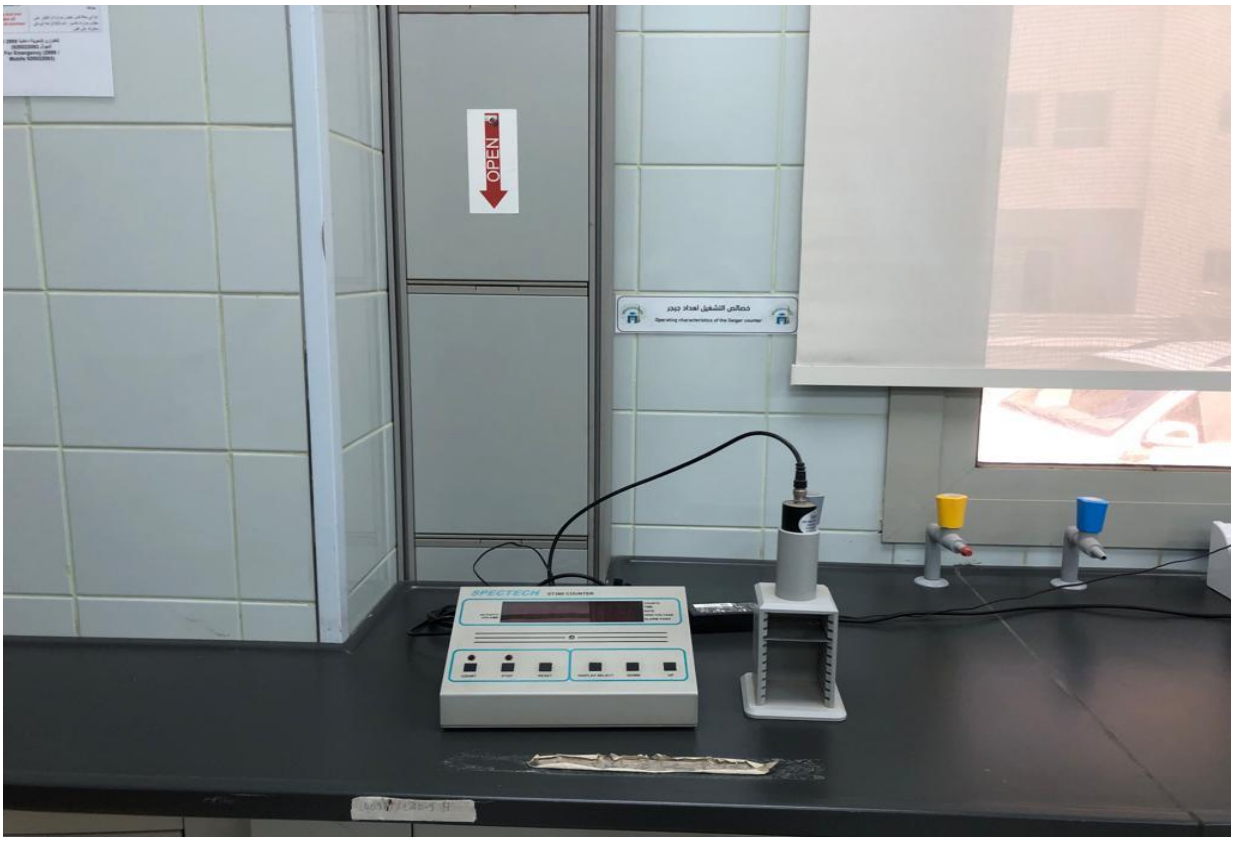
6- Experiments of Nuclear Physics Lab

Experiment 1: Characteristics of Geiger Muller Counter

Objectives:

- Plotting the characteristic curve of the GM counter.
- Determination of:
  a) Starting voltage Vs of the GM counter.
  b) Threshold voltage Vth. (or V1) of the GM counter.
  c) Plateau length of the GM counter.
  d) Operating voltage V0 of the GM counter
- Calculation of the percentage gradient of the GM detector.

Pictures:



Procedures:

1. Connect the plugs of the electric mains.
2. Set the timer to 60 s and the HV to 600 Volt.
3. Record the count rate per one minute for the back ground (NB.G).
4. Put the source in front of the Gieger tube on the second shelf from top .
5. Set the high voltage to 640 V and start counting. Increase the applied voltage in steps of 40 V until the detector begins to operate, this is the starting voltage (Vs).

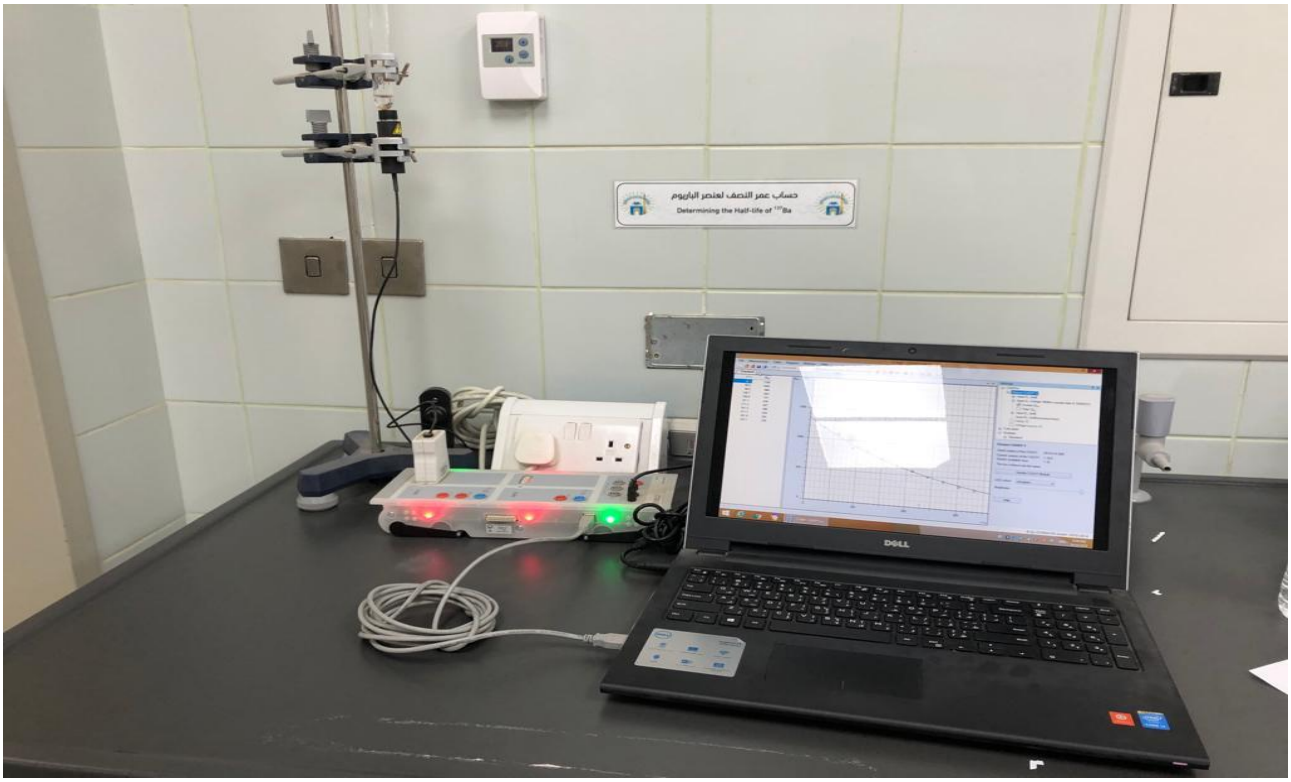
6. Increase the applied voltage and record the count rate per one minute (N1) for each voltage. Take two readings for each voltage and take their average.
7. Plot the counting rate (N) versus the applied voltage (V) deduce the threshold voltage, the plateau length, the operating voltage and the percentage gradient of the detector.

Experiment 2: Determining the half-life of Ba-137

Objectives:

- Studying how activity of a radioactive source changes with time.
- Determining the half-life of Ba–137m

Picture:



Procedures:

1. Attach the universal clamps to the stand rod and clamp the end-window Geiger tube in the lower universal clamp so that it is directed upwards and remove the protective cap of the Geiger tube.
2. Clamp a test tube in the upper universal clamp so that its distance from the entrance window is approx. 0.5 cm.
3. Connect the Geiger tube to the counter and turn on the counter.
4. Follow the instructions of your lab instructor to elute the sample.

5. Immediately start counting (start the counter, then start your timer as you freeze the screen for your first reading) and record the count every 30 seconds until 10 minutes have passed, using the screen freezing feature in the device.
6. Draw a graph of N on y-axis vs t (time) on x-axis, and find the half-life from it.
7. Find percentage error using $t_{(1/2)Theo}$= 2.551 min.
   a. $t_{1/2}$=..... min.
   b. λ (decay constant) =ln 2/ $t_{1/2}$ = ... min^{-1}
   c. % Error = (|Measured value- Accepted value |/ Accepted value) 100 %

EXPERIMENT 3: Inverse Square Law

Objectives:

- Verify the inverse square relationship between the distance and intensity of radiation

Picture:

Procedures:

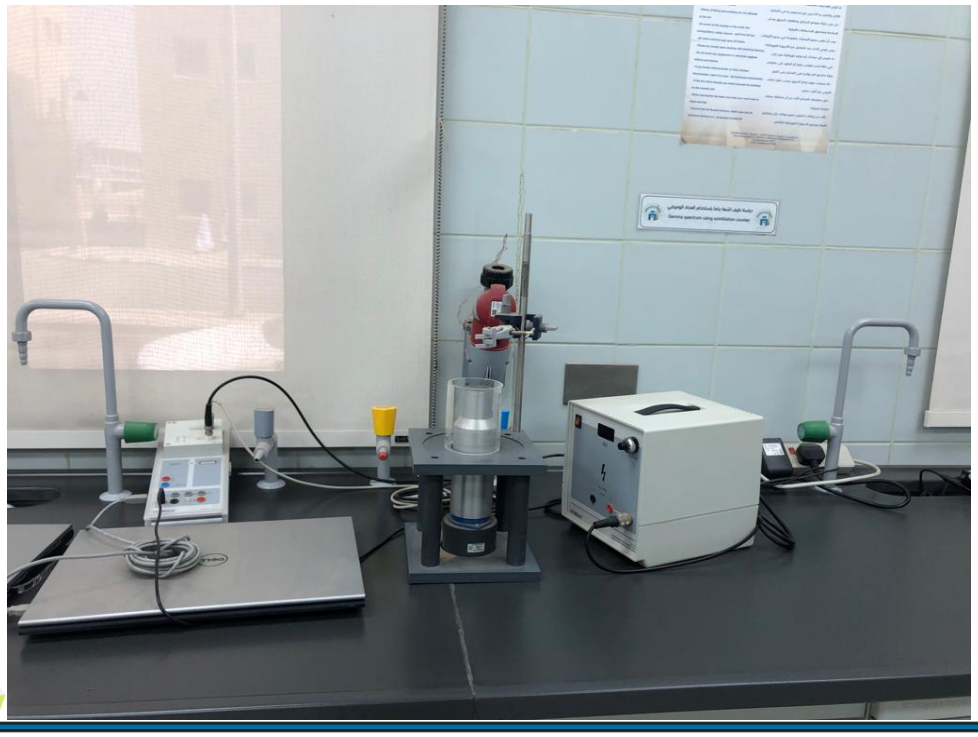
1. Setup the Geiger counter as you have in the previous experiments. Set the Voltage
2. of the GM tube to its optimal operating voltage, which should be around 900 Volts.
3. From the Preset menu, set Runs to zero and set Preset Time to 60 s.
4. First do a run without a radioactive source to determine your background level.
5. Next, place the radioactive source in the top shelf and begin taking data. In this position, the source is 2 cm from the GM tube's actual detector components.
6. Move the source down one shelf each time and take another run. You should see the data accumulating in the Data window. After all ten shelves have been used, save the data onto disk or record in a data table. Remember that the first run is a background number.
7. Next, make a graph of Counts vs. 1/d2.
8. Use your graph to determine if the data does indeed obey inverse square law.

Experiment 4: Gamma Ray spectroscopy Using a Scintillation Detector Nal (Ti)

Objectives:

- To observe the spectra of different gamma sources.
- To study the full structure of 137Cs and 60 Co spectra

Picture:



Procedures:

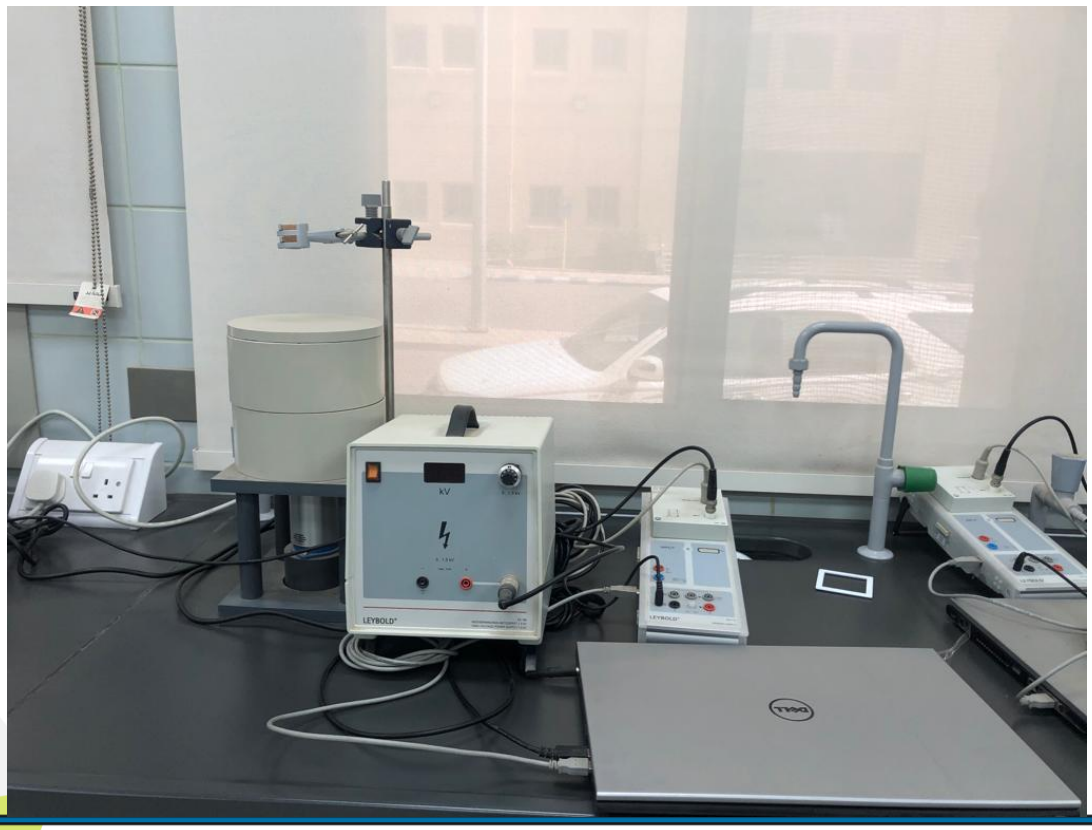
1. Connect the detector to the computer (make sure not to confuse the HV cable with the NBC cable)
2. Connect the plugs to the electric mains and switch the computer and monitor ON.
3. Go to start menu then programs then spechtech and click on ICW16 to open the software.
4. Set the high voltage to 700 V and to the on position. (A green bar will appear on lower part of the window, written on it 700V indicating that the high voltage is on).
5. Put the Cs-137 source on the second shelf under the detector.
6. Click the start button (green diamond) on the software window to start counting and acquiring the spectrum.
7. Keep the spectrum and replace the Cs-137 source with a Co-60 source and repeat steps 5-6 highlighting this time the rightmost peak of the Ba133 spectrum

Experiment 5: Absorption of Gamma Rays

Objectives:

- Investigate the attenuation of radiation via the absorption of gamma rays.

Picture:



Procedures:

1. Setup the Geiger counter as you have in the previous experiments. Set the Voltage
2. of the GM tube to its optimal operating voltage, which should be around 900 Volts.
3. From the Preset menu, set Runs to zero and set Preset Time to 60.
4. First do a run without a radioactive source to determine your background level.
5. Next, place the radioactive source in the second shelf from the top and begin taking data.
6. Place an absorber piece in the top shelf and take another run of data.
7. Repeat this a minimum of 7 more times with absorbers of increasing thickness.

Experiment 6: Effect of magnetic field on Alpha particles

Objectives:

- To observe the effect of magnetic field on α radiation.

Picture:

Procedures:

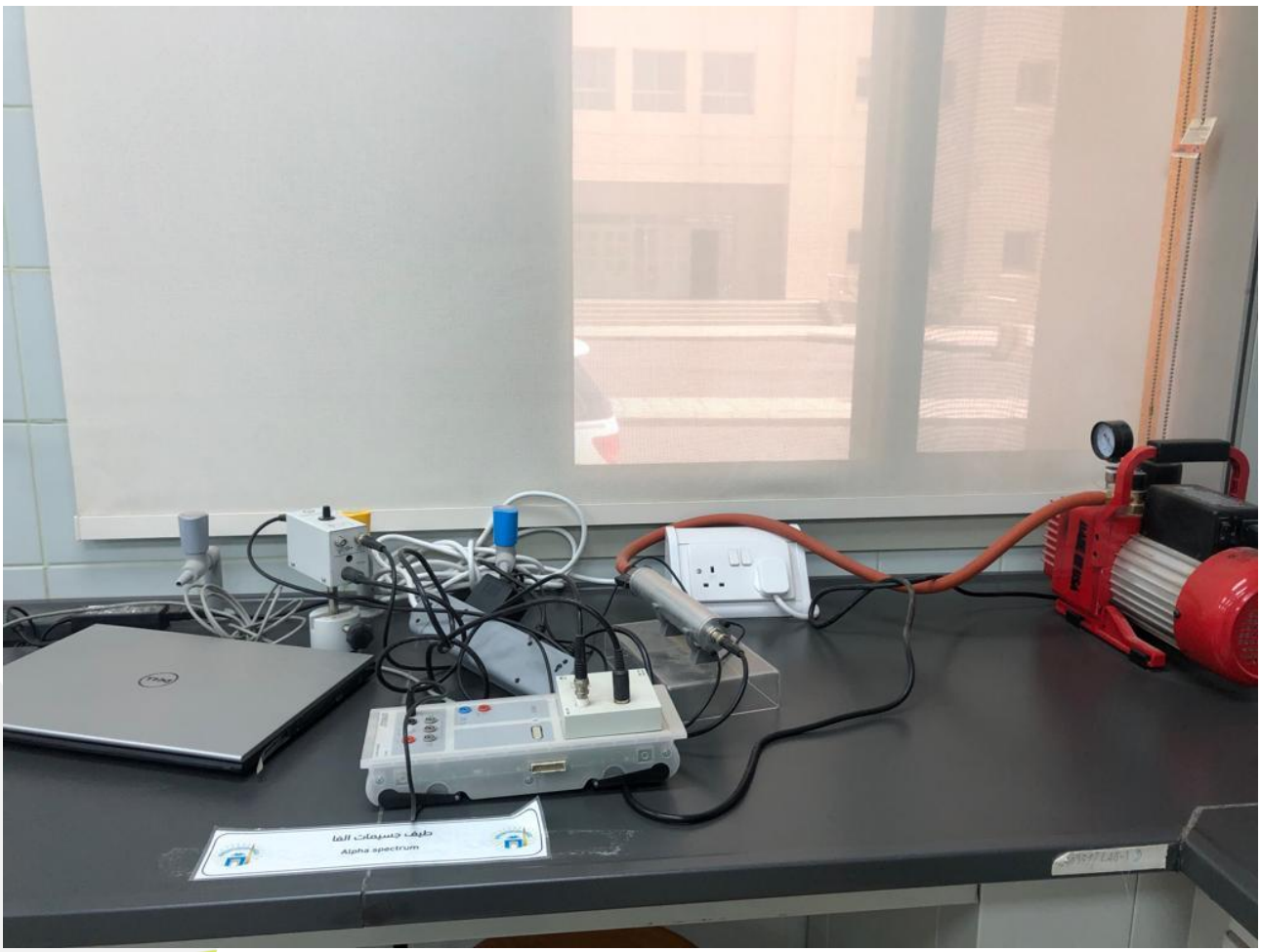
1. Connect the apparatus as shown in Fig.1.
2. In the beginning without magnetic field record the number of count (N) per 60 s .
3. Increase the current to 0.3 A and repeat step2.
4. Plot a graph between the count and Magnetic field.
5. Deduce the direction of the applied magnetic field.
6.

EXPERMINT 7: α spectroscopy of radioactive samples

Objectives:

- The aim of this experiment is to demonstrate how α-particle energy spectra may be obtained using a semiconductor surface barrier charged particle detector. The spectrometer will be used to investigate the energy loss of α particles in air using an 241Am α source.

Picture:



Procedures:

1. Evacuate the alpha spectroscopy chamber.
2. Start the measurement with ⏱.
3. Vary the gain of the MCA box until the spectrum covers all available channels. Thistypically occurs at gains around -3.
4. After every change of the gain the measured spectrum should be deleted with 🗋 to avoid mixing of different spec- tra. The measurement goes on then, and the measuring time is restarted.
5. When the set measuring time is over, the measurement is stopped.

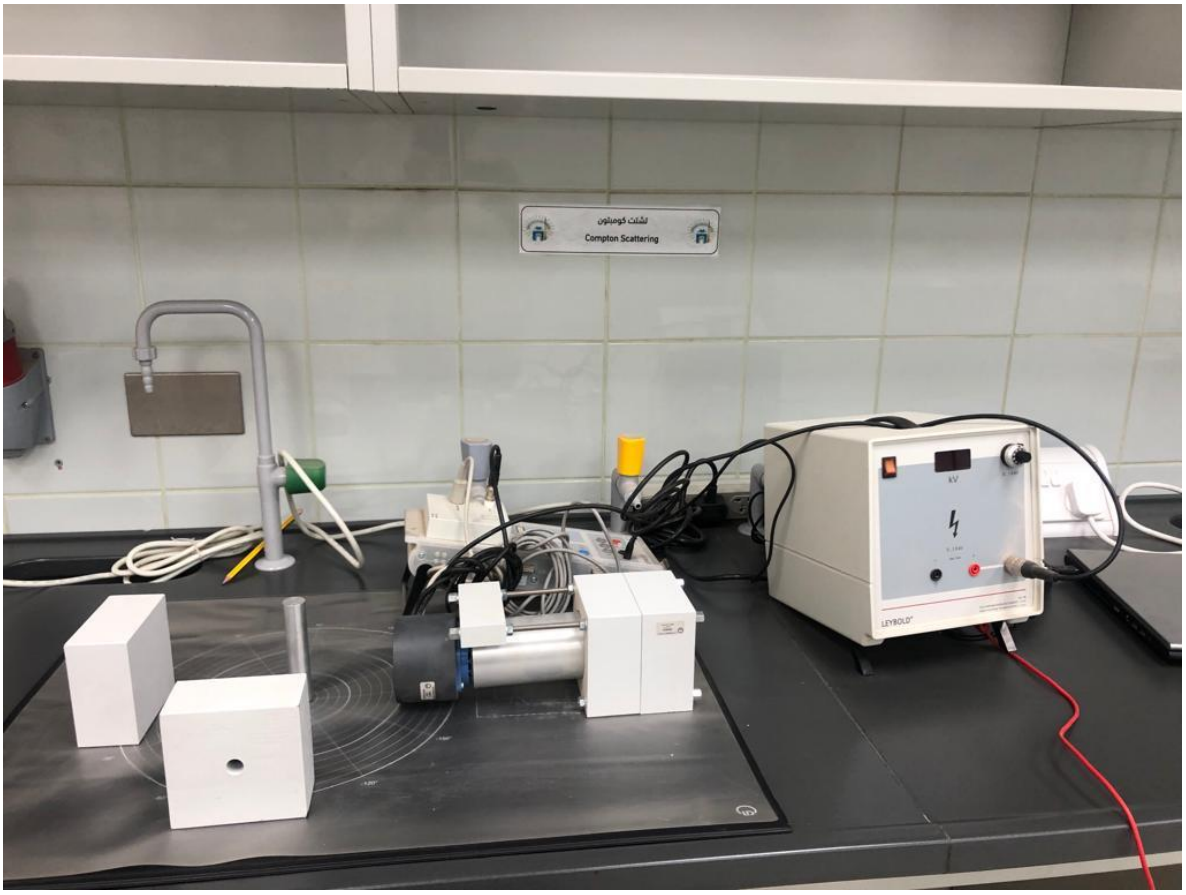
EXPERMINT 8: Quantitative observation of the Compton Effect

Objectives:

The objectives of this experiment are:

- To study the interaction of high energy photons with matter.
- To study photon-electron interactions.
- To study the effects of backscatter and to learn about soft X-ray and Bremsstrahlung production.
- To learn experimental techniques and procedures for measuring gamma-ray energy distributions.
- To learn about photomultipliers and scintillation counters for measuring high energy photons

Picture:



Procedures:

1. First make an energy calibration of the scintillation counter. For this insert the mixed preparation in the sample holder from the Equipment set Compton, align it at the 0° mark. Leave the aluminum scatterer aside.
2. Record the spectrum with ⏱, and make the energy calibration with the lines at 662 keV and 59.5 keV.
3. Replace the mixed preparation with the Cs-137 preparation, set up the preparation at 30°, and set up the alumi- num scatterer. Place the additional screening in the direct line of vision between the preparation and the detector.
4. Record the spectrum with ⏱, then remove the aluminum scatterer, and record a new spectrum.
5. The difference between the two spectra (with and without the aluminum scatterer) is the scattering spectrum.
6. Repeat the measurement at various angles of the preparation, each time subtracting a spectrum without the alu- minum scatterer from a spectrum with the aluminum scatterer. Always shift the additional screening in the setup so that the direct line of vision between the preparation and the detector is blocked

Experiment 9: Nuclear magnetic resonance in polystyrene, glycerine and Teflon

Objectives:

- Nuclear Magnetic Resonance on protons and fluorine in liquids and solid samples
- Determination of the line width of the fluorine resonance
- Determination the g-factor of protons and fluorine

Picture:

Procedures:

1. Set the oscilloscope to xy-mode
2. Select fast sweep and set the modulation amplitude to a large value
3. Set the value of the frequency to a maximum value.
4. Slowly enhance the HF amplitude until the red LED lights up and a frequency of about 19 MHz is displayed.
5. Reduce the frequency to a value of about 18.5 MHz.
6. Shift the O-ring of the glycerine sample tube (8 protons) so that the sample will be located approximately in the center of the measuring chamber.
7. Carefully insert the sample tube into the measuring cham- ber.
8. Remark: if the sample tube is inserted at an angle with too much force the rf coil can be damaged.
9. Slowly increase the current though the 10 A coils until an NMR signal appears on the oscilloscope of the screen.

تابع: أجهزة المختبرات في قسم الفيزياء

Laboratory Equipment in Department of Physics

7- محتويات مختبر فيزياء الجوامد من التجارب

7- Experiments of Solid State Physics Lab

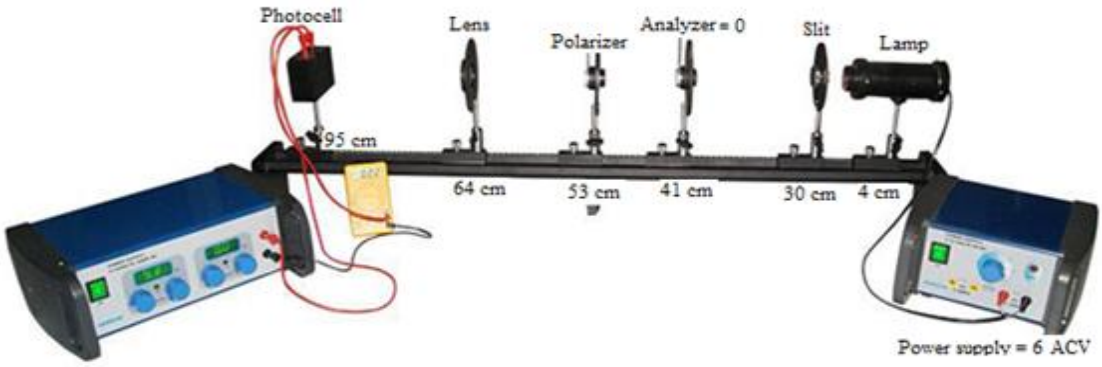
Experiment 1: The Photoconductivity

Objectives:

To study the Photoconductivity of CdS photo-resistor at constant polarization angle (θ) and constant voltage (V) must be:

- Determine the resistance (R) of the material at constant polarization angle (θ) by plotting the current-voltage (I – V) characteristics.
- Investigate the polarization phenomena by measuring the photocurrent (I_{Ph}) as a function of polarization angle (θ) at constant voltage.

Pictures:



Procedures:

PART I: Adjust the system:-

1. Mount the lamp housing, adjustable slit, polarizer, analyzer, lens, and photo-resistor on the optical bench.
2. Connect the leads of the lamp housing to the power supply (0 - 12V AC/DC, 5A) and apply 6V AC to the lamp.
3. Adjust the height of the lamp housing, adjustable slit, polarizer, analyzer, lens and photo-resistor such that all of them lie on the same optical axis.
4. Make the connections to the photo-resistor and multi-meter.
5. Initially set the polarizer and analyzer at 0˚.
6. Adjust the lamp, lens and photo-resistor so that the homogeneous ray of light illuminates the photo-resistor.

PART II: Calculate the resistance (R, Ω) of the photocell at constant polarization angle (θ)

1. Put the polarizer (receiver) at (0°) angle.
2. Put the analyzer at polarization angle (θ = 0°).
3. Find the relation between the photocurrent (Iph, mA) and the voltage (V, volt) and put the results in a table.
4. Drew the relation between the Photocurrent (Iph, mA) and the voltage (V, volt), and find the slope of the relation to calculate the resistaRepeat the previous steps at polarization angle (θ = 50°) and calculate the resistance of the photocell (R = ...Ω, at θ = 50°).

PART III: To investigate the polarization phenomena

1. Set the voltage of DC power supply to 6 volt.
2. Put the polarizer (receiver) at (0°) angle.
3. Find the relation between the photocurrent (I_{ph}) and the polarization angle (θ) of the analyzer and put the results in a table.
4. Drew the relation between the Photocurrent (I_{ph}, mA) and the polarization angle (θ, o), this relation will investigate the polarization phenomena.
5. Drew the relation between the photocurrent (I_{ph}, mA) and cos2θ, and find the slope of the relation (slope ≈ 1), this investigate the polarization law (Malu's Law, $I = I_o \cos2\theta$).

Experiment 2: The Elasticity (Stress-Strain)

Objectives:

- To find the relationship between tensile stress (σ) and strain (ε) for various materials.

Pictures:

Procedures:

1. Remove the calibration bar and re-install the springs, clamps, washers, and nuts as shown in Figure 1.
2. When installing coupons, loosen the nuts but do not remove them. The coupon should be slid completely under the clamp top on each end. Turn the crank to make room for the coupon so the coupon does not buckle and is straight. Then tighten the nuts with the wrench as tight as possible, making sure the coupon does not twist. (Figure 2).

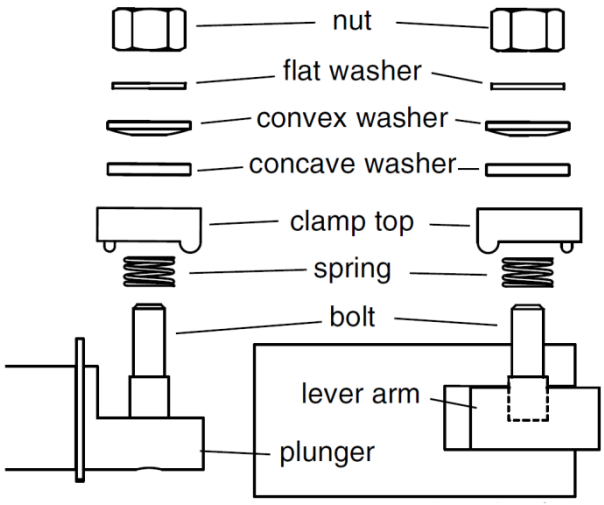


Figure 1: Washer Arrangement

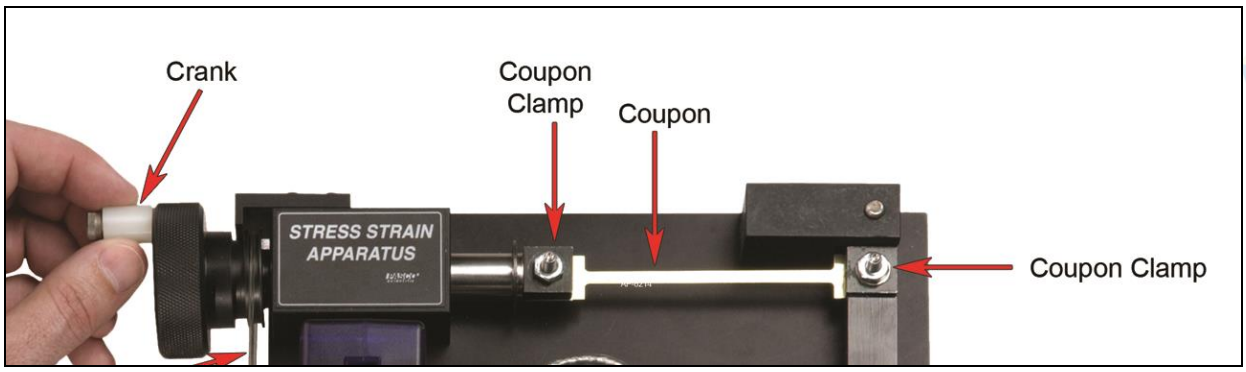


Figure 2: Clamping the sample (Coupon)

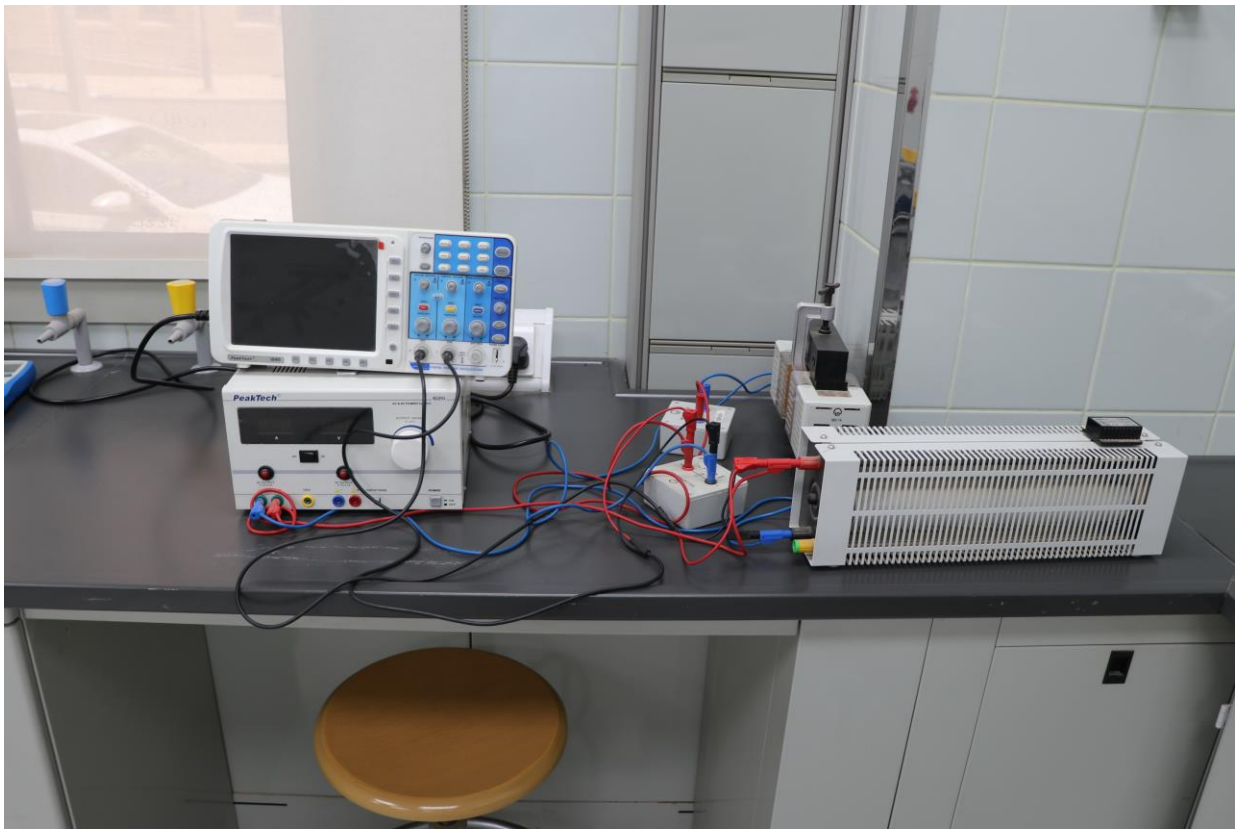
3. Pre-loading Coupons: This is the procedure you will follow each time you test a coupon. You must pre-load the coupon so the initial slack is taken up and the force sensor is zeroed at position zero.
   a. In PASCO Capstone, set up a Digits display of the Actual Force.
   b. Turn the crank so the lever bar does not touch the force sensor. Then zero the force sensor.
   c. Start recording and turn the crank and watch the digits display of the force. When the force reaches about 5N, stop recording and press the zero button on the force sensor.
   d. Now the apparatus is ready to record the curve for the coupon. You should immediately start recording again and proceed to stretch the coupon over the entire range.
4. Set up a graph of Metal Stress vs. Metal Strain. You will need to know the cross-sectional area and the length of the narrow part of the metal coupons. Make a calculation called "Metal Stress" and one called "Metal Strain" using equations (Stress, $\sigma = F/A$) and (Strain, $\varepsilon = \Delta L/L$). Also, create calculations called "Plastic Stress, σ" and "Plastic Strain, ε" using the cross-sectional area (A) and the length (L) of the narrow part of the plastic coupons.
5. Install a coupon and pre-load it.
6. Set up a graph of Metal Stress (σ) vs. Metal Strain (ε).
7. While recording, slowly turn the crank until the coupon breaks or the maximum stretch is reached. Then stop recording.
8. Rename the data run to identify the type of material that was tested.
9. Test other coupons. When you test a plastic coupon, graph Plastic Stress (σ) vs. Plastic Strain (ε).
10. From the slope of the previous relation, the young's modulus ($Y = \sigma/\varepsilon$) can be determined.

Experiment 3: The Hysteresis Loop

Objectives:

- To illustrate the energy losses in the coil (transformer) by using Hysteresis curves.
- To study the relation between the magnetic field (B) and the magnetic strength (H).

Pictures:



Procedures:

1. Connect the circuit as shown in the above figure. In this experiment, an oscilloscope as an X-Y display to analyses the Hysteresis curve will be used. Set the coupling for each channel on the oscilloscope to DC.
2. Adjust the voltage (Vx) from the alternating power supply to get a suitable Hysteresis loop on the oscilloscope.
3. Determine the magnetization current from this relation: $I = (V_x/R)$, so $R = 100\ k\Omega$.
4. Drew the Hysteresis loop from the oscilloscope and find the area (A) of the loop.
5. Drew the relation between the magnetization current (I) and the area of the loop to calculate the saturation current (I_{sat})

Experiment 4: The Hall Effect

Objectives:

- To investigate the Hall Effect in a semiconductor material.
- To determine the Hall parameters (RH, μH, n) of the semiconductor material.

Pictures:

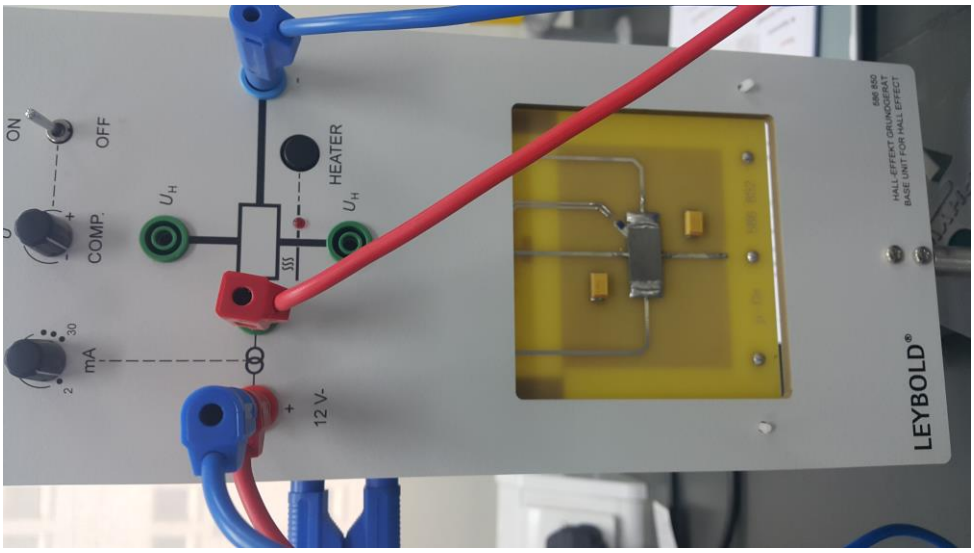


Image (1): The semiconductor material

Image (2): The electromagnet, the power supply that provides the sample current and the multimeter that measures the Hall voltage.

Procedures:

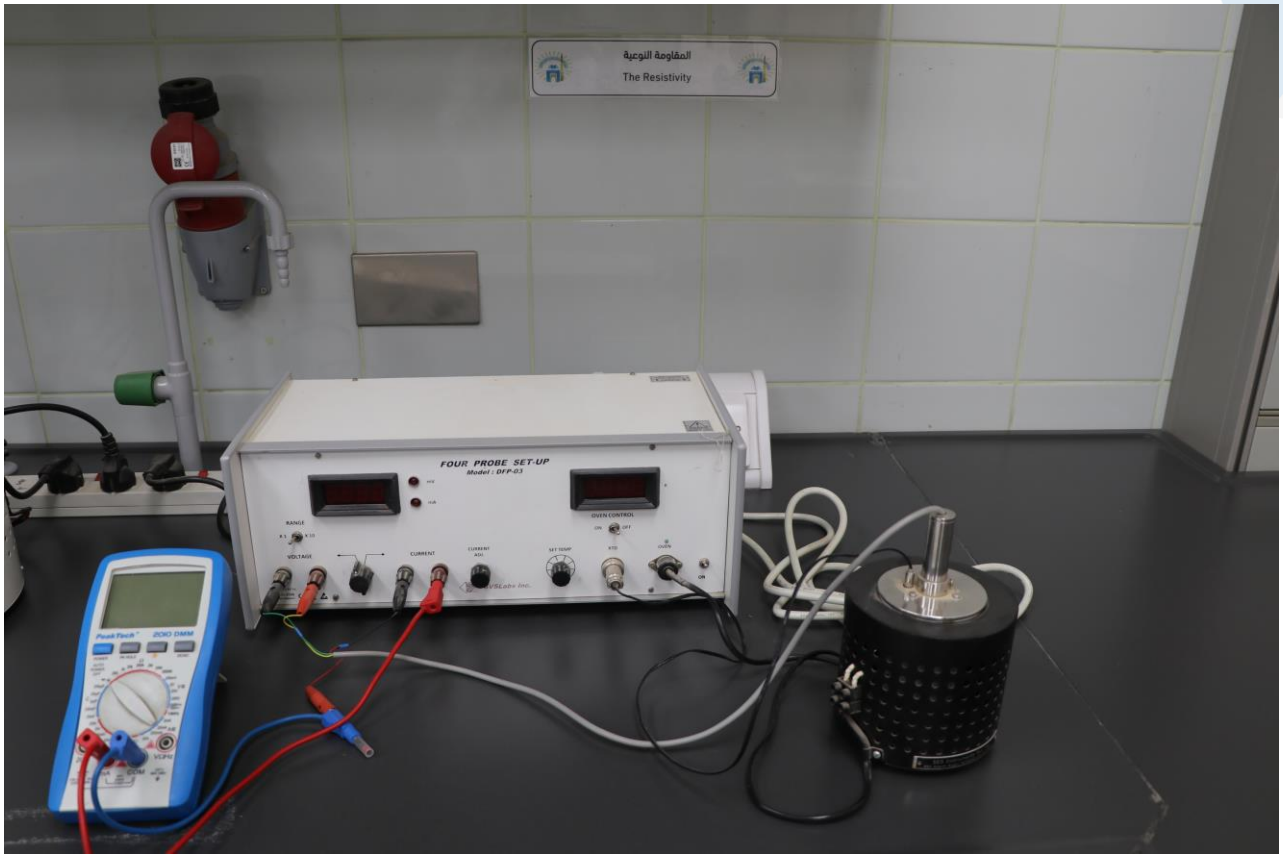
1. Images above show the experimental setup arranged to determine the Hall voltage (VH) and the Hall constant (RH) in a semiconductor material.
2. Four electrodes have been connected in the semiconductor material as shown in image (1).
3. Connected the circuit as shown in image (2).
4. Also, connected the power supply, ammeter and voltammeter to measure the Hall voltage (VH).
5. The electromagnet current has been applied and the Hall voltage (VH) has been taken.
6. Drew the (I – V) characteristics at magnetic field (B) = 0 mT. From this relation determine the resistance (R, Ω), resistivity (ρ, Ωm) and the conductivity (σ, Ωm^{-1}).
7. Find the calibration curve of the magnet by drawing the relation between the magnetic field (B, mT) and the current of the magnet (I, A).
8. Drew the relation between the Hall voltage (VH, volt) and the magnetic field (B, mT) of the magnet. From this relation determine the Hall constant [RH = (VH/I) (d/B)], so (d) is the thickness of the material.
9. Also, determine the Hall mobility (μH = RH σ) and the Carriers concentration (n), so (RH = 1/n q).

Experiment 5: The Four Point Probes

Objectives:

- To determine the resistivity (ρ) of the semiconductor material (Ge) by four point probes method.
- Estimate the band gap (Eg) of the semiconductor material (Ge).

Pictures:



Procedures:

<u>PART I: The resistivity (ρ) of the semiconductor material (Ge)</u>

1. Connect the unit of the experiment to the mains.
2. The sample crystal is attached with the probe arrangement. Place it in the holder which attached with the oven.
3. Connect the four probes to the given socket of measurement unit.
4. Connect the heater terminals of the oven to the measurement unit.
5. Set the oven switch at off position (Now, the temperature is room temperature, RT).
6. At starting, current & voltage, the LCD display will show the current and the voltage along with the sample.
7. Drew the relation between the current (I) and the voltage (V) at T = RT, from the relation, the sheet resistance [Rs = 2π s(V/I)] can be determined, so (s = 2.0 mm) is the probe spacing.
8. Calculate the resistivity (ρ) of the semiconductor material (Ge) by using the following relation (ρ = Rs x d), so (d = 0.23 mm) is the thickness of the sample.

PART II: The band gap (Eg) of the semiconductor material (Ge)

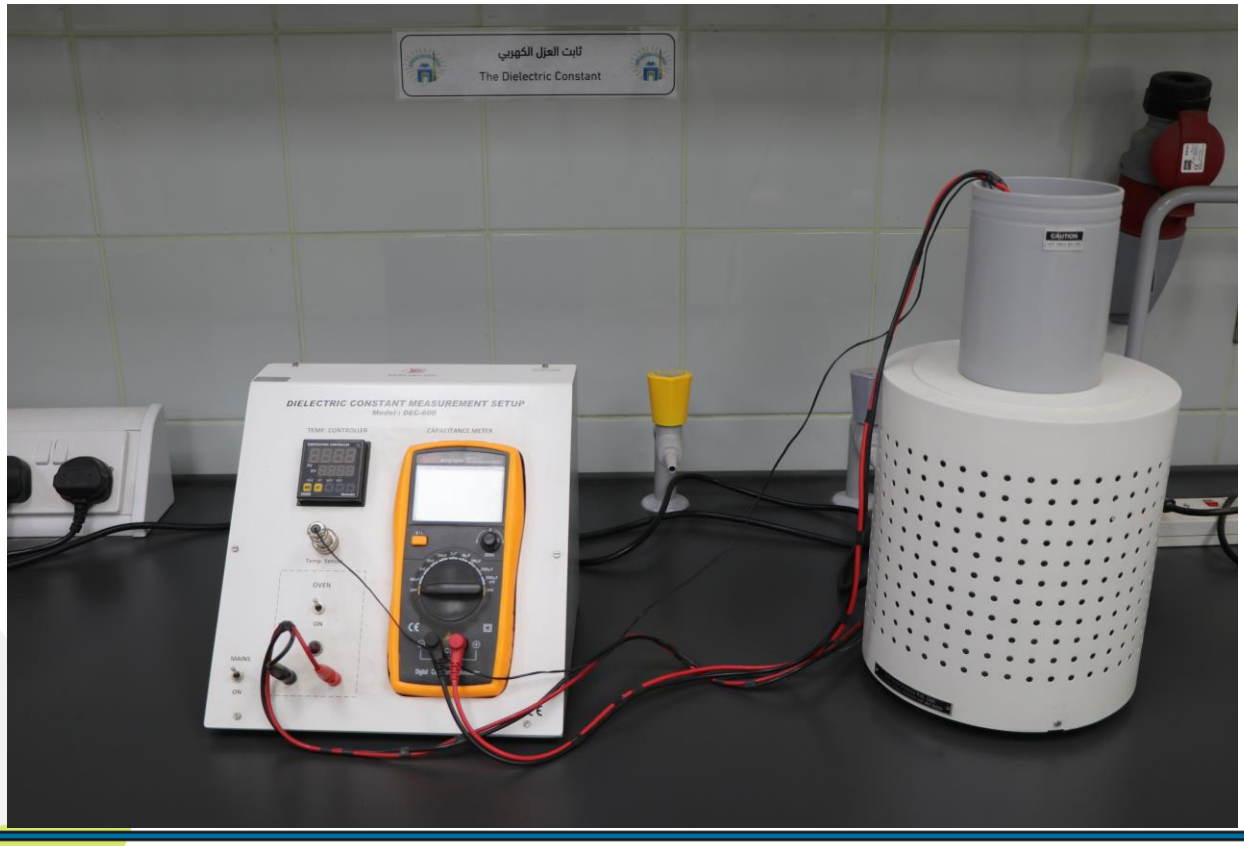
1. Set some suitable value of low current to the probe, say I = 0.6 mA. Keep this current constant throughout the experiment.
2. Switch on the oven current supply. Now temperature will increase slowly.
3. Record the value of voltage corresponding to a fixed interval of temperature rise, say 10 K.
4. Take at least (9) readings for different values of temperatures.
5. Calculate the experimental resistivity (ρ) using the following Eq. (ρ = Rs x d).
6. Express resistivity (ρ) in units of Ohm-meter (Ω m) and temperature in Kelvin (K).
7. Plot "lnρ" versus (1/T). Find the best linear fit to the points (choose only the linear portion of the curve).
8. From (the slope = Eg /2k) of the graph, calculate the band gap (Eg), so the Value of Boltzmann's constant, k = 8.617x10^{-5} eV/K.

Experiment 6: The Dielectric Constant

Objectives:

- To measure the Dielectric Constant (κ) of the magnetic material.
- Estimation the Curie temperature (T_C).

Pictures:



Procedures

PART I: Determine the Dielectric Constant (κ) of the capacitor

1. Determine the thickness (d) between both the plates.
2. Note: Take the help of digital micrometer (C) for better result.
3. Determine the value of the area (A) by using the formula ($A = \pi r^2$)
4. Note: Take the help of digital Vernier caliper for better result of (r).
5. Now calculate the value of Dielectric Constant (κ) of the given material by following formula:

$$C = \frac{\kappa \varepsilon_0 A}{d}$$

Where,

κ = Dielectric Constant, A = Area of plate

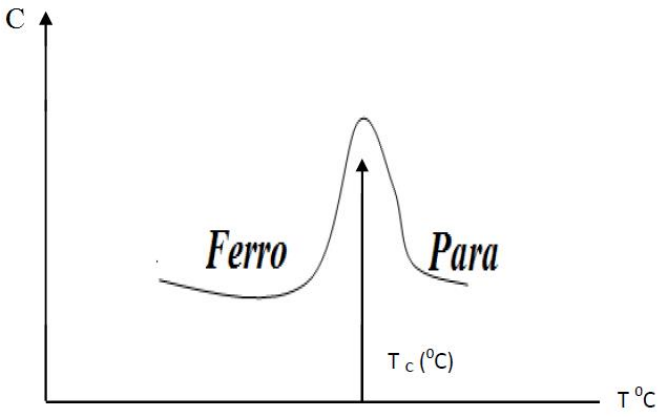
d = Thickness of the capacitor (Distance between two plates)

C = Capacitance

ε_o = Permittivity of free space its value is $\varepsilon_o = 8.854 \times 10^{-12}$ F m^{-1}

PART II: Determine the Curri temperature (TC)

1. Connect the Mains Cord to the device.
2. Place the dielectric sample (capacitor) between the plates of the device such that the dielectric sample just touches both the plats with the help of adjusting screw.
3. Now connect the Test Capacitor (meter) with dielectric sample with the help of patch cords.
4. Switch (On) the device and the heater and record the value of the capacitance (C) with different temperature (T, °C) and record the data in a Table.
5. Drew the relation between the capacitance (C, nF) and the temperature (T, °C), you will get the following graph:



6. From the graph, determine the Curri temperature (T_C).

Experiment 7: The X-Ray

Objectives:

- To observe one method of evaluating atomic crystalline structure by using x-ray diffraction.
- To understand the use of Bragg's Law and its relation to crystal structure.

Pictures:

Procedures

<u>1. Putting the X-ray apparatus into operation:</u>

1. Connect the X-ray apparatus to the mains and switch it on.
2. Press the key (U).
3. Use the ADJUST knob to set e.g. (U = 20 kV): The display panel shows the set value.
4. Press the key (I)
5. Use the ADJUST knob to set e.g. (I = 1.00 mA): The display panel shows the set value.
6. Check to make sure that the lead glass sliding doors are properly closed, then press the HV
7. ON/OFF key: The high voltage indicator starts flashing and the hot cathode of the X-ray tube

8. becomes luminous. The system is now generating X-rays.
9. Press the key (I) and use the ADJUST knob to vary the emission current (I). The brightness of
10. the hot cathode changes.

2. Selecting the measuring parameters:

1. Press key (U), (I), (Δt), (Δβ) or (β LIMITS).
2. Set the desired value with the ADJUST knob. The set value appears in the display field.
3. Press any key to terminate parameter setup.

3. Manually positioning the goniometer arms:

Note: The goniometer is positioned solely by means of electric stepper motors: Do not block the target arm and sensor arm of the goniometer and do not use force to move them.

Also:

1. Press the key COUPLED.
2. Set the desired target value with the ADJUST knob.
3. The set value appears in the display panel, the target arm moves to the desired angular position and the sensor arm automatically moves with twice the set angular step width.

4. Bragg reflection at an NaCl crystal:

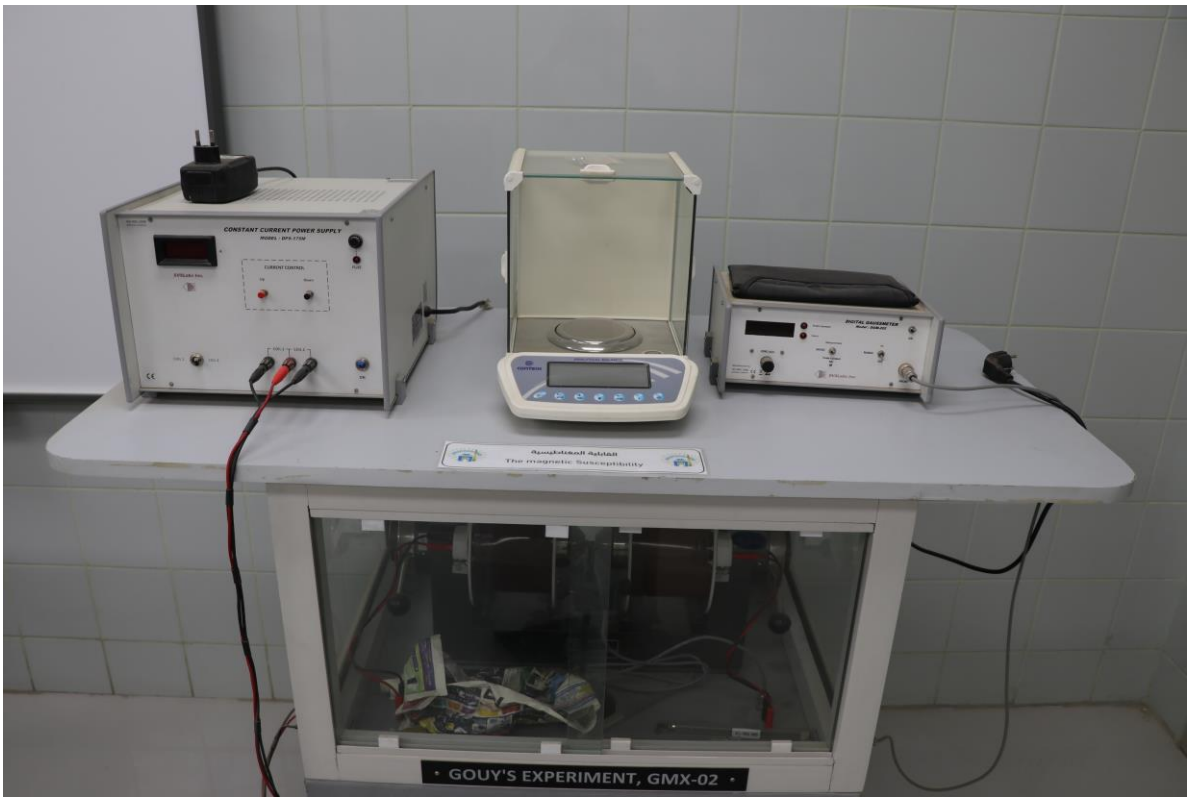
1. Mount the collimator.
2. Mount the goniometer completely.
3. Mount the end-window counter as the sensor.
4. Mount the NaCl crystal for Bragg reflection as the target.
5. Restore the setup to the zero position of the measuring system.
6. Select the measuring parameters (U), (I), (Δt) and (Δβ): (e.g. U = 35.0 kV , I = 1.0 mA, Δt = 10 s and Δβ = 0.1°).
7. Press the key COUPLED.
8. Set the upper and lower target limit angles (Δβ) to the desired values (e.g. 2.5° and 30°)
9. Connect the X-ray apparatus to a computer via the USB port and start the software “X-ray Apparatus”.
10. Press SCAN to start recording.
11. By using the Bragg's law of diffraction ($2d\sin\theta = n\lambda$), you can determine the spacing of the lattice planes (d).

Experiment 8: The Magnetic Susceptibility

Objectives:

- To measure the magnetic susceptibility (χ) by the Gouy's method.

Pictures:



Procedures:

1. Test and ensure that each unit (Electromagnet and Power Supply) is functioning properly.
2. Make a Current Vs. Magnetic Field Chart of Electromagnet and Power Supply using Gaussmeter DGM-202.
3. Level the Balance with the help of leveling screws.
4. Suspend the sample specimen from the lower hook of the Balance and make adjustments such that its lower end is centrally and symmetrically between the pole pieces of the electromagnet without touching them.
5. Note volume (V) of the specimen and measure its weight (m).
6. Apply the magnetic field (H) and note its value from the calibration, which is done earlier as an auxiliary experiment. Note, whether there is an apparent increase in weight or decrease. It increases for paramagnetic substances while decreases for diamagnetic ones. Again measure the weight. The difference of these two readings gives (Δm) for the field (H).

7. Measure the apparent change (Δm) in weight as a function of applied field (H) by changing the current of the magnet in small steps.
8. Plot the graph of Δm as a function of H2. The slope (Δm/H2) of the relation can be obtained.
9. From the following relation:

$$\chi = (2g/A)\,[\Delta m/H^2] = (2g/A)\,[\text{slope}],$$

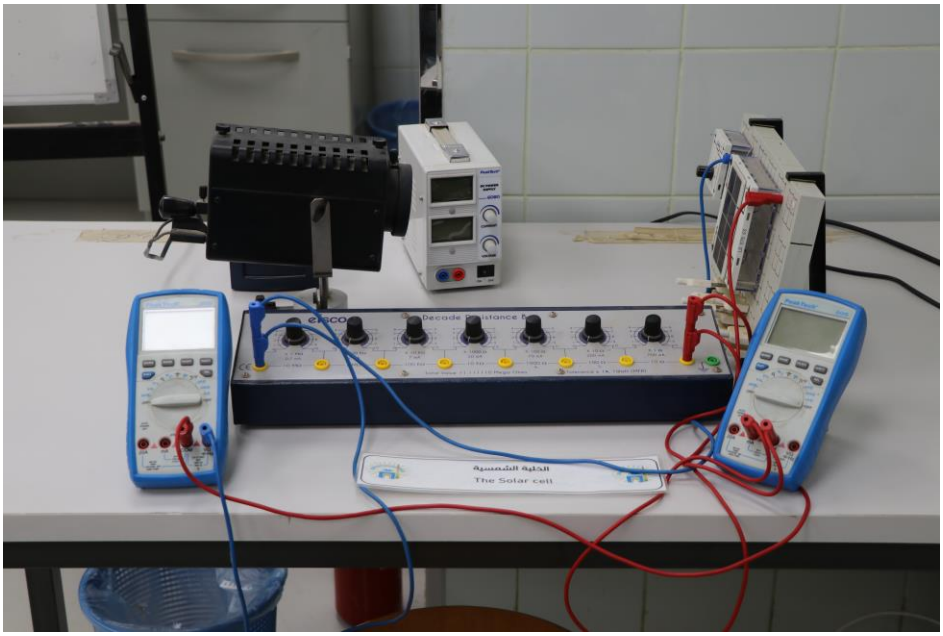
10. The magnetic susceptibility (χ) can be determined, so the gravity (g = 980 cm/sec^2) and the cross section area of the rode sample (A = 0.2 cm^2).

Experiment 9: The Solar Cell

Objectives:

- Investigating the current-voltage (I – V) characteristics in dark and the resistance (R) of the solar cell.
- Investigating the current-voltage (I – V) characteristics under illumination and the parameters of the solar cell.

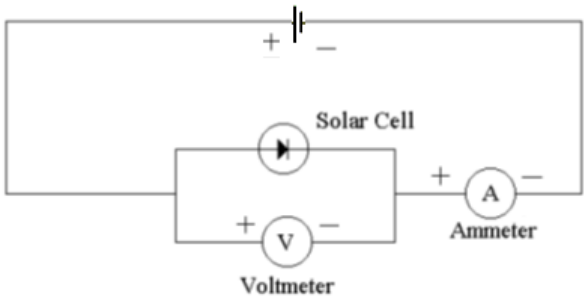
Pictures:



Procedures:

PART I: I-V measurements in dark

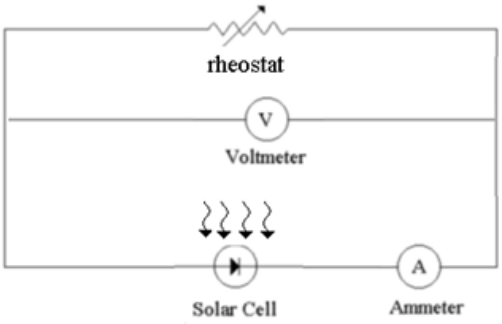
1. Set up the circuit as seen from the following figure:



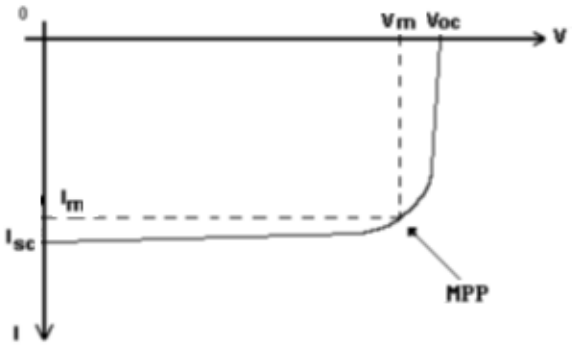
2. Start with positive voltage (not exceed +5 volt) and measure the corresponding current (I).
3. Drew the relation between the current (I – in y-axis) and the voltage (V – in x-axis).
4. Determine the resistance of the cell (R = V/I) from the slope of the (I – V) relation.

PART II: I-V measurements under illumination

1. Set up the circuit as seen from the following figure:



2. Set up the light source directly above the cell.
3. Set the resistance to zero in order to measure the short circuit current (ISC). Record the current and the voltage.
4. Increase resistance until current is very close to zero. This corresponds to the open circuit voltage (VOC). Record the current and voltage.
5. Vary the resistance and take a few current and voltage measurements along the curve.
6. Drew the relation between the current (I) in -y axis and the voltage (V) in x axis, you will get the relation similar as in the following Figure.



7. From the relation, determine the short circuit current (I_{sc}), the open circuit voltage (V_{oc}), the maximum current (I_m), the maximum voltage (V_m) and the fill factor (FF) of the cell.

تابع: أجهزة المختبرات في قسم الفيزياء

Laboratory Equipment in Department of Physics

8- محتويات مختبر الفيزياء الحديثة والذرية من الأدوات والاجهزة

8- Experiments of Modern and Atomic Physics Lab

Experiment 1: Alpha particles scattering

Apparatus:

- To record the direct counting rate of Alpha particles scattered by a gold foil and aluminum foil as function of the angle.
- To classify the relation between the number of counts and the angles.
- To demonstrate a new model of the atom based on the data gained from the experiment.

Pictures:

Procedures:

A. <u>Recording scattering rate as function of the angle</u>

1. - Prepare the counter S for pulse counting by pressing the push button MODE to activate NA,E.
2. - Select gate time t(θ) = 100 s by pressing the toggle button GATE three times Note: t(θ) = 100 s is useful for small angles, i.e. angle up to +/ 15°. By pressing GATE + MODE, longer gate times are can be adjusted, i.e. up to 9999 s (MODE upwards, GATE downwards).

B. <u>Determining the nuclear charge number of aluminium</u>

1. Carefully vent the chamber, take of the lid and remove the 5 mm slit with the gold foil. Put the 1 mm slit together with the gold foil back into the holder, put the lid on the chamber and evacuate.

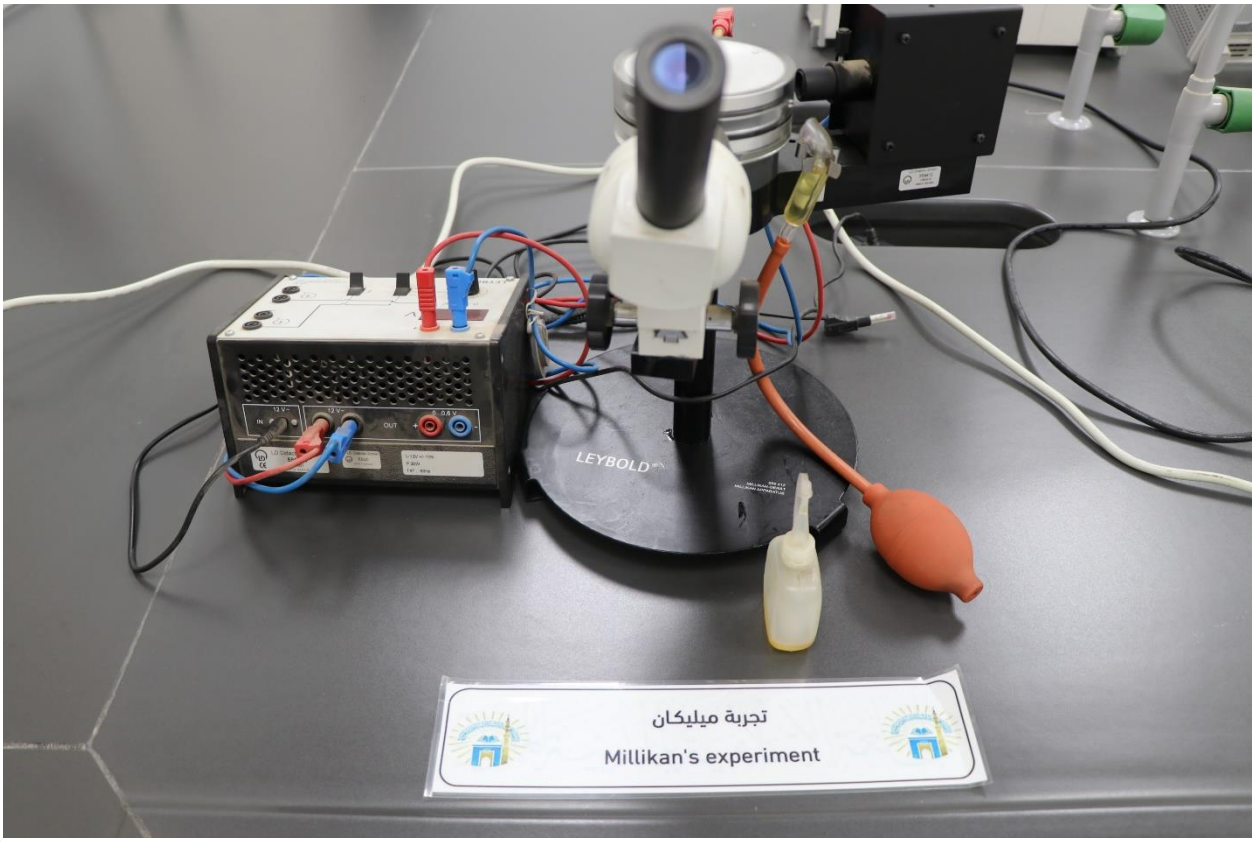
2. Set the swivel arm first to a position of +15°, count for suffi-cient time (100 s), then go to –15° and count again.
3. Carefully vent the chamber, take of the lid and remove the slit with the gold foil. Put the 1 mm slit together with the alumi-num foil back into the holder, put the lid on the chamber and evacuate.
4. Count again at the same postion of +15° and –15°, but for a much longer time (1000 s), as the aluminum foil scatters less particles.

Experiment 2: Millikan's experiment

Apparatus:

- To calculate the time that the oil droplet takes to reach a determined distance.
- To calculate the charge of the electron.
- To demonstrate the relation that occurs as integral multiples of an elementary charge e.

Pictures:



Procedures:

1. First connect the Millikan supply unit and then carry on preforming the experiment:
2. Connect the plate capacitor with the connector for plate capacitors on the Millikan supply unit (if need be, use the adapters for the safety plug at the sockets of the plate capacitor).
3. Connect the illumination device to the connector for illumination devices on the Millikan supply unit and turn on the illumination device.
4. Turn the lens holder of the micrometer eyepiece until you can clearly see the micrometer scale.
5. If necessary, turn the eyepiece to orient the micrometer scale vertically. For this purpose, you should slightly loosen the fastening screw.
6. Use the knurled knob to push the measuring microscope close to the plastic cover.
7. The illuminated capacitor plates can be seen at the top and bottom in the circular-viewing field. The beginning and end of the micrometer scale are at a small distance to the capacitor plates.
8. To eliminate disturbing light reflex or to correct the observation space, if you are not satisfied with the illumination:
   A. Loosen the fastening screw of the capacitor and move the capacitor.
   B. You can also adjust the lamp with the help of the adjusting screw (recessed head screw).
   C. Use the rubber ball to spray oil between the capacitor plates so that oil droplets can be seen in the entire observation field.
9. By moving the measuring microscope with the help of the knurled knobs, create a plane, in which a selected oil droplet is clearly seen as light point.
10. Orient the eyepiece micrometer vertically and turn the lens holder of the eyepiece until you can clearly see the micrometer scale.
11. First set the switches U and t in the down position.
12. Switch the voltage at the capacitor on with the switch U and adjust it with the rotary potentiometer so (400-600 V) that a selected oil droplet rises with a velocity of approximately 1-2 scale graduation marks per second (i.e. it is seen falling when observed through the eyepiece).
13. Switch the voltage at the capacitor off with the switch U.
14. As soon as the oil droplet is located at the height of a selected scale graduation mark, start the time measurement with the switch t.

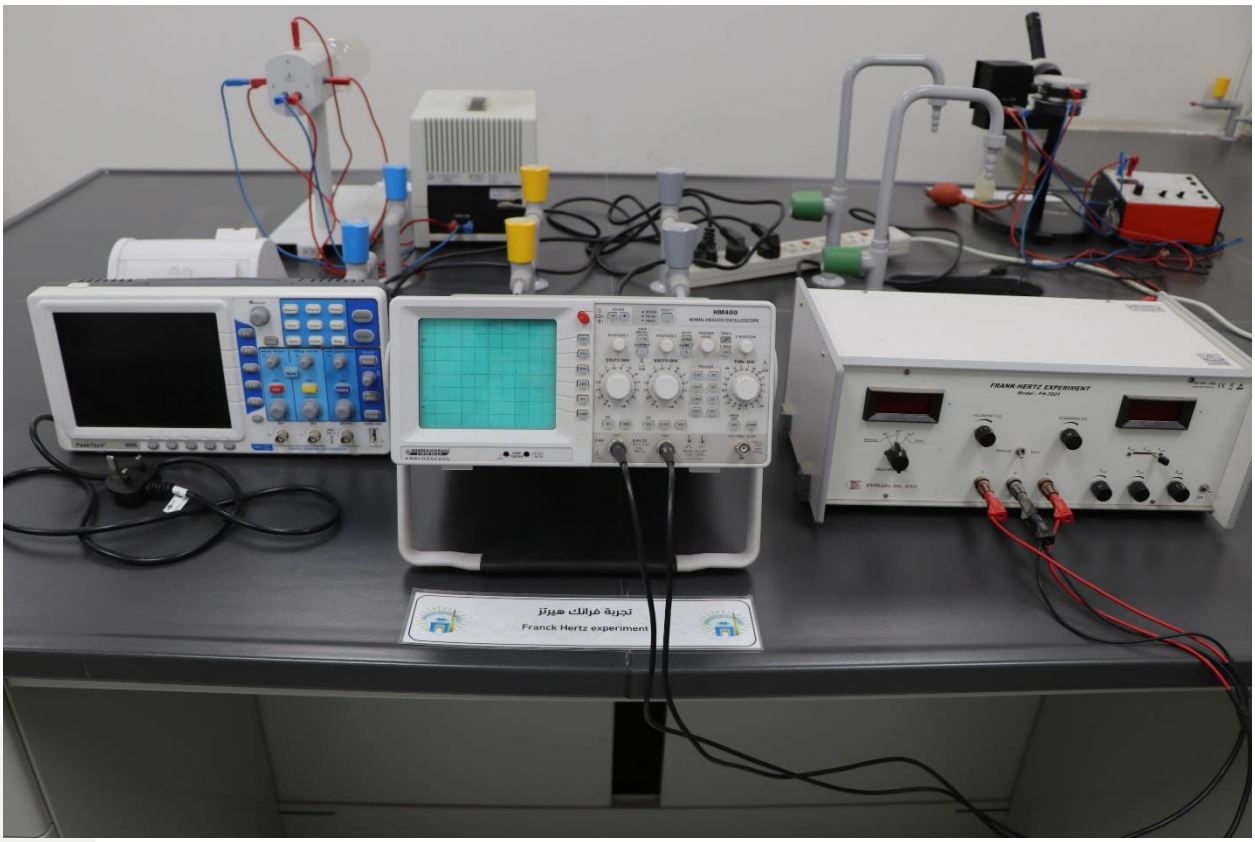
15. As soon as the oil droplet has fallen (i.e. risen as observed in the eyepiece) by another 20 scale graduation marks (corresponds to 1 mm), switch the voltage at the capacitor on again with the switch U. Thereby the time measurement t2 is started automatically.
16. As soon as the oil droplet is at the height of the first scale graduation mark again, stop the time measurement with the switch t.
17. Enter the measured values of the falling time t1, the rising time t2 and the voltage U in the table. The calculated charge q is entered in the histogram automatically.
18. Repeat the measurement for other oil droplets.

Experiment 3: Frank-Hertz Experiment

Apparatus:

- To experimentally demonstrate the concept of quantization of energy levels according to Bohr's model of atom.
- To determine the minimum excitation energy of argon.

Pictures:



Procedures:

C. Manual Mode

1. Ensure that the Electrical power is 220V ± 10%, 50 Hz.
2. Before the power is switched 'ON' make sure all the control knobs are at their minimum position and Current Multiplier knob at 10-7 position.
3. Switch on the Manual-Auto Switch to Manual, and check that the Scanning Voltage Knob is at its minimum position.
4. Turn the Voltage Display selector to VG1K and adjust the VG1K Knob until voltmeter reads 1.5 V.
5. Turn the voltage Display selector to VG2A and adjust the VG2A Knob until the voltmeter read 7.5 V.
6. Before proceeding to the next step check that the initial parameters are Filament Voltage: 2.6V (minimum position) VG1K: 1.5 V, VG2A: 7.5V, VG2K: 0V, Current Amplifier: 10^-7
7. These are suggested values for the experiment. The experiment can be done with other values also.
8. Rotate VG2K knob and observe the variation of plate current with the increase of VG2K. The current reading should show maxima and minima periodically. The magnitude of maxima could be adjusted suitably by adjusting the filament voltage and the value of current multiplier.
9. Now take the systematic readings, VG2K vs Plate Current. For better resolution and observation of the maxima / minima VG2K is varied from 0-80 V in the increments of 0.1 V or 0.01 V. Increments of 0.1 will be used for the data set away from the peak or the dip. The interval 0.01V may be chosen to finer the observation near maxima or minima.
10. Plot the graph with output current on Y- axis and Accelerating Voltage VG2K at X-axis.

D. ❖ Auto Mode

11. Turn the Manual-Auto switch to 'Auto', connect the instruments Y, G, X sockets to Y, G, X of Oscilloscope. Put the Scanning Range switch of Oscilloscope to X-Y mode/external 'X'.
12. Switch on the power oscilloscope, adjust the Y and X shift to make the scan base line on the bottom of screen. Rotate the Scanning Knob of the instrument and observe the wave form on the Oscilloscope Screen. Adjust the Y-gain and X-gain of oscilloscope to make wave form clear and Y amplitude moderate.
13. Rotate the scanning potentiometer clockwise to end. Then the maximum scan voltage is 85V.

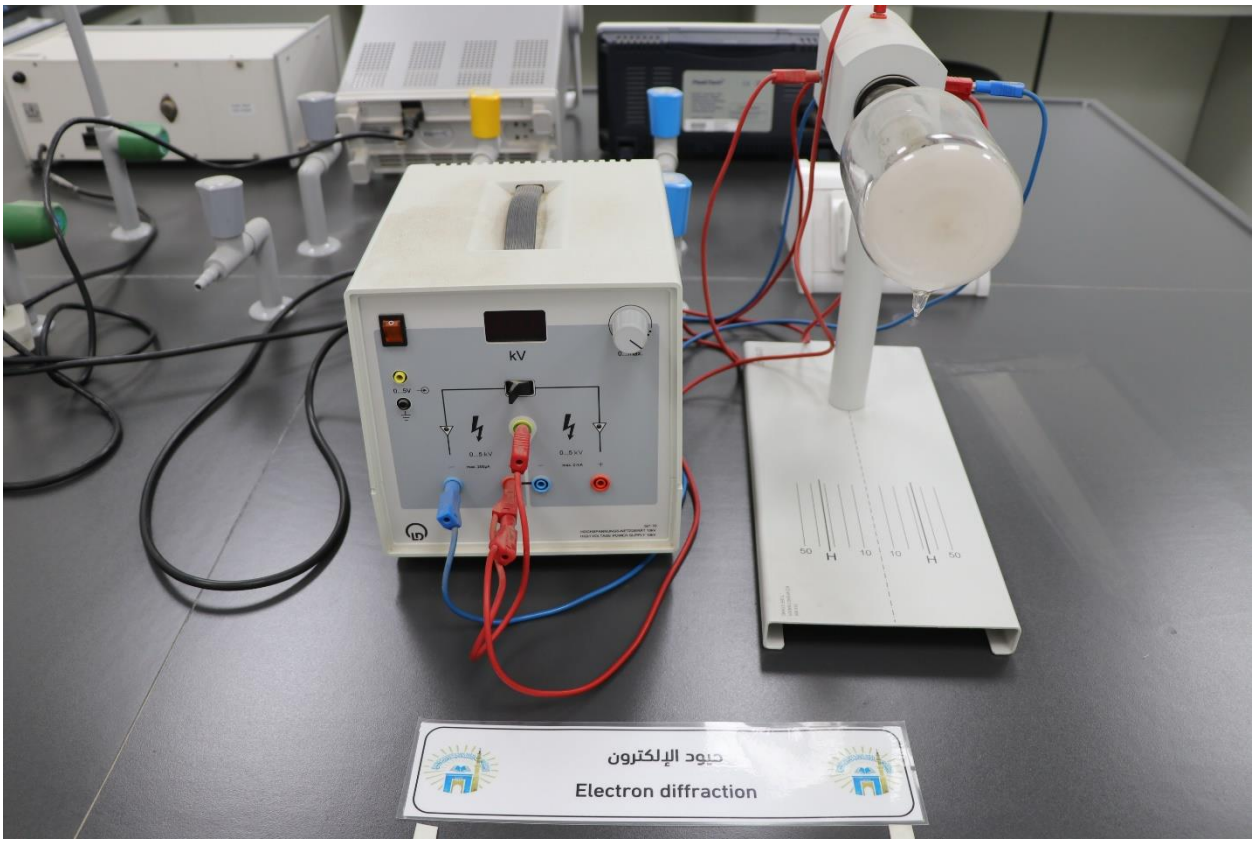
14. Measure the horizontal distance between the peaks. The distance of two consecutive peaks (no of grids) and multiply it by V/ grid factor (X-gain) of oscilloscope. This would give the value of argon atom's first excitation potential in eV

Experiment 4: Electron diffraction

Apparatus:

- To determine the wavelengths of the electrons.
- To verify de Broglie's equation.
- To calculate the lattice plane spacing of graphite.

Pictures:



Procedures:

1. Apply an accelerating voltage U ≤ 5 kV and observe the diffraction pattern.

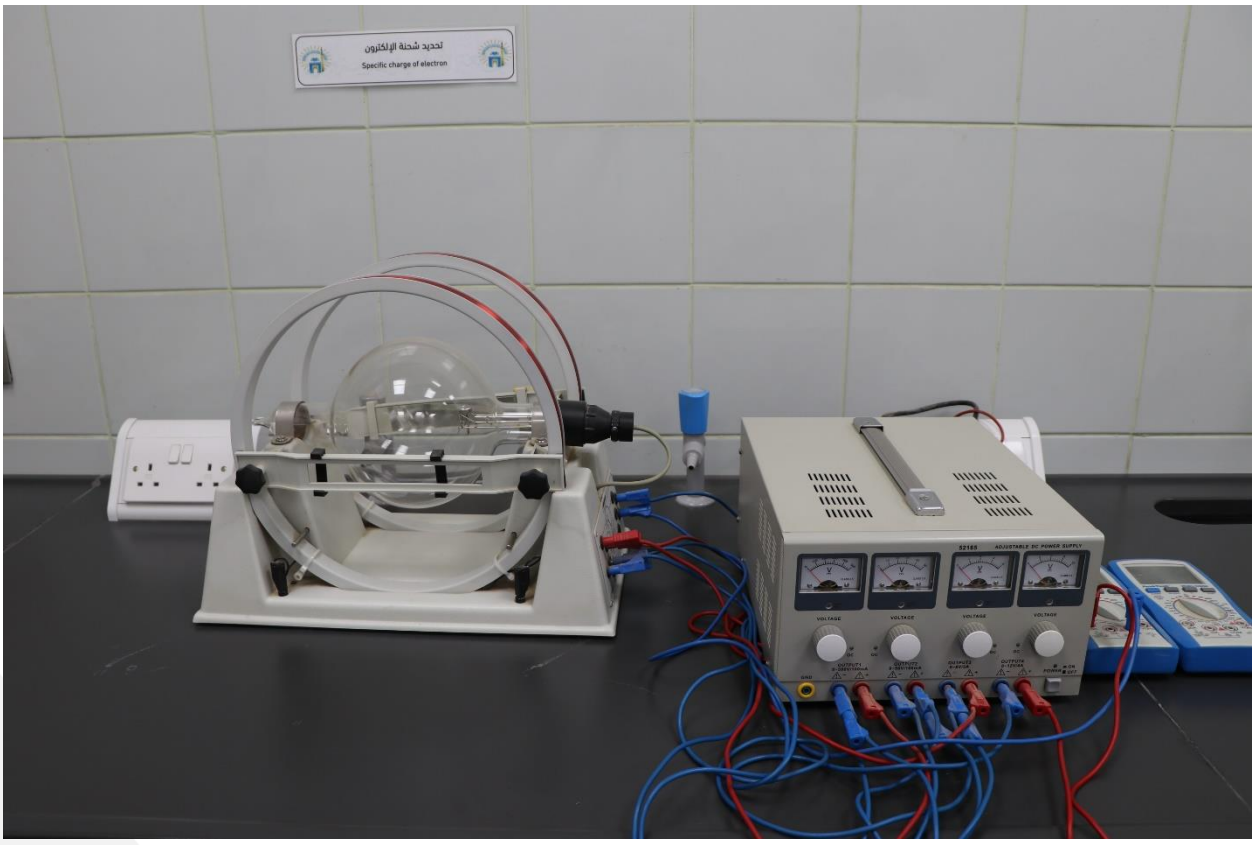
2. Hint: The direction of the electron beam can be influenced by means of a magnet which can be clamped on the neck of tube near the electron focusing system. To illuminate another spot of the sample an adjustment of the magnet might be necessary if at least two diffraction rings cannot be seen perfectly in the diffraction pattern.
3. Vary the accelerating voltage U between 3 kV and 5 kV in step of 0.5 kV and measure the diameter D1 and D2 of the diffraction rings on the screen.
4. Measure the distance between the graphite foil and the screen.

Experiment 5: Determination of the Specific Charge of the Electron

Apparatus:

- Study of the deflection of electrons in a magnetic field into a circular orbit.
- Determination of the magnetic field B as a function of the acceleration potential U of the electrons at a constant radius r and once again with keeping the current constant.
- Determination of the specific charge of the electron.

Pictures:



Procedures:

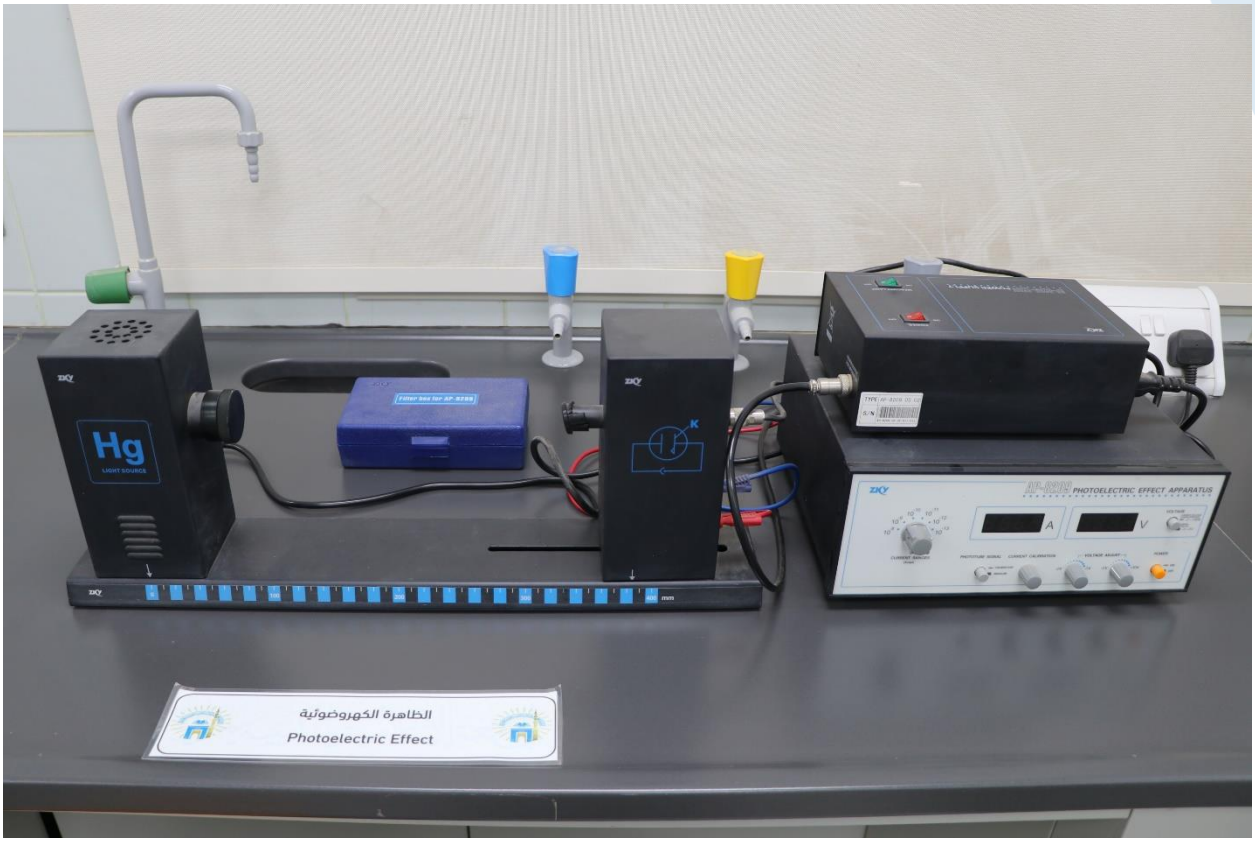
1. Move the left slide of the measuring device so that its inner edge, mirror image and escape aperture of the electron beam come to lay on one line of sight.
2. Set the right slide for both inside edges to have a distance of 8 cm.
3. Sight the inside edge of the right slide, align it with its mirror image and adjust the coil current I until the electron beam runs tangentially along the slide edge covering the mirror image. Reduce the acceleration potential U in steps of 10 V to 200 V and choose the coil current I so that the orbit of the electron beam has a diameter of 8 cm.
4. Record acceleration potential U and coil current I.
5. Power up the tube power supply and set acceleration potential U = 300 V. Thermionic emission starts after warming up for a few minutes.
6. Optimize focusing of the electron beam by varying the voltage at the Wehnelt-cylinder from 0...10 V until it leads to a narrow, well defined beam with clear edge definition.
7. Connect the DC power supply of the Helmholtz coils and look for current I, at which the electron beam is deflected into a closed orbit. If the electron beam after leaving the anode is deflected to the wrong (left) side:
8. Disconnect both power supplies.
9. Exchange the connections at the DC power supply in order to change the polarization of the magnetic field. If the electrons do not move on a closed orbit but on a helical curve line:
10. Loosen the mounting bolts of both holding brackets (read the information manual for the fine beam tube).
11. Carefully rotate the fine beam tube around its longitudinal axis, until the electron beam runs on a closed circular orbit.
12. Fasten mounting bolts.
13. After setting up the experiment, we shall get a trajectory of electrons beam and this is because of the exerted magnetic and electric fields.

Experiment 6: Photoelectric Effect

Apparatus:

- Measuring and Calculating Planck's Constant, h.
- Measuring Current-Voltage Characteristics of Spectral Lines - Constant Frequency, Different Intensity .
- The relationship between the frequency of light and the intensity.

Pictures:



Procedures:

1. Switch on the multimeter and set the range switch to 1 V DC.
2. Turn the interference filter for yellow light (Hg = 578 nm) into the beam path.
3. Discharge the capacitor by holding down the key switch until the multimeter reads zero V.
4. Start the measurement by releasing the key switch; wait about 30 s to 1 minute, until the capacitor has charged to the limit voltage U0. Write down the measured value for U0.
5. Turn the interference filter for green light (Hg = 546 nm) into the beam path and repeat the measurement.
6. Extend the measuring range to 3 V and repeat the measurement with the blue (Hg = 436 nm) and violet (Hg = 405 nm) interference filters.
7. Vary the intensity of the incident light at the photocell using the iris diaphragm of the filter revolver and measure the limit voltage U0 for each setting.

تابع: أجهزة المختبرات في قسم الفيزياء

Laboratory Equipment in Department of Physics

9- محتويات مختبر طرق التحضيرات الفيزيائية من الأدوات والاجهزة

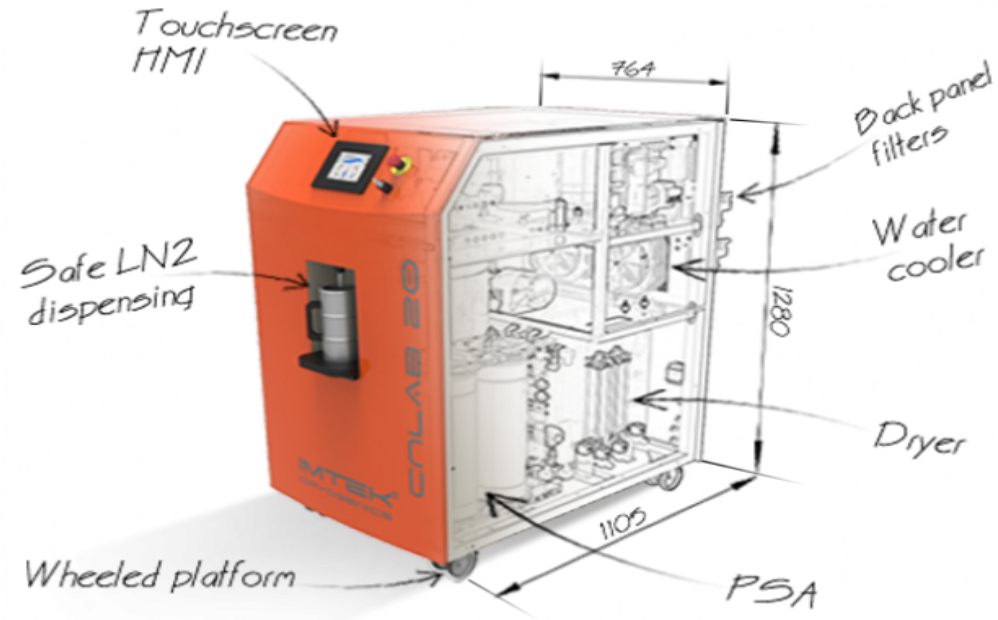
9- Physical Preparation Methods Lab

1- Liquid Nitrogen Maker IMTEK Cryogenic (CN-Lab 20)

Objectives:

- Producing liquid nitrogen (LN)
- CNP20 is a liquid nitrogen plant with production capacity of 20 lt/day. CNP20 also have its labstation version for applications required only small volumes of liquid nitrogen (LN2) at a time.

Picture:



Procedures:

1. Make the electrical connection
2. Turn the key ON
3. Start producing your own cryogen!
4. Stored LN in an internal dewar.

5. Note: Advanced alarm management system designed to integrate more friendly with the user, decrasing user burden while increasing user accesability.

2- Ultrasonic Cleaner USC 500-TH

Objectives:

- Cleaning laboratory glassware such as flasks, graduated cylinders, burettes, and pipettes ...etc.
- Cleaning the glass slides and ITO-glass substrates for preparing thin films and solar cells.
- Sample preparation, dissolve, disperse, emulsify, homogenize and mix samples

Picture:

Procedures:

1. Check if the mains connection, which must have a protective earth conductor
2. Connect the power socket to the flange connector
3. The ultrasonic cleaning unit must be located on a dry, hard and flat horizontal surface
4. Fill the cleaning tank with a suitable cleaning liquid depending on the application. The level must be at least 7/8 of volume
5. Connect the ultrasonic cleaning unit to the mains, when the display lights up, the unit is ready for operation
6. Table top cleaning unit with digital control and display, ultrasonic frequency approx. 45 kHz

7. Adjust timer from 1 to 99 min
8. Adjust the temperature up to 80 °C
9. Click start up to automatically stop.

3- UV-Vis-IR Spectrophotometer - Agilent Technologies (G9825A)

Objectives:

- Solid Sample Measurements (UV-Vis & UV-Vis-NIR)
- UV-Vis Liquids Analysis
- Quantifying a Molecule—Concentration Measurements using UV-Vis
- Observing Structural Changes with UV-Vis—Conformational Studies of Proteins
- Color Measurement using UV-Vis
- Monitoring Reaction Kinetics with UV-Vis

Picture:

Procedures:

To start the Cary WinUV software:

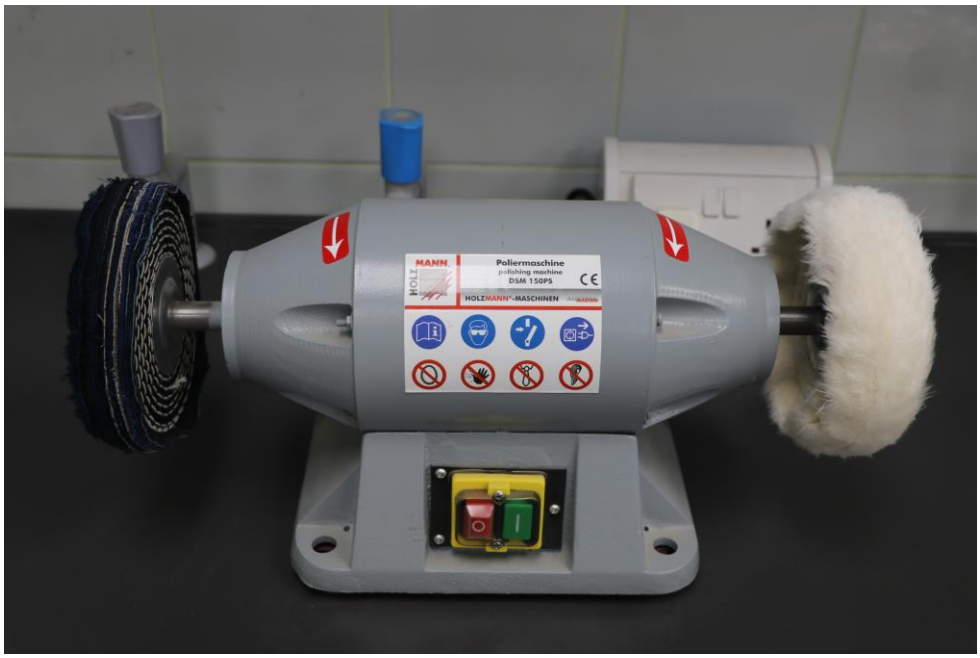
1. Double-click the Cary WinUV folder on the desktop.
2. Select the desired application. Refer to the Cary WinUV Help for information about the available applications.
3. The first time the Cary WinUV software is open a Software Registration dialog will appear.
4. Click Next.
5. Complete all the fields on the 'Customer Details' page. Click Next.
6. NOTE The Product Key is found on the cover of the Agilent Cary WinUV software CD case.
7. Complete all the fields on the 'Product Details' page. Click Next.
8. Complete all the fields on the 'Work Environment Details' page. Click Register.
9. A dialog appears stating 'Your Agilent Software Registration has been successful'.
10. NOTE If your computer is not connected to the internet, refer to the Software Registration Help for further information.
11. The application will now open, and you can collect your data.
1. NOTE To familiarize yourself with the Cary WinUV software, browse the Help after installing the software.

4- Polishing Machine HolzMANN (DSM 150PS)

Objectives:

- The Holzmann DSM150PS is a high-quality 150mm double-ended professional polishing tool with a powerful 520W motor and twin 150mm Ø polishing wheels for buffing and fine polishing.

Picture:



Procedures:

1. Switching ON/OFF.
2. Leave after switching the polishing wheels to full rotational speed before you start polishing.
3. Polishing: The polishing heels can be polished different metal alloys such as stainless steel, steel, aluminum, brass, ...etc.
4. Do not overload the machine when the polishing wheel loses it speed.
5. Safety glasses is required when polishing the wearing.
6. The fixing screws and flange shall be inspected before each use.

5- Small Optical table ThorLabs MB2436

Objectives:

- These solid aluminum, nonmagnetic baseplates provide a convenient and cost-effective platform for assembling prototype optical assemblies, conducting experiments, and mounting small subsystems.

Picture:

Features:

1. Large range of sizes available from stock.
2. 1/2 "(12.7 mm) or 3/4" (19.05 mm) thick.
3. Standard imperial and metric breadboard hole patterns.
4. Offset mounting counterbores allow a full, uninterrupted, threaded hole matrix.
5. Larger breadboards have a fifth center-located counterbore.
6. Imperial: at least 18" wide.
7. Metric: at least 450 mm wide.
8. Black anodized surface with low reflectance.
9. Double-density, high-density versions, and custom sizes available.

6- Heating Magnetic Stirrer with Timer

VELP Scientifica (AREC-T) 305707

Objectives:

- ARE-6 Hot Plate Stirrer Versatile hot plate stirrer with powerful motor, enhanced magnet coupling and excellent resistance to chemicals, hot top warning and safety heating switch. AREX Digital PRO Hot Plate Stirrer Digital hot plate stirrer with CerAlTop™ aluminum alloy and ceramic coating, for precisely set speed and temperature.

Picture:

Procedures:

1. Put the solution in a beaker and insert the rod magnet in the beaker.
2. Put the beaker on the center of the ceramic surface of the magnetic stirrer.
3. Switching ON.
4. Adjust speed rpm.
5. Adjust temperature.
6. Adjust time.
7. Switching OFF.

7- Gas Chromatography, (Shimadzu GC-2030)

Objectives:

- The analysis of gas chromatography is utilized to calculate the quantity of a chemical substance such as in ensuring the quality of chemicals used that are used in the chemical industry or to determine the presence of harmful substances in soils or air.
- The use of gas chromatography can be found for the analysis of:
  - air-borne pollutants
  - performance-enhancing drugs in athlete's urine samples
  - oil spills
  - essential oils in perfume preparation
- The gas chromatography method is extremely accurate when utilized correctly, and it can be used to measure picomoles of a substance within 1 ml of liquid samples or parts-per-billion concentrations of gaseous samples.
- Gas Chromatography is widely used in the field of Forensic Science. Different disciplines, such as the solid drug dosage (pre-consumption form) identification and quantification arson investigation as well as paint chip analysis and toxicology investigations, use GC to determine and quantify different biological specimens and crime scene evidence.
-

Picture:

Procedures:

Step 1: Sample Injection and Vapourization

1. A small amount of the liquid sample to be examined is drained into the Syringe.
2. The needle in the syringe is set in the hot injector channel of the gaschromatograph. the sample is quickly injected.
3. The time of the sample's injection is thought of as an "point" in time, which means it is believed that every sample will enter the gas chromatograph simultaneously and therefore the sample needs to be injected rapidly.
4. It is designed to have a temperature greater than the boiling point of the components in the mixture, so that the components begin to evaporate.
5. The vaporized components mix with the gas mobile phase of inert gas and are then transported into the column of gas chromatography, where they will be separated.

Step 2: Separation in the Column

1. The components in the mix are separated according to their ability to adsorb onto, or bond to in the stationary phase.
2. A substance that adsorbs the strongest heavily to stationary phases will stay most duration in the column (will be kept within the column the most amount of time) and, consequently be the most retentive duration (Rt). It will be released from the gas chromatograph at the end of the process.
3. The component that adsorbs most strongly towards the stationary phase is likely to stay most time inside the column (will remain by the column over the most period of time) and, consequently be the one with the shortest period of retention (Rt). It will come out of the gas chromatograph the first.
4. If we look at a 2- components mixture in which components A and B are more extreme than B, then:
   a) component A will have a longer retention time in a polar column than component B
   b) component A will have a shorter retention time in a non-polar column than component B

Step 3: Detecting and Recording Results

5. The constituents of the mixture enter into the detector with different timings because of variations in the length of time they remain within the column.
6. The part that is retained with the shortest amount of period in the column is discovered first. The part that is retained for longest inside the column will be discovered the last.
7. The detector transmits a signal for the chart recorder, which produces a peak appearing on the paper chart. The part that is first detected gets recorded as the first. The component that is discovered the last time is recorded as the last.

تابع: أجهزة المختبرات في قسم الفيزياء

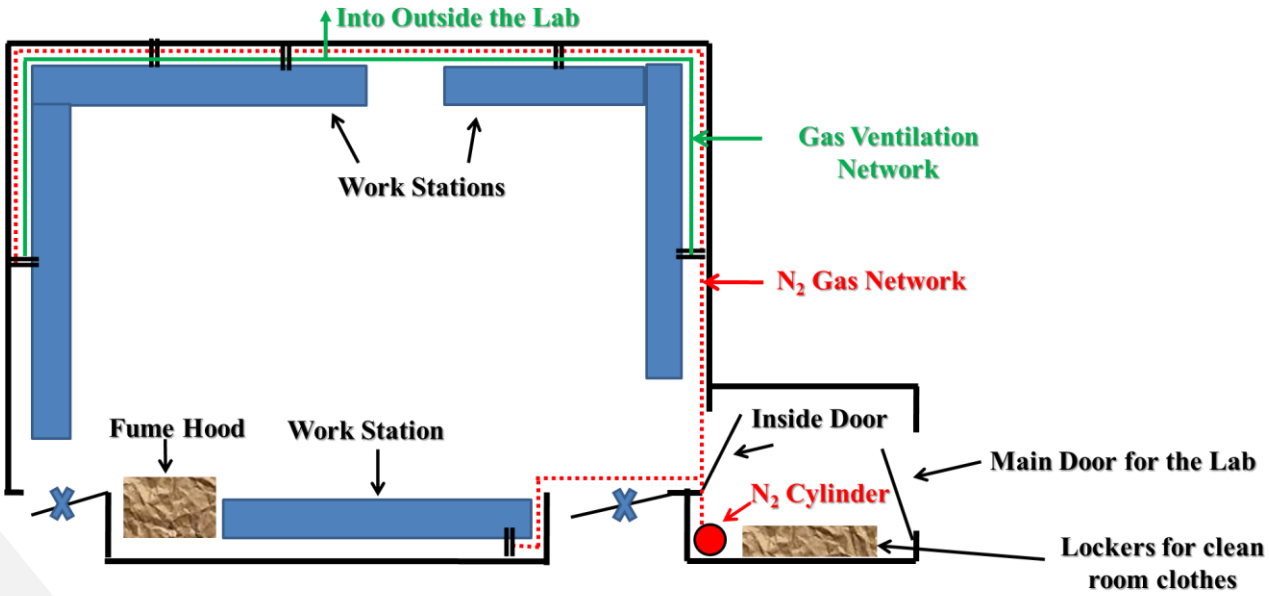
Laboratory Equipment in Department of Physics

10- محتويات مختبر أبحاث الخلايا الشمسية من الاجهزة

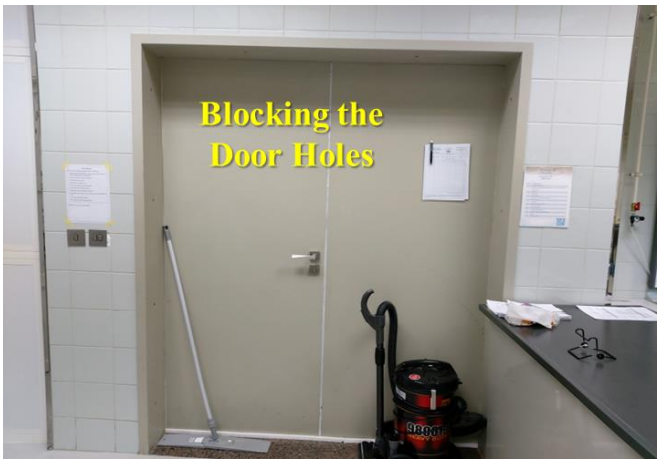
10- Equipment of Solar Cell Research Lab

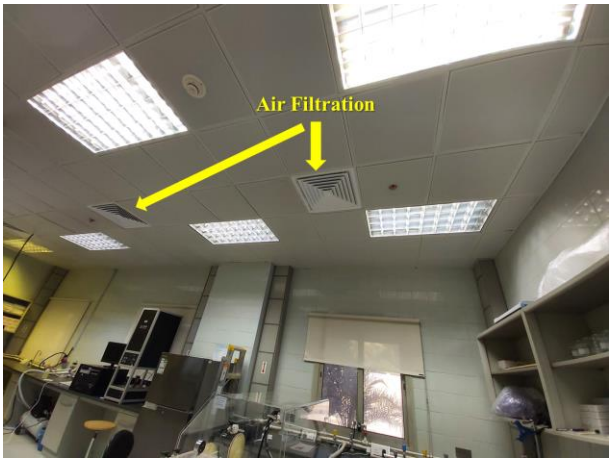
A. Construction of infrastructure for Solar Cell Research Lab

Schematic Draw of the Lab

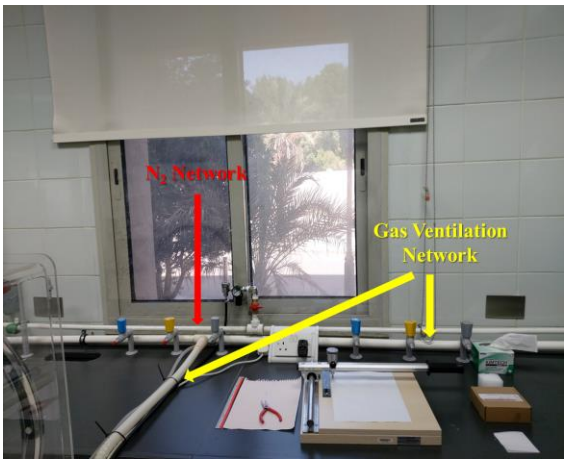


1- Preparing the lab as a clean environment

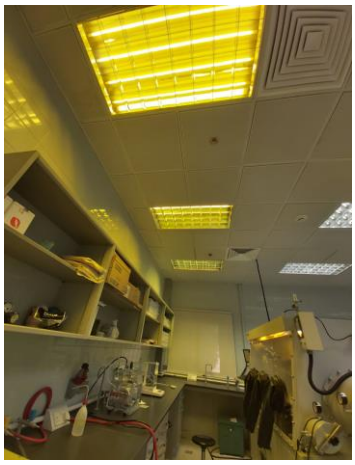




2- Constructing N_2 gas network and gas ventilation network



3- Preparing yellow light for solution and organic film preparations



4- Wearing lab suit and interring into the lab

5- Storing the consumables in shelves

6- Storing the chemical inside refrigerator

7- Fume hood for cleaning of ITO-glass substrates

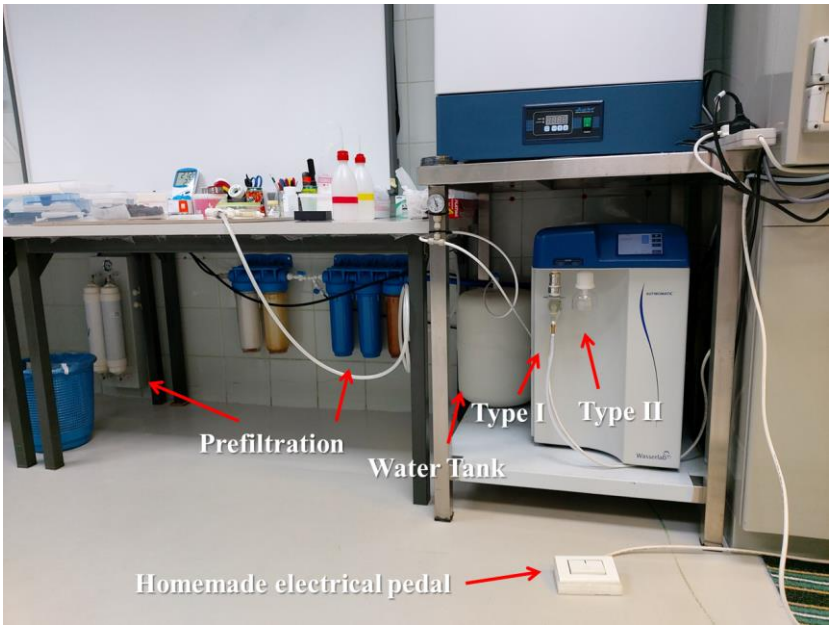
The contents of the lab from equipment and tools

1- Water Purification System (for Type I & II water)

Objectives:

- It is used for feeding with type I and type II purified water for washing the glassware.
- Type I ultra-pure water is used for cleaning ITO-glass substrates used for solar cell fabrication.

Picture:



Procedures:

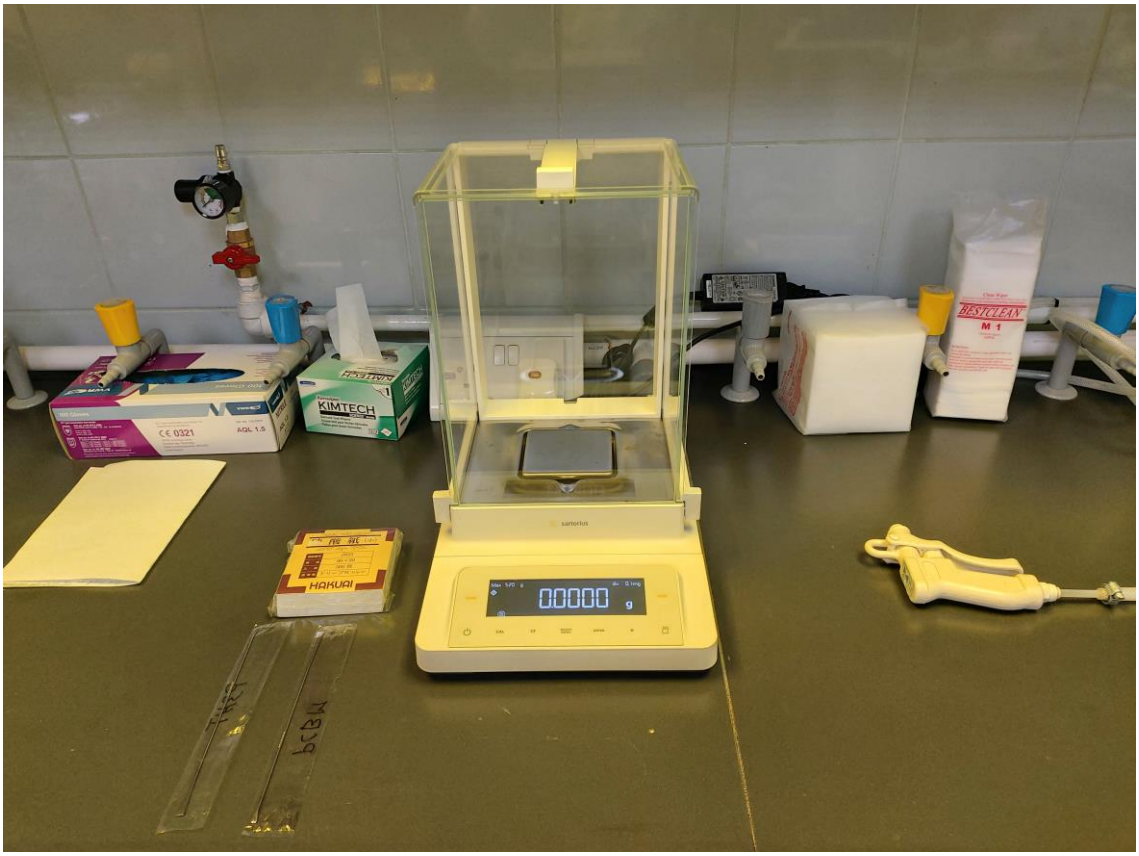
1. The water from the main source is very dirty, so it is very recommended to pre-filtrate that water using the usual home filter.
2. After that, the water is purified to pure (Type 3) water by Reverse Osmosis (RO).
3. The pure water produced by the Reverse Osmosis is stored in a tank designed to minimize risks of contamination during water storage.
4. From that reservoir, water can be sourced though a front valve or sent by a delivery pump to feed instruments such as a glassware washing machine, or further processed to produce ultrapure (type1) water.
5. For using type II water open the device screen by the touch.
6. Press the type II button on the device screen to get water from the tap connected to the device, and press "Stop" after finish.
7. For using Type I for cleaning ITO-glass substrates you can use the remote dispenser inside fume hood.
8. Open the devise screen by the touch, and after that press the Type I button.
9. Use the electrical pedal to allow the water to follow from the dispenser.

2- Analytical Balance

Objectives:

- The sensitive balance is used for weighting the solid chemicals in the milligram range with high accuracy.
- It is used for preparing the solutions for preparing solar cell active layers.

Picture:



Procedures:

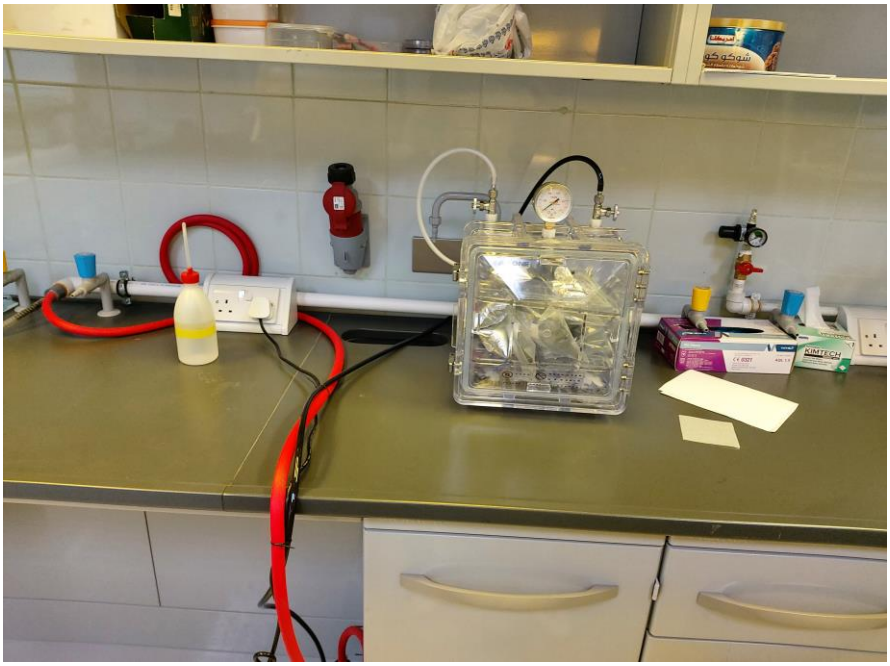
1. Open the electricity and power buttons.
2. Press on the button of the automatic calibration "CAL" up to finish.
3. Open the glass windows of the balance and put the small butter paper, which is used for weighting the chemicals, on the balance pan and close the glass windows of the balance.
4. Zero the weight of the butter paper by press on the button "TARE".
5. Open the glass windows of the balance, put the chemicals, close the glass windows, and weight your chemicals.
6. After finish, close the glass windows, close the power and electricity buttons.

3- Desiccator with Vacuum Bump for Chemical Storage

Objectives:

- Transparent acrylic desiccator is used for storing chemical materials and keeping them away from atmosphere and humidity.
- By the way the sensitive chemicals will be protected from interaction with oxygen and will be safe for long time.

Picture:



Procedures:

<u>Opining the Desiccator</u>

1. Open the air valve up to the end of inserting air inside desiccator, and after that close the air valve.
2. Open the door clamps and remove which you need outside desiccator.

<u>Close the Desiccator</u>

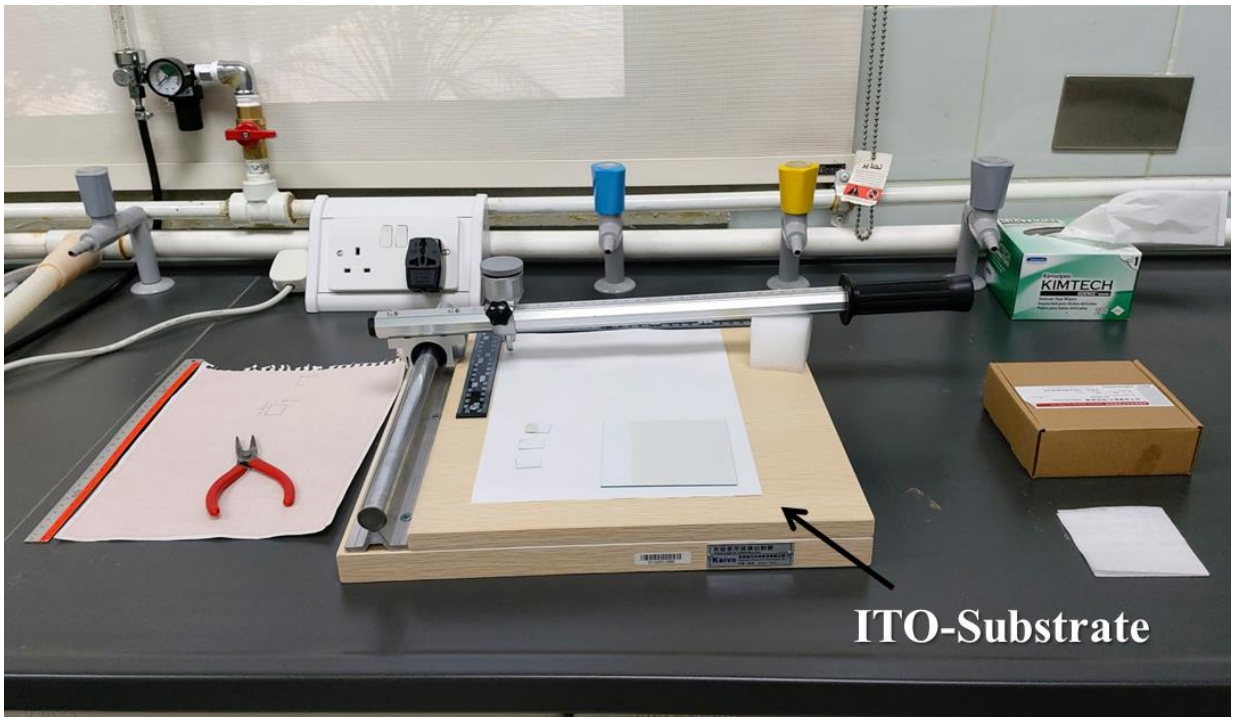
1. After removing which you need from desiccator, close the door clamps, and open the power of the vacuum bump.
2. Open the evacuation valve up to complete evacuation indicated by the vacuum gauge, and after that, close the evacuation valve.
3. Close the power of the vacuum bump.

4- ITO-Substrate and Glass Cutter

Objectives:

- It is used for cutting glass and ITO-glass substrates for preparing thin films and solar cells.

Picture:



Procedures:

1. Adjust the length which you need to cut using the meter and screws found in the diamond bin which attached with the machine arm.
2. Put the glass or ITO-glass substrates (from the face of the glass not from the face of ITO) on the corner of the meters and cut the glass by pull the machine arm with little press.

5- Ultrasonic Cleaner, USC 500-TH

Objectives:

- Cleaning laboratory glassware such as flasks, graduated cylinders, burettes, and pipettes ...etc.

- Cleaning the glass slides and ITO-glass substrates for preparing thin films and solar cells.
- Sample preparation, dissolve, disperse, emulsify, homogenize and mix samples

Picture:

Procedures:

1. Check if the mains connection, which must have a protective earth conductor
2. Connect the power socket to the flange connector
3. The ultrasonic cleaning unit must be located on a dry, hard and flat horizontal surface
4. Fill the cleaning tank with a suitable cleaning liquid depending on the application. The level must be at least 7/8 of volume
5. Connect the ultrasonic cleaning unit to the mains, when the display lights up, the unit is ready for operation
6. Table top cleaning unit with digital control and display, ultrasonic frequency approx. 45 kHz
7. Adjust timer from 1 to 99 min
8. Adjust the temperature up to 80 °C
9. Click start up to automatically stop.

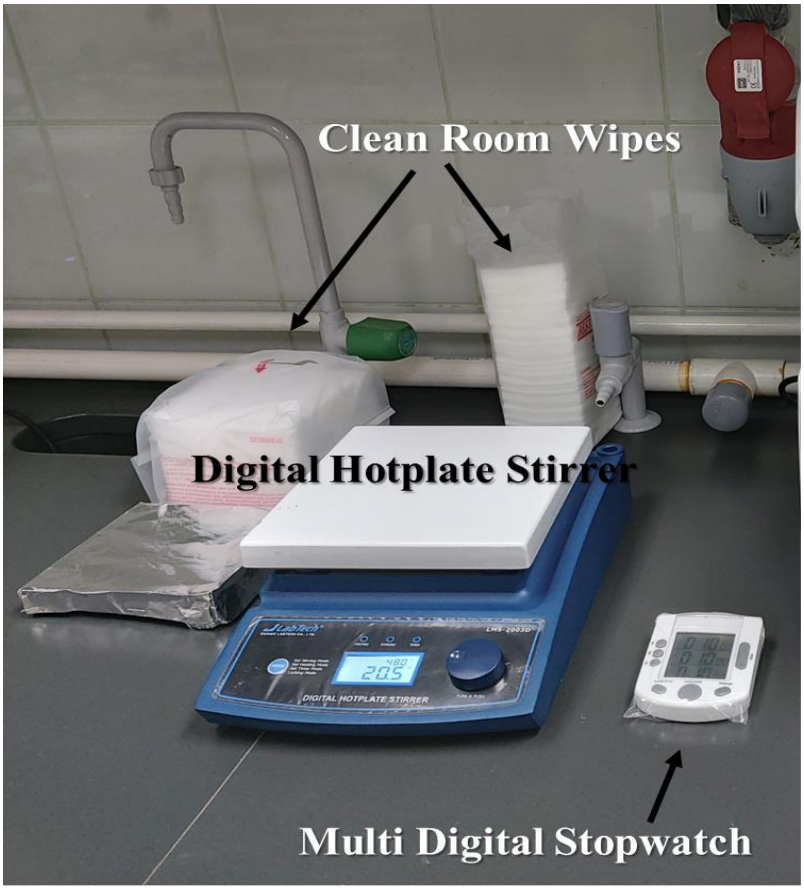
6- Heating Magnetic Stirrer with Timer

Lab TechLMS-2003D, Korea

Objectives:

- It is used for warming up the solutions and liquid to elevated temperatures.
- Thermal annealing thin films and different layers of solar cells.
- Stirring the solutions for preparing active layer solutions of the solar cells.

Picture:



Procedures:

For stirring a solution at specific temperature and time

1. Put the solution in a beaker and insert the rod magnet in the beaker.
2. Put the beaker on the center of the ceramic surface of the magnetic stirrer.
3. Switching ON.
4. Adjust speed rpm.
5. Adjust temperature.
6. Adjust time.
7. Switching OFF.

8- Vacuum Oven

Objectives:

- It is used for warming up the thin films and different layers of solar cells under vacuum.
- It is used for warming up the glass or ITO-glass substrates, after washing by water, under vacuum for removing the hole contents of water which can be found on the surface of the substrates, for preparing thin films and solar cell layers.

Picture:

Procedures:

1. Open the power of the oven and adjust the temperature and time.
2. Open the oven door and put the substrates on the shelves and close the door tightly.
3. Transfer the vacuum valve found on the front panel of the oven to "Vacuum" and open the power of vacuum bump up to the vacuum gauge reaches to an appropriate value.
4. Transfer the vacuum valve to "Lock" and press "Start" button up to the temperature and time reach to the adjusted values.

5. After that, machine will stop automatically, then transfer the vacuum valve to "Vent" up to opining the oven door.
6. Transfer the vacuum valve to "Lock" and open oven door then take out your substrates.
7. Close oven door and shut down the power of the oven from the front panel of the oven.

9- Oxygen-Plasma Cleaner

Objectives:

- It is used for increasing surface energy of the glass and ITO-glass substrates for increasing wettability of the surfaces with solutions.
- It can be used for cleaning materials and the surfaces by ionic bombardment under low pressure.

Picture:

Procedures:

1. Open the power of the machine found in the front side.
2. Adjust the timer and power of the generated plasma.
3. While the door of the machine is closed, press on "Ventilation" button for opening the

door.

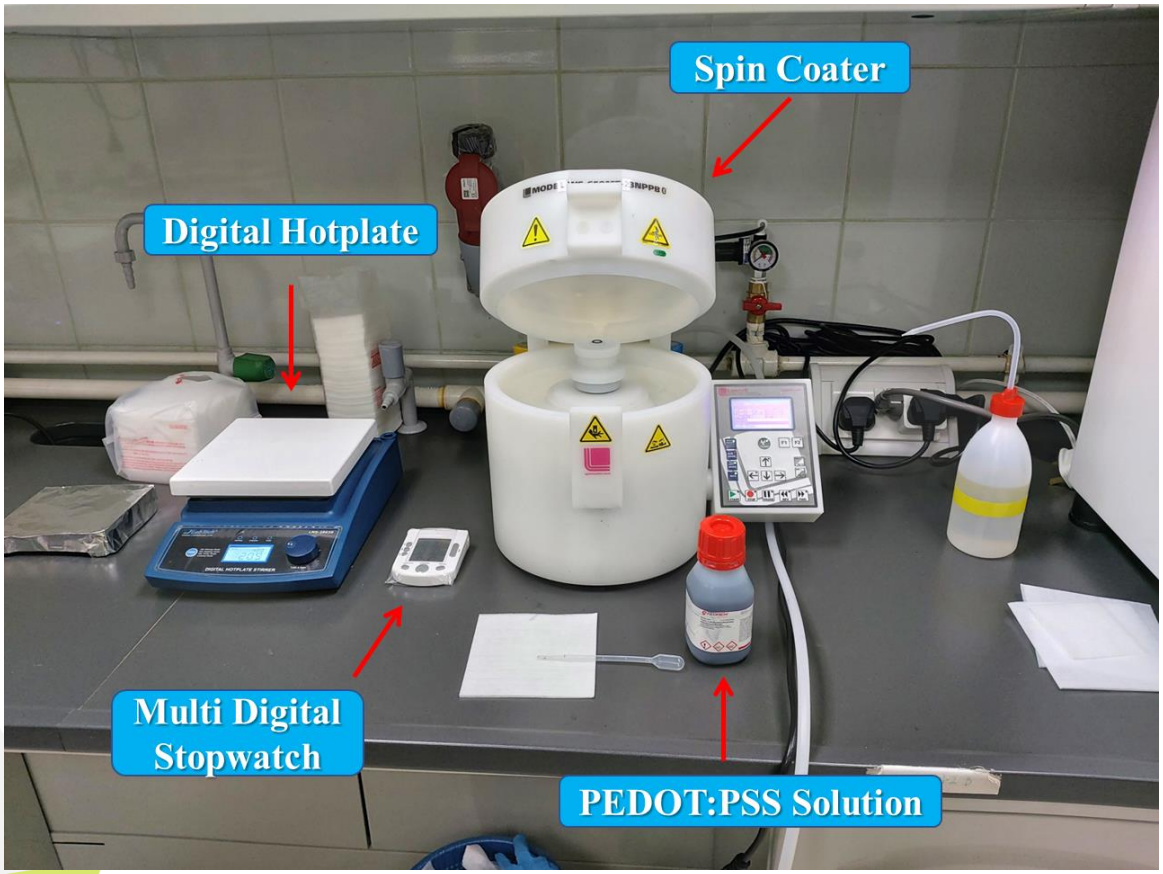
4. Put your samples inside the chamber of the machine and close the door.
5. Open vacuum button "Pump" up to the vacuum gauge reaches the end of the level.
6. Open the oxygen valve up to the adjusted level and still maintaining this level until the end of the experiment.
7. Open the "Generation" button to allow the machine to work.
8. After reaching the adjusted timer, the "Generation" will stop, then close the oxygen valve.
9. For opining the machine door, close the vacuum pump and then press on "Ventilation" button until opening the door.
10. Remove your samples and close machine door by pressing on "Pump" button.
11. Close the power of the machine.

10- Spin Coater for Preparing of Layers outside Glove Box

Objectives:

- It is used for preparing organic thin films and solar cell layers such as PEDOT:PSS layer.
- Thickness of the thin films can be varied by varying spinning speed from 500 to around 10000 rpm.

Picture:



Procedures:

For preparing PEDOT:PSS layer for solar cell preparation we should follow the following procedures:

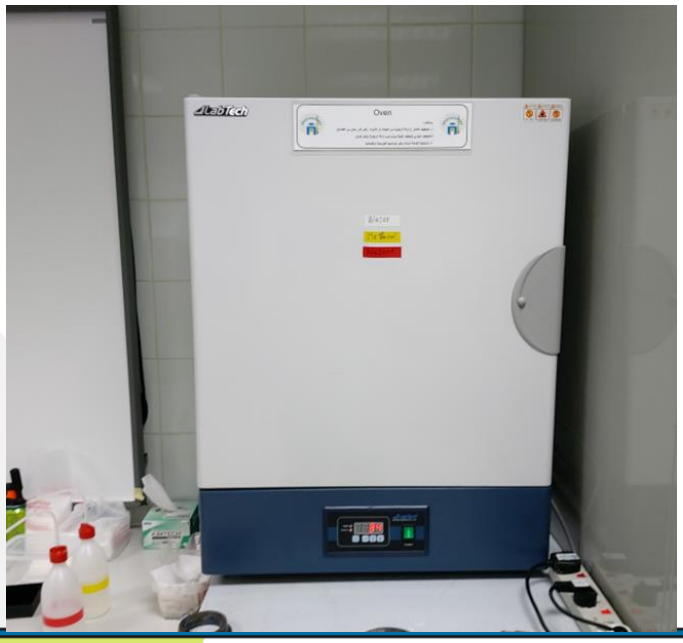
1. It is better first to filtrate the PEDOT:PSS solution using 0.45 µm filter with syringe to remove the solid particles formed in the solution.
2. The ITO-glass substrates are cleaned and prepared for spin coating.
3. Open both power of spin coater and its suitable program.
4. Open N_2 gas valve and rotary pump which are used for fixing the substrate on the stage of the spin coater.
5. Open the cover of the spin coater, put the substrate on the stage, press on "V" (vacuum) button, put drops from filtered PEDOT:PSS solution on the substrate (using a plastic pipette), and then, start the program of spin coater to deposit a film with specific thickness depending on the speed of the spin coater.
6. After stop, press on the "V" button of the spin coater to remove the substrate.
7. Put the coated substrate on hot plate for thermal annealing for 10 mints at 120 °C.
8. Close N_2 gas valve, rotary pump, power of the spin coater, and hot plate after the 10 mints.

11- Drying Oven

Objectives:

- It is used for drying the cleaned glassware which are used for cleaning ITO-glass substrates.

Picture:



Procedures:

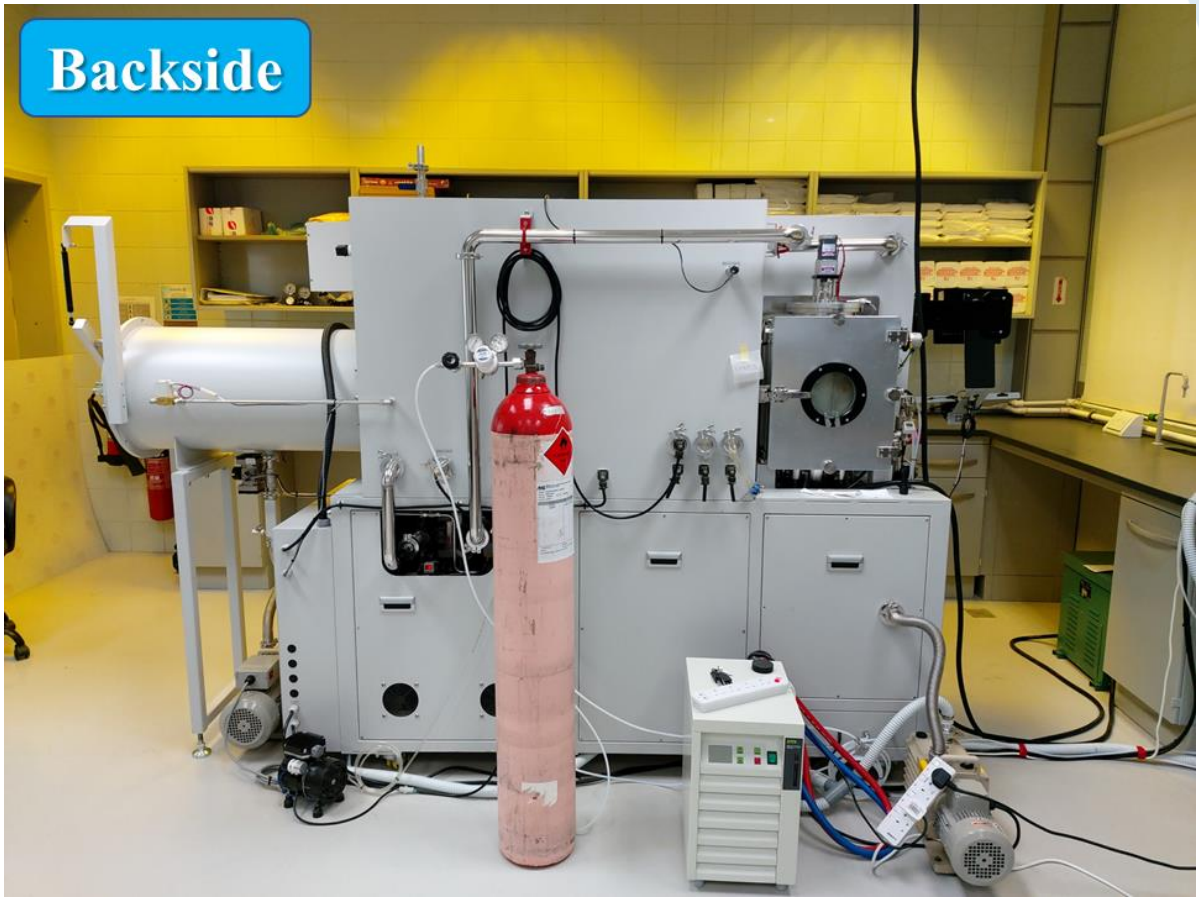
1. Make sure that the plug is plugged into the electrical socket.
2. Determine the temperature range by rotating the wheel next to the device.
3. Press the power key.
4. Pressing the mode key, choosing the temperature, choosing the time.
5. Press the start key to start the process.

12- Digitally Controlled Glove Box with Thermal Evaporation System

Objectives:

- It is used for preparing thin films and solar cell active layers under N_2 atmosphere inside glove box.
- The glove box is filled with high pure N_2 gas and contains sensors for controlling oxygen and moisture inside the box.
- The machine contains purification unit to purify the N_2 gas inside glove box from moisture.
- After preparation of solar cell active layers using organic solution, it is directly transferred to Thermal Evaporation System contained for preparing metal electrode as a back contact of the solar cells.
- Separately, the Thermal Evaporation System can be used for preparing thin films of organic materials or metals.
- Several equipment can be inserted inside glove box such as: spin coater (for preparing solar cell active layers and thin films from solutions), hot plate (for thermal annealing), hot plate magnetic stirrer (for dissolving chemicals to prepare solar cell solutions), and many other tools.

Picture:



Procedures:

For inserting samples inside glove box

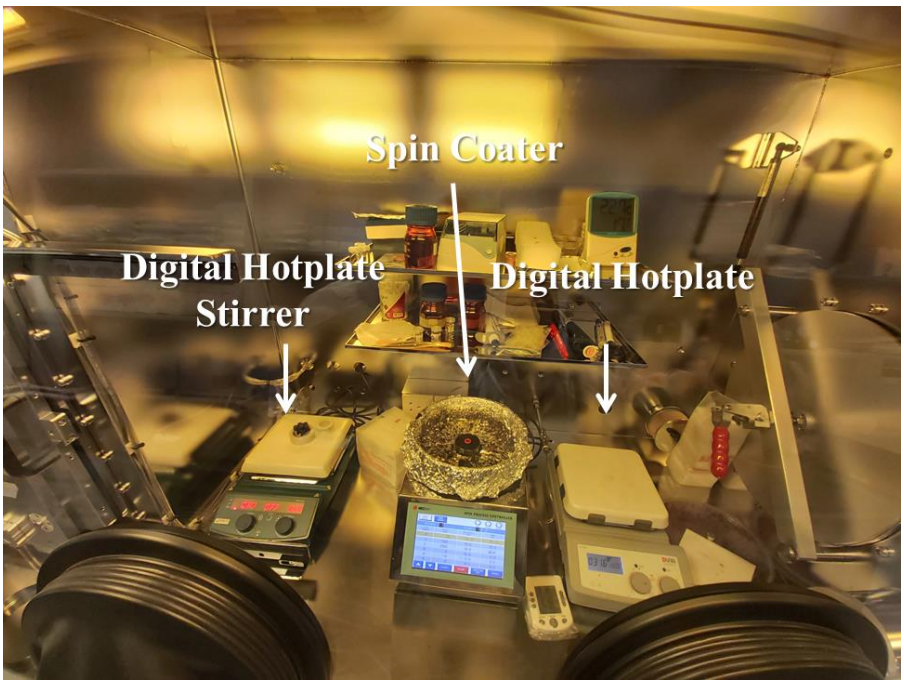
1. Open the outside door of the small pass box, then insert the samples and close it.
2. Open the vacuum valve to evacuate the pass box up to the end of the gauge level and wait for 2 mints.
3. Open the N_2 gas valve for opining the inside door of the pass box.
4. Transfer your samples into glove box and close the door of the pass box.

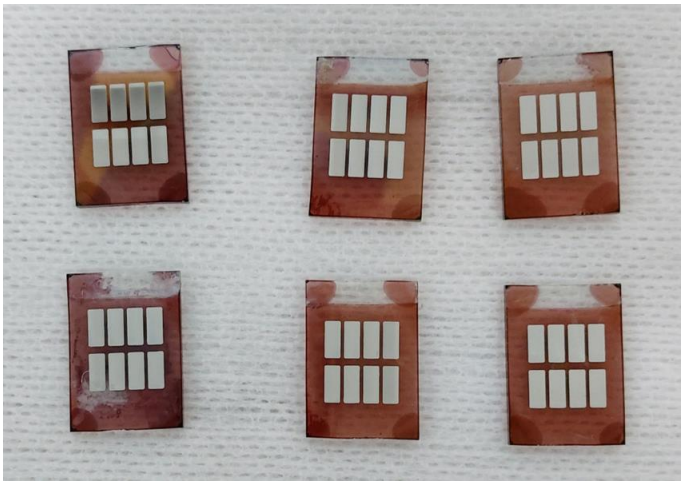
The work in the glove box

1. Insert your hands inside the gloves to work using the glove box.
2. Work freely using the glove box for preparing solar cell active layer and other organic thin films using the spin coater, hot plate, and other tools found inside glove box.

The use of Thermal Evaporation System

1. After preparing solar cell active layer it is directly inserted into Thermal Evaporation System (without exposure to outside atmosphere) from the inside of glove box.
2. The pure metal is hold in the Tungsten bot (as a source).
3. Thermal Evaporation System works automatically using computer program with the aid of different tools such as water sheller (for colling), air compressor, and N_2 gas.





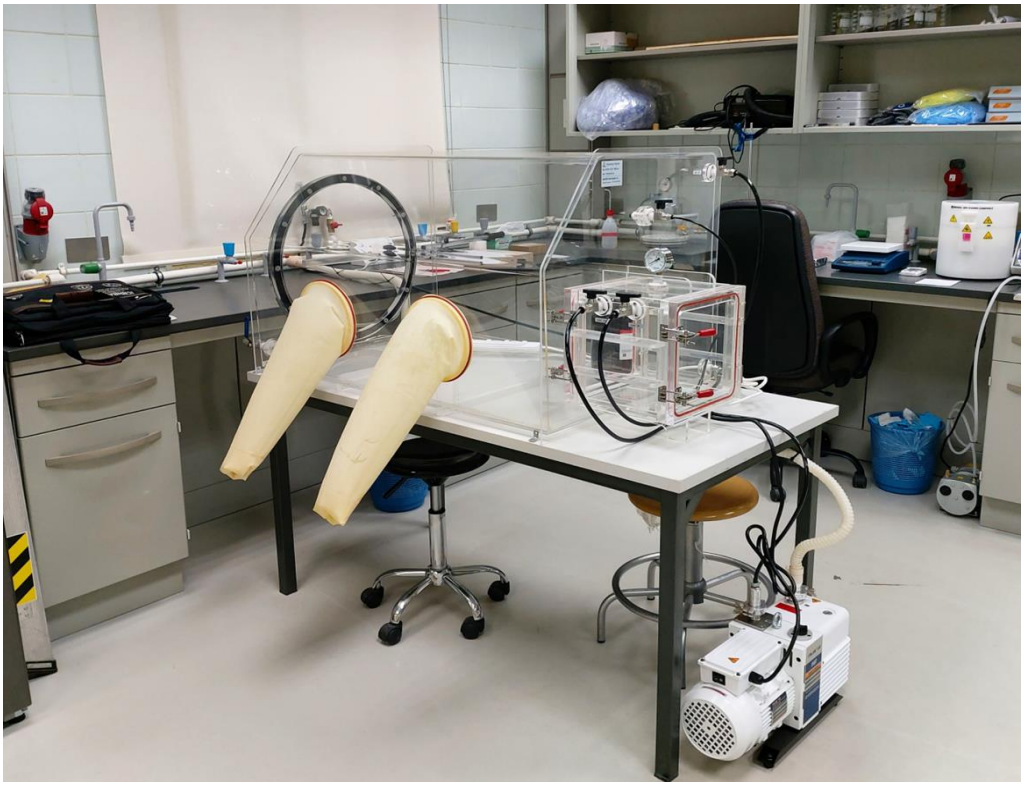
FIRST prepared organic solar cell in our lab in Faculty of Science – Islamic University of Madinah, KSA

13- Transparent Glove Box

Objectives:

- It is used for preparing materials under inert atmosphere for avoiding the interaction with oxygen.
- The glove box is filled with high pure N_2 gas and have connected rotary vacuum pump for evacuation of oxygen from pass box.
- The glove box is transparent for allowing to observe the work inside from every side of the box.
- It is cheaper than metal globe box.
- Several equipment can be inserted inside glove box such as: spin coater (for preparing solar cell active layers and thin films from solutions), hot plate (for thermal annealing), hot plate magnetic stirrer (for dissolving chemicals to prepare solar cell solutions), and many other tools.

Picture:



Procedures:

<u>For inserting samples inside glove box</u>

5. Open the outside door of the small pass box, then insert the samples and close it.
6. Open the vacuum valve to evacuate the pass box up to the end of the gauge level and wait for 2 mints.
7. Open the N_2 gas valve for opining the inside door of the pass box.
8. Transfer your samples into glove box and close the door of the pass box.

<u>The work in the glove box</u>

3. Insert your hands inside the gloves to work using the glove box.
4. Work freely using the glove box for preparing solar cell active layer and other organic thin films using the spin coater, hot plate, and other tools found inside glove box.

14- J/V Characterization System

(Photo Emission, Model CT100AAA, USA)

Objectives:

- It is used for measuring performance parameters of the solar cells under white light illumination using standard solar irradiation of 100 mW/cm^2 (AM1.5G) having a xenon lamp as the light source and a computer-controlled voltage-current source meter (Keithley 4200) at ~25 °C under nitrogen atmosphere.
- The measured performance parameters of the solar cells are short circuit current density (Jsc), open circuit voltage (Voc), fill factor (FF), and power conversion efficiency (PCE).

Picture:

Procedures:

1. Open the power of the J/V Characterization System and other related items following the observed numbers in sequence.
2. You have to wait 15 mints before beginning the requested measurements for warming the system lamp.
3. Open the program of the tester found on the computer
4. For measuring J-V characteristics of solar cells using this system, the solar cell, first, is hold in solar cell holder with connection to its electrodes as shown in the figure.
5. Then the solar cell holder is put inside the box and inserting N_2 gas.
6. The solar cell under measurement is put under the lamp of solar simulator with connecting to tester contacts.
7. Now you are ready to open the lamp shutter and start measurement using the program.
8. After finishing, close lamp shutter and replace the solar cell or other device.
9. For shutting down the J/V Characterization System, close power of the lamp (No. 5) and other items following the order inversely as observed up to number 1 (the main power).

تابع: أجهزة المختبرات في قسم الفيزياء

Laboratory Equipment in Department of Physics

11-محتويات مختبر القياسات الفيزيائية من الاجهزة

11- Equipment of Physics Measurement Lab (Research)

1- Fluorescence Lifetime System

Objectives:

- The DeltaFlex time correlated single photon counting (TCSPC) system is the next generation time correlated single photon counting lifetime instrumentation.
- This system is designed for measuring luminescence lifetimes ranging over 11 orders of magnitude, without the need to change cables or cards.
- The heart of the system is the DeltaHub timing electronics, which offers nearly lossless counting and allows for the measurement of lifetimes from 25ps to 1 second.
- The accessories include DeltaDiode of wavelength 320 nm, 550 nm and 660 nm, temperature controller.

Picture:

Procedures:

Measurement modes

The principal modes of measurement that can be utilized are given below·

A.Lifetime:

For measurements of decay times from 25ps to 1s*, shortest data acquisition time of 1 ms·

1. After checking that the appropriate hardware is connected and the optical system in turned on at the baseplate, turn on the computer and electronics (ie. DeltaHub, light source and detector power as appropriate).
2. Make sure that they have initialized (eg the power indicator on the DeltaHub becomes constant) prior to launching the software.
3. For critical measurements it is recommended to leave the hardware for 30 minutes to stabilise.
4. Launch the EzTime software by clicking on the icon on the desktop.
5. This software should automatically find and initialise any accessories present. If it does not load check the connections and retry.
6. Leave the DeltaFlex until the power indicator on the DeltaHub becomes constant before launching this application.
7. Once EzTime has loaded, the Data page appears. This is the page for acquiring (both time-resolved and steady state) and analysing data.
8. All data are stored in “containers” which can be saved and opened in EzTime.

B.Steady state:

Uncorrected emission spectrum using your chosen pulsed excitation source [a]

1. After checking that the appropriate hardware is connected, turn on the individual components and computer.
2. For critical measurements it is recommended to leave the hardware for several minutes to stabilize.
3. Prior to commencing a measurement it is helpful to know a few details about the sample, such as;
4. Excitation wavelength (λexc) and emission wavelength (λem) – obtained from steady state absorption and emission measurements.
5. Steady state measurements made using the pulsed excitation source can be simply performed by adding an additional node from the radial menu obtained in the Data Tree. This adds a steady state node to that of the IRF and decay.

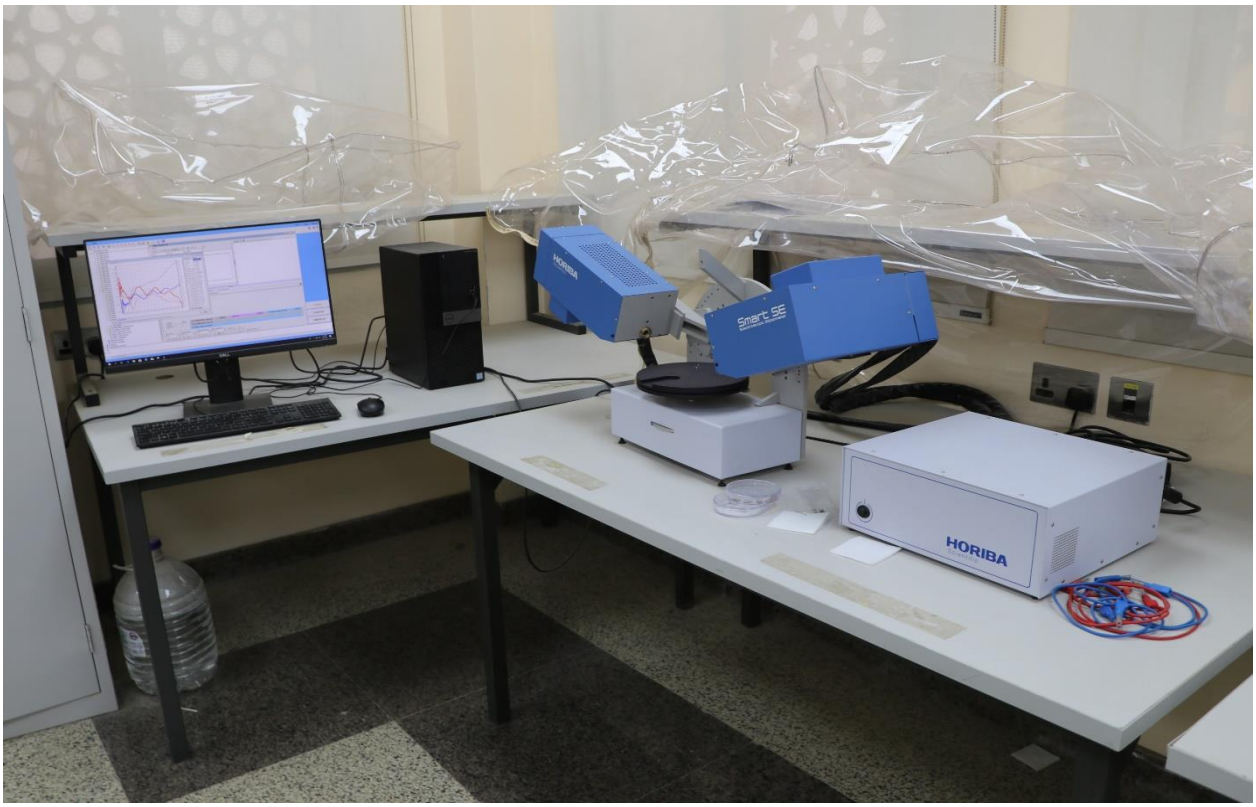
6. Presets for the wavelength and dwell time parameters are found along with those for the Lifetime measure.
7. Selecting the steady state node and selecting the Start Measurement will enable collection of the spectral data

2- SPECTROSCOPIC ELLIPSOMETRY

Objectives:

- For measuring the thickness of sample and the optical constants such as extinction coefficient and reflection index.

Picture:



Procedures:

The main steps for work with ellipsometer spectroscopy are:

1. Open the device and leave it for 20 min.
2. Open computer and software of your ellipsometer spectroscopy device.
3. Put tha sample at surface and focus light from lamp of device on tha sample.
4. Do scan from the program to make sure from sample before measure.
5. Open program and chose "ACQUISITION" then start.

6. Go to Model and use your acquisition and model from program.
7. try to find best xi, better be less than 1.
8. Take the measurement of your sample from the program.

3- Agilent 34972A Data Acquisition System

Objectives:

- This instrument allows collecting data in form of voltage via different sensors such as: Temperature sensor, Shunt for current, etc...

Picture:

Procedures:

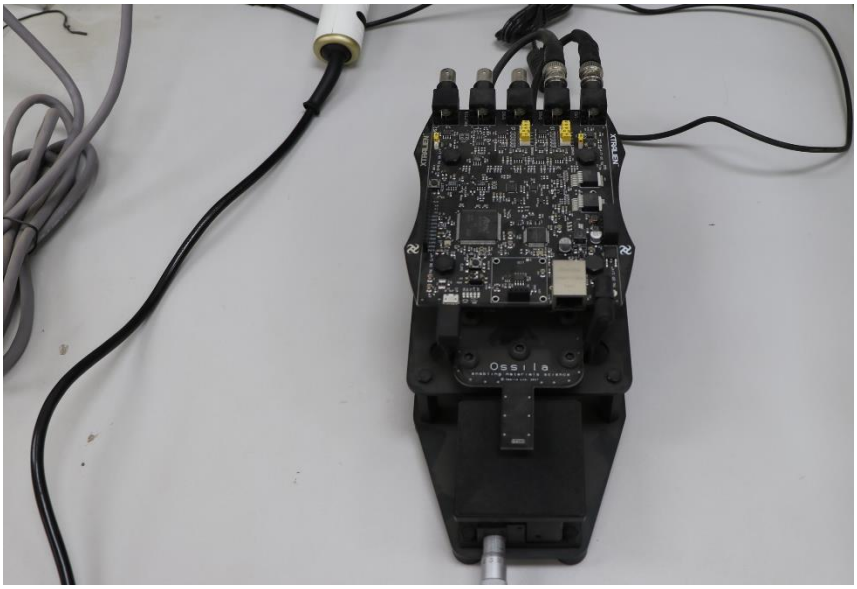
1. Select the channel to be added to the scan list.
2. Select the measurement parameters for the selected channel.
3. Run the scan and store the readings in non-volatile memory.
4. View the data from the scan.

4- Measurement of electrical parameters by 4-Probe method

Objectives:

- By using this instrument, we can evaluate the surface electrical resistivity of thin films by measuring the current- voltage characteristics.

Picture:



Procedures:

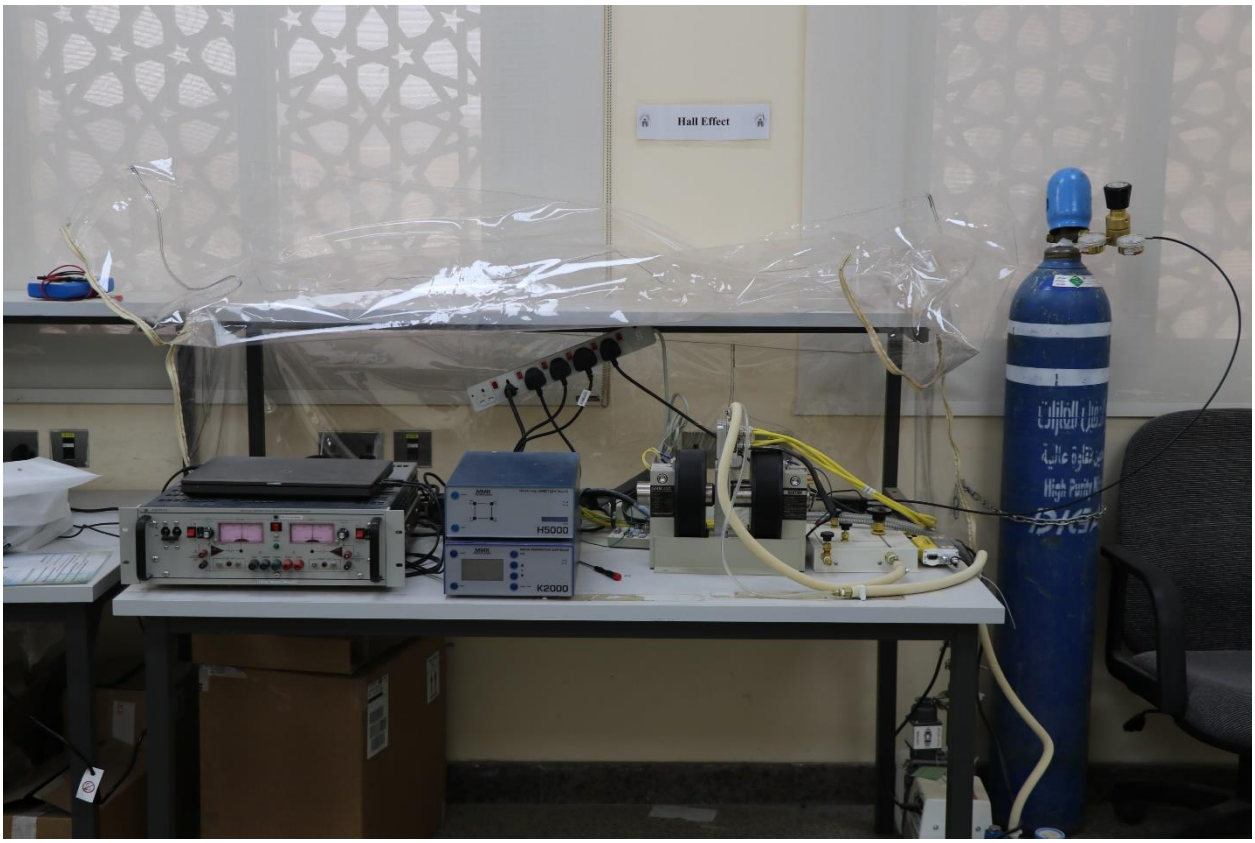
1. Preparation of samples to be measured
2. Measure the length and thickness of the sample
3. The device is started and making sure that all connections and wires are in the correct place.
4. Running the program,
5. Insert the Sample Details i.e.: Geometry, Long side (mm), Short side (mm), Diameter (mm) and Thickness (µm, optional),
6. Choose the Experimental Parameters, i.e. Target current (µA), Maximum voltage (V), Voltage increment (V).
7. Start the measurement with a control button.
8. Save the data.

5- Determination of electrical parameters via Hall Effect

Objectives:

- By using this instrument, we can study the Hall Effect of thin films.
- Calculating the Hall mobility, type of semiconductor, carrier concentrations under vacuum and at different temperatures (up liq. N2 temperature).
- The system also able to measure the magnetoresistance of spin valve/tunnel junction at different temperatures.

Picture:



Procedures:

- Please turned ON vacuum pump (PFEIFFER Vacuum) & wait to reach 9.5 mtorr or below(Expected take 12 Hours or overnight), Then follow the below steep (DO NOT TRY LOW TEMPRATURE WITHOUT VACUUM)
- If The vacuum you received inside the chamber (below 9.5 mtoor) is good to do variable temperature experiments. NOW! YOU SHOULD NOT CONNECT ROBINAIR PUMP TO EXHAUST of LTHS chamber until 80K is reached! The Robinair pump will block the exhaust and restrict nitrogen flow! THIS WILL CAUSE DAMAGE of Joule-Thomson refrigerator. **Here is the right Procedures:**

1. Wait until the vacuum is below 10 mTorr inside the chamber;
2. Connect high pressure gas line to LTHS input using filter/dryer between regulator and LTHS chamber;
3. Connect flowmeter to exhaust of LTHS chamber; DO NOT CONNECT ROBINAIR PUMP AT THIS POINT!
4. Set in Software temperature of 300K;
5. Apply N_2 gas pressuse to inlet of LTHS chamber of 500 PSI for 10 minutes. The flowmeter readings will be below 2 SCCM.
6. After 10 minutes (required purchase to clean capillary system of JT from water and other organic molecules) apply pressure of 1800 psi slowly;
7. Set temperature of 80K in software;
8. Let the system cool down. When cooling down, monitor flowmeter readings. The flow should increase when you getting lower in temperature.

WARNING: In case your cooling stopped at some temperature and you see that there is almost no gas flow on flowmeter (flow drops suddenly below 1 SCCM). **Please do the following:**

A. Close nitrogen gas supply to LTHS inlet;
B. Increase temperature to 300K at 15K/min;
C. Repeat step (5)-(7) above;
D. If the system again could not cool down and saturated at some temperature not reaching 80K do the following:
E. Repeat (A)-(C)
F. Then at applied pressure of 500 PSI, set the temperature to 375K and ramp rate of 15K/min
G. Let system reach temperature of 375K. Keep your system at 375K for 2 hours while supplying N2 gas at 500 PSI. This should clean all water molecules adsorbed by capillaries and get all capillary channels clean.
H. After two hours set ramp rate to 15K/min and cool down system at 500 PSI pressure to 300K.
I. Repeat steps (6) –(7)

C. Operation of MMR system below 80K.

1. When temperature of 80K reached or close to 80K (can be 81K or 82K);
2. Keep N_2 gas pressure at 1800 psi;
3. Disconnect flowmeter from the exhaust;
4. Open valve on Robinair pump;

5. Start Robinair pump;
6. Set temperature in software to 70K;
7. Connect Robinair pump to exhaust;
8. You should see temperature lowering to 70 – 72 K;
9. You can set in software any temperature between 70K and 80K at this point;
10. If you want to go above 80K, you should disconnect Robinair pump from the exhaust.

WARNING! FIRST DISCONNECT ROBINAIR PUMP AND THEN TURN THE ROBINAIR PUMP OFF! If you will turn off the pump and leave it connected to LTHS exhaust at supplied gas to inlet of LTHS – THE Joule-Thomson CAN BE DAMAGED!

6. Keithley 4200 Semiconductor characterization System (SCS)

Objectives:

- This instrument gives the characteristic of semiconductors devices like Diode, Transistor, Solar Cells.
- The system also able to measure the IV, CVf characteristics of resistor and capacitor.

Picture:

Procedures:

1. Turn on the device
2. Set up the measurements in Clarius
3. Select and rename a new project
4. Add a device
5. Select a custom test
6. Configure the test
7. Execute the test
8. View and analyze the test results.

تابع: أجهزة المختبرات في قسم الفيزياء

Laboratory Equipment in Department of Physics

12- بعض من تطبيقات الخلايا الشمسية

12- Some of Solar Cell Applications (Research)

1- Smart Greenhouse Powered by Photovoltaic System

Objectives:

- A smart model for cooling a greenhouse with solar energy, which is completely remotely controlled, in order to create a suitable environment for planting some crops in the summer in Al-Madinah Al-Munawwarah.

Picture:

2- Hybrid Solar Still-Solar Heater

Objectives:

- Solar water desalination model, where a solar water heater was added to this model to speed up the process of evaporation and condensation of salty well water and raise the efficiency of the traditional model of water desalination (Solar Still)
- The product is a hybrid model between a solar heater and a desalination device.

Picture:

ثانيا: أجهزة المختبرات في قسم الكيمياء

Second: Laboratory Equipment in Department of Chemistry

مختبرات قسم الكيمياء

Labs of Chemistry Department

يحرص قسم الكيمياء بكلية العلوم في الجامعة الإسلامية منذ الإنشاء عام 1433هـ على الوصول إلى مصاف المراكز الأولى بين الأقسام المماثلة بالجامعات السعودية وتطبيق معايير الجودة العالمية. وقد كللت جهود القسم بالحصول على الاعتماد المشروط لبرنامج بكالوريوس العلوم في الكيمياء من هيئة تقويم التدريب والتعليم (NCAAA) بالمملكة العربية السعودية. والبرنامج هو رابع برنامج كيمياء على مستوى المملكة يتم اعتماده، وهذا انجاز كبير وشهادة اعتراف بجودة البرنامج وجودة المخرجات التعليمية التي يحققها خريجو البرنامج. **علم الكيمياء** هو العلم **الذي** يدرس المادة والتغيُّرات **التي** تطرأ عليها، تحديدًا **بدراسة** خواصها، بنيتها، تركيبها، سلوكها، تفاعلاتها وما **تحدثه** من خلالها. يدرس الطالب بالقسم عددًا من المقررات الدراسية، ويحتوي القسم على عدد من المختبرات التعليمية التي تستخدم في تدريس الطلاب ويستفيد منها طلاب القسم وطلاب الأقسام الآخرى بالكلية وكذلك كلية الهندسة وهي-:

1. مختبر طرق التحليل الآلي والعلوم البيئية (أبحاث) (101)
2. مختبر الكيمياء غير العضوية التجريبية (102)
3. مختبر الكيمياء العامة 1 (103)
4. مختبر الكيمياء العامة 2 (104)
5. مختبر الكيمياء الفيزيائية التجريبية (105)
6. مختبر الكيمياء العضوية 1 (106)
7. مختبر الكيمياء العضوية 2 (107)
8. مختبر الكيمياء التحليلية (108)
9. مختبر أبحاث (206)
10. مختبر أبحاث (207)

No.	Lab Name	Lab No.	Floor	Lab supervisor	Lab Technician
1	Automated Analysis Methods and Environmental Sciences (Research)	101	1st	Dr. Mohamed Emad	Mr. Yasser Algabry Mr. Farhan Alsehamy
2	Experimental Inorganic Chemistry Lab	102	1st	Dr. Mohd Gulfam Alam	Mr. Omar Alraheely Mr. Fahad Alsaady
3	General chemistry I Lab	103	1st	Dr. Emad Masoud	Mr. Fahd Alsaady Mr. Omar Alraheely
4	General chemistry II Lab	104	1st	Dr. Yasser Mohammed Riyad	Mr. Fahd Mr. Omar Alraheely
5	Experimental Physical Chemistry Lab	105	1st	Dr. Saheed Abiodun Popoola	Mr. Fahd Alsaady Mr. Omar
6	Organic Chemistry I Lab	106	1st	Dr. Reda Haggam	Mr. Rayan Algabry Mr. Omar
7	Organic Chemistry II Lab	107	1st	Dr. Reda Haggam	Mr. Rayan Algabry Mr. Omar Alraheely
8	Analytical Chemistry I Lab	108	1st	Dr. Mohamed Emad	Mr. Yasser Algabry Mr. Farhan Alsehamy
9	Research Lab	206	2nd	Prof. Sobhy Gomaa Dr. Maher Fathalla	Mr. Yasser Algabry Mr. Farhan Alsehamy
10	Research Lab	207	2nd	Prof. Sobhy Gomaa Dr. Fathy Abdelgawad	Mr. Yasser Algabry Mr. Farhan Alsehamy

No.	Practical Course Name	Number of Units
1	Practical inorganic chemistry	5
2	General chemistry I	10
3	General Chemistry II	10
4	Experimental Physical Chemistry	8
5	Organic Chemistry I	7
6	Organic Chemistry II	9
7	Analytical Chemistry I	12
8	Analytical Chemistry II	12

List of experiments for each of the practical courses in the chemistry Department

No.	Name of Practical Course	List of Experiments
1	Practical inorganic chemistry	1. Synthesis and characterization of $[Co(en)_3]Cl_3$ complex
		2. Synthesis and characterization of $Cu(NH_3)_4SO_4$
		3. Synthesis and characterization of $[Co(NH_3)_5Cl]Cl_2$
		4. Preparation and characterization of some double salts
		5. Synthesis and characterization of Ni(II)-pyridine complex
2	General Chemistry I	1. Introduction to safety rules
		2. Introduction to common equipment
		3. Introduction to acidic radicals
		4. Detection of acidic radicals (group of dil HCl) (CO_3^{2-}, HCO_3^-,S^{2-}, SO_3^{2-}, $S_2O_3^{2-}$,NO_2^-)
		5. Detection of acidic radicals (group of Conc. H2SO4) (Cl-, Br-, I-, NO3-)
		6. Detection of acidic radicals (Miscellaneous group) (SO42-, PO43-, B4O72-)
		7. Scheme for identification of acidic radicals in simple

		salts
		8. Detection of unknown acidic radical
		9. Preparation of a solution with known concentration
		10. Preparation of a solution with known concentration from concentrated one (Dilution)
3	General Chemistry II	1. Preparation of Salt Solution
		2. Detection of Group I (Ag^{+}, Pb^{2+}, Hg_2^{2+})
		3. Detection of Group II (Cu^{2+}, Cd^{2+}, Bi^{3+}, Hg^{2+})
		4. Detection of Group III (Al^{3+}, Fe^{3+}, Cr^{3+})
		5. Detection of Group IV (Zn^{2+}, Mn^{2+}, Ni^{2+}, Co^{2+})
		6. Detection of Group V (Ba^{2+}, Ca^{2+}, Sr^{2+})
		7. Detection of Group VI (NH_4^{+}, Mg^{2+}, K^{+}, Na^{+})
		8. Scheme for Identification of Basic radicals in simple salts
		9. Detection of unknown basic radical
		10. Preparation of Salt Solution
4	Experimental Physical Chemistry	1. Safety in the laboratory -Laboratory Report Guidelines
		2. Adsorption Isotherm
		3. Computational Chemistry
		4. Three Component System
		5. Ionic Strength and Solubility
		6. Freezing Point Depression
		7. Distribution of A Solute Between Immiscible Solvents
		8. Heat of Solution
5	Organic Chemistry I	1. Melting point determination
		2. Recrystallization
		3. Boiling point and distillation
		4. Chromatography
		5. Alcohols
		6. Aldehydes and ketones
		7. Carboxylic Acids
6 \	Organic Chemistry II	1. Safety-general laboratory instructions
		2. The detection of elements in an organic compound – lassaigne sodium fusion test
		3. Properties and Types of Carbohydrates
		4. Properties and Identification of Carbohydrates, Chemical Tests

		5. Prepare of phenol formaldehyde resin. (Bakelite)
		6. Prepare of phenol formaldehyde resin using HCl
		7. Synthesis of an Azo dye: 1-Phenyazo-2-naphthol and 1-(4-hydroxyphenylazo)-2-naphthol
		8. Synthesis of benzamide from benzoyl chloride and ammonia
		9. Preparation of Soap
7	Analytical Chemistry I	1. Introduction and analytical glassware and apparatus
		2. Preparation and standardization of solutions
		3. Titration of strong acid (HCl) with strong base (NaOH)
		4. Titration of weak acid (HAc) with strong base (NaOH)
		5. Titration of a mixture of NaOH and Na2CO3 with HCl
		6. Determination of total alkalinity of water
		7. Determination of water hardness of water with EDTA
		8. Gravimetric determination of chloride by Mohr method
		9. Determination of chloride by Volhard method
		10. Determination of the pH of different solutions
		11. Analysis of iron with permanganate (oxidation - reduction)
		12. Iodometric- and iodimetric titrations
8	Analytical Chemistry II	1. Lab safety
		2. Calibration for instruments
		3. Introduction to spectroscopic methods
		4. Determination of λ max for $KMnO_4$
		5. Determination of concentration of $KMnO_4$
		6. Determination of concentration of $K_2Cr_2O_7$
		7. Determination of a mixture of $KMnO_4$ and $K_2Cr_2O_7$
		8. Spectrophotometric determination of Iron
		9. Photometric titration of copper by EDTA
		10. Determination of copper in copper ore using Atomic Absorption spectrophotometry (AAS)
		11. Determination of sodium in water using flame emission spectrophotometry
		12. Determination of metal ion in a mixture using Inductively Coupled plasma (ICP) spectrophotometry

أجهزة المختبرات في قسم الكيمياء

Laboratory Equipment in Department of Chemistry

1. Equipment of Research Laboratory Lab (206)

1. UV-Vis Spectrophotometer
2. Milli-Q distilled water
3. Ovens
4. Centrifuge
5. Photochemical Reactor
6. Orbital Shaker
7. Polymix
8. IKA Temperature Control
9. Lyoquest Freeze Dryer
10. BUCHI rotavap
11. GC-Mass Spectrometer
12. High Performance Liquid Chromatography (HPLC)
13. IKA rotavap
14- Water Bath
15. pH Meter
16. Anton Paar Ball Mill BM500
17- Agilent 7820A Gas Chromatograph
18- LG Microwave Oven

2. Equipment of Research Laboratory Lab (207)

1. Jenway 7305 Spectrophotometer
2. Thermo Nicolet iS5 TR
3. Evolution 300 UV- Vis Spectrophotometer
4. Sterilizer

3. Equipment of General Chemistry I Lab (103)

1. Ice Maker
2. Refrigerator
3. Water bath
4. Balance

5. Fume Hood

4. Equipment of General Chemistry II Lab (104)

1. Balance (Model: S1002)
2. Water Bath (Model: LWB-211A)
3. Hotplate Stirrer

5- Equipment of Inorganic Chemistry Lab (102)

1. Water bath
2. Melting point
3. Vacuum pump
4. Magnetic susceptibility balance
5. Ice Maker
6. Oven
7. Balance

6. Equipment of Organic Chemistry I Lab (106)

1. Melting point

7. Equipment of Organic Chemistry II Lab (107)

1.Water Bath
2.Melting points Apparatus
3.Rotary Evaporator
4 .pH meter
5.Hotplate magnetic stirrer
6.Balance
7.UV Lamp- UV Light Box

8- Equipment of Analytical Chemistry Lab (101)

1. Thermo iCE 3500 (Atomic absorption spectrophotometer (AAS)
2. Jenway PFP7 (Flame photometer)
3. DR 6000 UV-Vis Spectrophotometer
4. Jenway7305 Spectrophotometer

9- Equipment of Analytical Chemistry Lab (108)

1. High Performance Liquid Chromatography (HPLC)

10- Equipment of Physical Chemistry Lab (105)

1. Jenway 6850 Spectrophotometer
2. FT-IR-ATR Nicolet iS10
3. Top load Balance
4. Oven
5. Digital hotplate stirrer
6. Hotplate stirrer
7. Water bath
8. Ice maker machine
9. Sensitive Balance
10. Refrigerator

أجهزة المختبرات في قسم الكيمياء

Laboratory Equipment in Department of Chemistry

1- محتويات المختبر البحثي (206) من التجارب

1- Equipment of Research Lab (206)

1- UV-Vis Spectrophotometer

Objectives:

- Describe dependence of transmitted light intensity for a light absorbing medium on sample depth and concentration
- Define ' absorbance ' in terms of transmittance, pathlength and concentration (the Beer - Lambert law).
- Define the term ' molar absorption coefficient.
- Apply the Beer - Lambert law to problems in UV - VIS spectroscopy.
- Define the term ' conjugation

Picture:

Procedures:

1. If it is not already on, turn on the Spectrophotometer using the power on/off
2. switch (Left h and side of instrument).
3. Turn on the computer and click on the UV Probe software (available on the desktop).
4. Click the “Connect” button to initiate communication between the computer and the Spectrophotometer. The instrument will now begin its initialization Procedures and begin to warm up. The machine should be allowed at least ½ an hour to warm up fully before proceeding with the remainder of this procedure.
5. Select the “Spectrum Mode” using the button on the toolbar.
6. Click on the “Spectrum Method” button on the toolbar. A tabbed dialogue button will now open to allow you to set the parameters for the measurement. In the “Measurement”

tab: -

a) Enter the wavelength range via the “Start” and “End” fields. Always enter the longer wavelength into the “Start” field and the shorter wavelength into the “End” field. NOTE the operational region of the spectrophotometer is between 1040 - 190nm.
b) Select the scan speed to be Medium via the drop-down menu. Medium is fine for the broad absorption bands typical of organic mate rials; if you have samples with sharp absorption features, it may be better to run a slower scan.
c) Select the sampling interval as 1nm from the drop-down menu.
d) The “Scan Mode” should be set to “Single”.
e) In the “Instrument Parameters” tab: -
f) Select Absorbance from the “Measuring Mode” drop down menu. (Transmittance is also possible)
g) Select a value of 1nm from the “Slit Width” drop down menu.
h) Ensure that the “Light Source Change Wavelength” is set to 360nm and the “S/R
i) Exchange” is set to “Normal”.

7. Set up the sample mounts in the configuration that you will use to carry out measurements without any sample or reference in place. Close the lid of the sample compartment.
8. Run a baseline calibration by clicking on the “Baseline” button at the bottom of the screen. Ensure that the baseline range matches that which you have previously entered in the “Spectrum Method” dialogue. Click “OK” to run the baseline calibration.
9. To obtain a spectrum, click on “Start” and the machine will begin collecting data with the Parameters you have specified.
10. Ensure that the baseline is good by first running a scan with no sample in place. You should obtain a flat baseline with noise distributed about zero.
11. Now insert your sample and reference into the sample mounts in the sample compartment (Ensure that the lid is closed before taking measurements) and take a spectrum as before.
12. When the scan is finished, enter a label into the dialogue box which appears. NOTE: This does not save your data.
13. To save a data set, select “Save As” from the “File” menu and enter a filename. Select “Data Print Table (*.txt)” from the “Save As Type” drop down menu. This will save the data in an ASCII text format which you can access using other software. Please only save data in your directory under the “Users Data” folder.
14. It is good practice to take another absorption spectrum with your sample oriented at 90o in the sample mount. This will give you two data sets for the same sample and will allow

you to assess the reliability of your data, which may be affected by the uniformity of the film.

15. To shut the instrument down press the “Disconnect” button at the bottom of the screen and turn the instrument off using the Power On/Off button. Close the software and shut the computer down when you are finished with it.
16. Ensure that the lid to the sample compartment is fully closed when you are finished as external light leaking into the can cause damage to the PMT.
17. It is quite acceptable to leave the machine running the day should it be used regularly; however, it be inactive for long periods of time (>3hours), it should be shut down to preserve the lamps. The machine should be shut down at weekends and overnight, if you see the instrument left on late at night or at the weekend, please shut it down.

2- Milli-Q distilled water

Objectives:

- An effective laboratory water purification system must efficiently remove contamination that would interfere with tests or procedures.
- A water purification system is composed of a series of purification stages
- Analysis of source water is used to determine the type and capacity of individual purification steps needed within the water system.

Picture:

Procedures:

1. Tap water is first purified to pure (Type 3) water by reverse osmosis (RO).
2. The pure water produced by the Reverse Osmosis is stored in a tank designed to minimize risks of contamination during water storage.
3. From that reservoir, water can be sourced though a front valve or sent by a delivery pump, to feed instruments such as a glassware washing machine, or further processed by the Milli - Q Direct to produce ultrapure (type1) water.

3- Ovens

Objectives:

- Laboratory ovens are commonly used ovens in several industries such as electronics, pharmaceuticals, material processing, etc, as well as for different process applications.
- Each of the processes usually has different results, so the ovens are mostly unique for each purpose like baking, curing, annealing, Drying, etc.

Picture:

Procedures:

1. Materials: 4 cardboard boxes (32cmx25cmx8cm) with no lid, 5 thermometers, black paper, white paper, aluminum foil, saran wrap, tape.
2. The ovens were lined as follows:
3. Oven1: no lining, bare cardboard 3.
4. Oven 2: single layer of black paper lining bottom and inside of walls.
5. Oven 3: single layer of aluminum foil lining bottom and inside of walls.
6. Oven 4: single layer of white paper lining bottom and inside of walls
7. A thermometer was placed in each box, then Saran wrap was stretched over the top " window " and tape was used seal the oven.
8. Ovens were placed outside in direct sunlight and positioned so that the sun was hitting the window as directly as possible.
9. Temperatures of the ovens and of the surrounding air was monitored for 20 minutes
10.

4-Centrifuge

Objectives:

- To separate the immiscible liquids
- To purify the component by removing impurities in the supernatant liquid.
- To separate crystalline drugs from the mother liquor.
- To test the emulsion and suspensions for creaming and sedimentation at an accelerated speed.

Picture:

Procedures:

1. 1n centrifugation, centrifugal force is used as the driving force for the separation of particles.
2. Centrifugal force is replacing a gravitational force which is responsible for the sedimentation of two particles. Thus, centrifugation is useful when the ordinary filtration methods do not apply to the separation of particles.
3. When two particles having different sizes, but same densities are suspended in any liquid medium then they may not be able to separate by a simple filtration method. In such kind of cases, centrifugation method is useful.
4. The particle size above 5-micrometre sediment at the bottom with the help of gravity but the particles having a size less than 5 micrometers, start Brownian motion and do not sediment because of the gravity that's why they require the centrifugal force to separate properly.
5. The centrifugal force causes the denser dense particle direction of the radical where writer practical moves to the center. The ratio of the force acting on radical the direction to the gravitational force is the centrifugal effect.

5- Photochemical Reactor

Objectives:

- TOPT-II photochemical reactor is a new generation photocatalysis reaction device.
- It is mainly applied to research gas / liquid / solid phases, fixed / simulated visible light, simulated UV light, special simulation light, whether could reaction vessel load TiO2, Photochemical reaction under conditions of photocatalyst and so on.
- This system has unique advantages: reasonable technology, simple structure, convenient operation, stable working, operator safety protection, free combination and flexible customization, etc.

Picture:

Procedures:

Advantages & features

1. Main parts: safety cabinet, light source device, glass reactors, fully quartz light source protection cold trap, magnetic stirring reaction vessel, 1-parallel magnetic stirring reactor, etc.
2. Could measure reaction kinetics and reaction constant, provide analysis of reaction products and free radical samples, etc.
3. Professional parallel reaction stirring apparatus could measure the temperature of material which in reactor, and digital display. At the same time could provide magnetic stirring and reactor fixed function.

Safety precautions

1. Room temperature and humidity
2. TOPT-II normal room temperature range ≤30℃， humidity range ≤60%，if over these ranges will affect device safety performance and operating performance.
3. Move photochemical reactor
4. Forbid move or incline instrument after storage liquid groove already have liquid

injection, so as to avoid working medium flow into instrument part and cause dangerous or instrument parts damage.

5. Ventilation and dust prevention
6. There needs enough space for the heat dissipation hole part of instrument and this space has well dust prevention. This instrument needs to be away from heating device and avoid direct sunlight.
7. Power voltage: AC220V 60HZ, with well ground connection system, equipped with standard three pole security socket.
8. Protect power wire
9. Please use hand handle plug to insert or pull off power wire, forbid drag the power wire. Strictly protect power wire without high temperature damage, etc.

Medium

1. Must use clean water or other medium, avoid silt flow into cooling system or circulating pump, if you find the medium is not clean please change in time.
2. Change protective tube
3. If you doubt protective tube burnout, please power off the total power source firstly, then change the same type same parameters protective tube, forbid use incorrect protect tube.

Maintenance

1. Please don't take apart and repair this instrument by yourself, except change protection tube and clean heat dissipation condenser, there's no parts could let you take apart and repair by yourself, if device fault, please find professional person to repair.

Clean

1. Please power off instrument firstly, then start clean and use soft dry cloth to clean panel and other parts of instrument body. Cleaner powder or cleanser could be used, but need to dry by dry cloth, avoid liquid or water flow into instrument parts.

Safety operating specification

1. Clean each accessory, keep it clean and tidy, place the protective dark box in a proper position; put the multi tube multi working position reactor host, install the stainless steel cold trap vertical rod and supporting rod, adjust its position at the appropriate height by adjusting the stainless steel screws at three points of the tube adapter, install the quartz tube, put the magnetic stirrer into the quartz tube in advance; put all quartz belt

extension tube light source to protect the cold before the reaction, the preparation filter can be quickly placed in the corresponding tube card slot on the tube adapter.

2. Connect low-temperature cooling water circulation device, use the matching pipe to put the liquid outlet pipeline through the corresponding position behind the protection dark box into the dark box, connect the water inlet of the full quartz belt extension tube light source protection cold well (one end with the extension pipe), pass the water outlet of the full quartz belt extension tube light source protection cold well through the corresponding position behind the protection box, and pass through the outside of the dark box, and connect to the low-temperature cooling water circulating device.
3. A light source controller is placed on the left or top of the protection dark box, and a single ended analog lamp tube is placed in the protective cold well of the full quartz band extension tube light source in the dark box. The lamp extension line passes through the corresponding through hole on the left side of the dark box and is inserted into the supply line behind the dark box is connected to AC 220v.
4. When using the low-temperature cooling water circulating device for the first time, please use the valve sealing tape to install the stainless steel drain valve to the outlet of the circulating liquid. When the temperature in the tank reaches the required temperature, open the valve for circulating liquid in and out of the body, and then turn on the circulating power on the control panel. After make sure cooling water start circulating work, turn on fan switch which is in dark box. Turn on controller switch, then lamp tube begin to become light, and start normal working after about five minutes.
5. After the reaction is completed, turn off the switch on the light source controller in turn, turn off the fan switch in the dark box and the power of the cooling water circulating device after five minutes; finally, put out all the power supplies to ensure the safety of using electricity when the product is not used for a long time.

6- Orbital Shaker

Objectives:

- Ideal for culturing cells to hybridization, staining and distaining gels, and conbinatiorial chemistry.Optimal platform rotation for intensive mixing.
- Brushless DC motor for intensive mixing.
- High precision digital rotation speed control
- Programable operation.
- Digital LCD display with back-light function.
- Smooth start and changing shaking speed.
- Universal platform for easy and fast fixation of any kind of flasks bottes etc.
- Program storage function
- Overload alarm.
- Safety locking mode.

Picture:

Procedures:

1. **Ensure the Shaker is Properly Supported**

   When in use, orbital shakers can vibrate significantly. Use on an uneven surface could

cause damage, especially for heavier machines. You can use a level and adjust the feet accordingly to ensure that the shaker is seated evenly.

2. **Consider Location Carefully**

   Squeezing a benchtop or floor model shaker into a tight spot isn't a good idea, as you need enough space to ensure good ventilation. You also don't want to place it where it will be exposed to direct sunlight as this can affect temperature controls. This is especially bad for a refrigerated model. Also consider other machines in the vicinity that could be giving off heat.

3. **Load Samples with Care**

   It may not seem as though it matters that much how you load your samples, but it can actually prolong the working life of the clamps if you use a little care. Simply forcing the sample into the clamp will lower the lifespan of the clamp itself. Plus it risks breaking the vessel. Instead, gently pull the clamp out enough for the vessel to easily be inserted.

4. **Even the Load**

   Similar to use on an uneven surface, an uneven load can cause the orbital shaker to vibrate. The added vibration could make for increased agitation of the contents which might adversely affect the outcome of the application. An uneven load could also cause asymmetrical wear to the machine and irregular shaking. You don't have to balance an orbital shaker like you might a centrifuge, but keeping the weight distribution in mind is always a good idea.

5. **Build Up the Speed Slowly**

   Even if you know the exact agitation speed you want to use, it's prudent to start slow and build up. Quickly increasing the speed can result in liquids sloshing instead of achieving the desired swirling motion. This is especially important if dealing with fragile cells, in particular those without a cell wall. Some models, such as the one below, come with a "smooth acceleration" feature which does the job of ramping up the speed gradually for you.

6. **Keep the Volume Low**

   While some applications allow for a larger fill volume, in general, a low fill level (around 10-25% of the volume of the flask) allows for optimal mixing. A low volume means a greater relative surface area, maximizing the amount of aeration. Plus, a lower filling volume means you minimize the risk of spillage.

7. **Limit Unnecessary Door Openings**

   If you're using an incubated or refrigerated shaker, opening the door unnecessarily with have a negative impact on the performance of the machine. Door openings will introduce ambient air and the incubation or refrigeration system will have to work harder

to maintain temperature. What's more, the fluctuation in temperature caused, even if brief, could impact the results of your application, especially with samples that are particularly sensitive to temperature.

8. **Don't Overload the Machine**

   Overloading your orbital shaker can cause damage in the short term or additional wear over time. Manufacturer specifications will tell you the weight limit (maximum capacity) for the machine. This includes the weight of the platforms, clamps, and screws, as well as the samples. Some shakers come with an overload protection shut-off, but this should be considered more of a 'just-in-case' feature. You shouldn't rely on the overload protection shut-off to tell you that you're putting too much weight on your shaker.

9. **Maintaining an Orbital Shaker**

   Aside from taking care to use your orbital shaker correctly, you also need to think about maintenance of the equipment. Taking care of your machine will keep it in good working order and prolong its lifespan.

10. **Clean Up Spills**

    Spills will inevitably occur with orbital shaker usage, but it's important not to let liquids get into the mechanisms. Spills can be cleaned as directed by the manufacturer, but 70% ethanol is usually a safe bet. Even if you don't tend to spill, dirt and grime can build up on shakers, so it's good idea to clean and disinfect them regularly. If you can remove the platform, you should do so while cleaning to get to any spills, dirt, or debris underneath. Just make sure it's thoroughly dry before replacing.

11. **Inspect the Belt and Fan**

    Many shakers operate using a belt-based system. The belt should be inspected periodically for wear and tear. If needed, replacement parts can be ordered from the manufacturer. Similarly, if you shaker has a circulating fan, its operation should be checked regularly too.

12. **Perform Speed Checks**

    It's easy to assume that if a machine switches on, then it's working correctly. Machines are usually calibrated upon purchase and during servicing but may need to be checked in between. If the speed isn't accurate, this can obviously throw off the results of your application. You can test the speed accuracy using a calibrated sensor. You might also want to check the accuracy of the temperature (if your shaker is incubated) and the time and test the alarms too.

13. **Check the Air Filter and Condenser Coil on Refrigerated Models**

    Many refrigerated shakers have an air filter. This can become a trap for dust and dirt so should be checked regularly, at least every few months. Similarly, in refrigerated shakers, the condenser coil can become covered with dust and dirt from the environment. This will insulate the condenser making heat removal less efficient. You can usually clean the air filter and condenser coils with soap and water and dry thoroughly, unless the manufacturer guide advises differently.

14. **Orbital shakers don't generally require a lot of upkeep.** However, if you want to ensure your machine is running as efficiently and for as long as possible, it's worth following the tips above.

7- POLYMIX

Objectives:

- Analysis or quality control requires finely ground samples.
- Easy to change grinding and sieves extend the range of any samples that can be processed, high user safety and efficient grinding mill.

Picture:

Procedures:

BLADE GRINDING

HAMMER GRINDING

1. An engineering suite of services, can address a variety of processes such as blending / mixing / stirring, emulsifying, deagglomerating, foaming, crushing and homogenizing with particle size reduction from a few micrometers down to nanometers in size: the proprietary design and innovative geometry of our aggregates / generators can downsize and provide perfect statistical particle distribution for the finest emulsions / suspensions and foam dispersions.

APPLICATION:

1. Grinding of solids for general sample preparation
2. Grinding samples for dry analysis or analysis in liquids
3. Sample preparation in content analysis
4. Sample preparation for quality control
5. Pollutant analysis (e.g. ground samples, foodstuffs etc.)

8- IKA Temperature Control

Objectives:

- The IKA C 6000 global standards/isoperibol calorimeter system is used for calorific value determination of solid and liquid substances.
- This is done by placing a known quantity of a substance in a decomposition vessel which is surrounded by a water bath.

Picture:

Procedures:

The menu item “Measurements” refers to both calibration of the calorimeter system and the actual measurements for determining the calorific value. The following preparations must be performed in order to prepare the system to take a measurement:

1. Weigh out the substance directly into the crucible with an accuracy of 0.1 mg. It may be necessary to put some distilled water or a solution into the decomposition vessel. The maximum acceptable weight of the sample that is added is restricted, and it may weigh from 0.001 g to 5 g.
2. To prolong the life of wearing parts (o-rings, seals, etc.) we recommend that you always work with a water trap.
3. As a rule the weighted sample must be selected in such a way that the temperature increase during the measurement is below 5 K and comes close to the temperature increase of the calibration (max. extra energy: 40000 J) Failure to observe these instructions could result in damage to the calorimeter.
4. If the maximum energy input is exceeded, we recommend that the calorimeter is sent back for repair (Chapter 12.1. Cleaning the system).
5. When working with unknown substances, select very small weighted samples (approx.

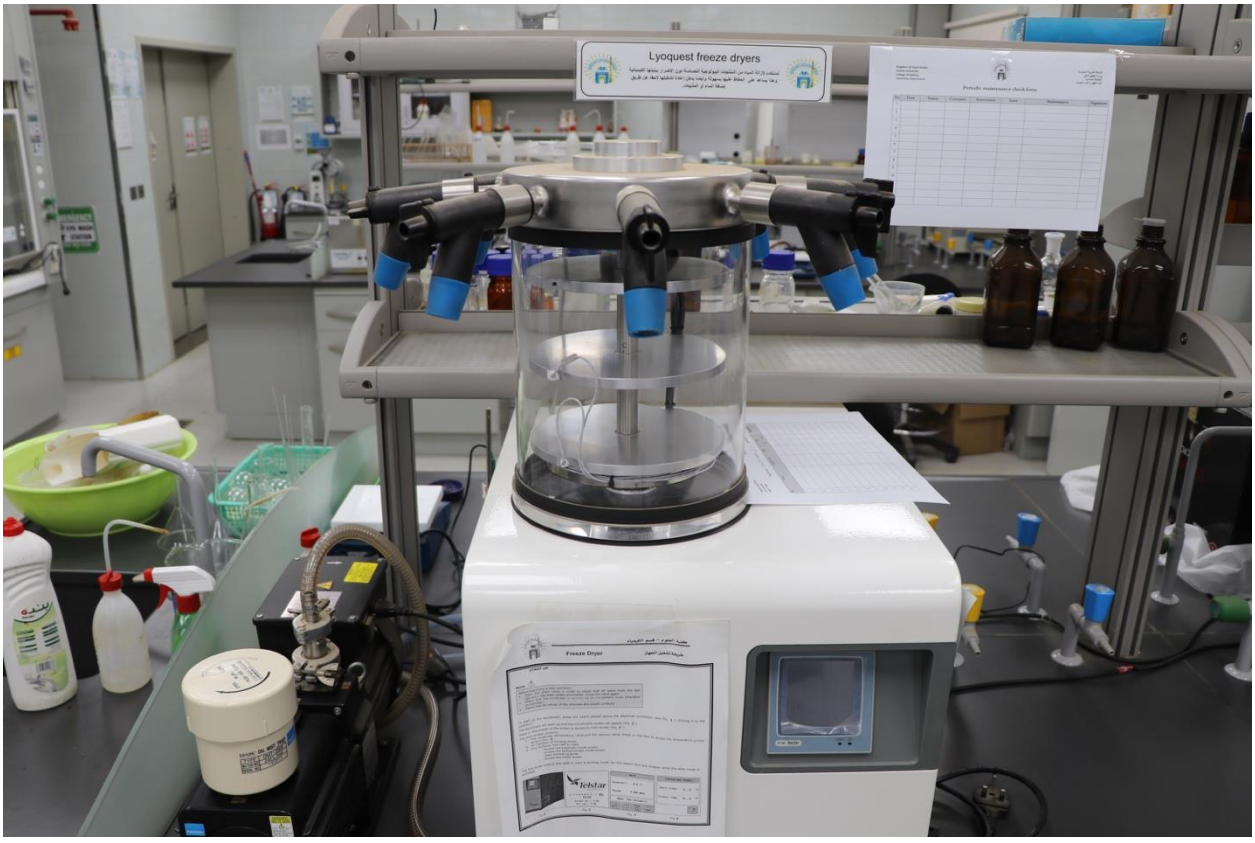
0.25 g) at the start in order to determine the natural energy. If you are burning unknown samples, leave the room or keep your distance from the calorimeter. If substances such as distilled water or solutions are added to the decomposition vessel for combustion tests, you must use exactly the same amount of those substances during calibration.

9- Lyoquest Freeze Dryer

Objectives:

- The LyoQuest laboratory freeze dryers are designed to be a multipurpose unit in the research and development field.
- The LyoQuest laboratory freeze dryers are designed to be a multipurpose unit in the research and development field.

Picture:



Procedures:

PREVIOUS OPERATIONS BEFORE START-UP

1. Check that all the water remains from de-freezing during the previous operation has been removed by opening the draining valve. Close again.
2. Check that the condenser transparent cover is on.
3. Check that the all the cocks of the chamber are turned off.

CONTROL PANEL

INSTRUCTIONS FOR START-UP

4. To start the equipment, proceed as follows:
5. Set the switch on placed in the back side, just above the electric inlet plug to position I.
6. The following screen will appear:

CRYODOS V 3.1 - 50

7. After a few seconds the main screen will show:

SYSTEM READY

8. Press ON/OFF key and the screen will show:

VAC.: 0.000 mBar

TEMP.: -000.0 °C

9. The vacuum level inside the chamber and temperature in the condenser will appear.
10. At this point, the following process automatically begins:
11. The cooling system starts (compressor 1).
12. In the CRYODOS –80, compressor 2 starts 4 minutes after compressor 1 has already started.
13. When the condenser reaches a programmed temperature (T), the vacuum pump automatically starts.

T=-30°C in the CRYODOS-50

T=-45°C in the CRYODOS-80

REMARK:

- These pump starting Temperature Points are set and cannot be modified by the user.
- Every 3 seconds Fig. 3 will be merge with Fig. 4.

COOL + VACUUM

TIME: 00:00:00

STOPPING THE FREEZE DRYER

Both models, when the freeze drying process ends, the equipment is stopped by pressing the ON/OFF key. Compressor 1 will continue running for 2 minutes to collect the system flui refrigerant.

Accidental freeze dryer stopping.

If there is in the CRYODOS –50 an accidental stop, disconnection or power cut, the freeze dryer stops and the vacuum in the chamber is maintained. Once the current is re-established, the process continues working at the same conditions before the stop.

If it happens in the CRYODOS –80 and once the current is re-established, compressor 2 will run after 4 minutes of the start-up.

Accidental freeze dryer stopping.

If there is in the CRYODOS –50 an accidental stop, disconnection or power cut, the freeze dryer stops and the vacuum in the chamber is maintained. Once the current is re-established, the process continues working at the same conditions before the stop.

If it happens in the CRYODOS –80 and once the current is re-established, compressor 2 will run after 4 minutes of the start-up.

10- Rotary Evaporator

Objectives:

- This device is used, in the chemistry labs to remove various solvents mixed samples efficiently and kindness by evaporation under reduced pressure.

Picture:

Procedures:

1. The substance to be evaporated is placed in the evaporation flask and dipped in the water bath.
2. The pump is running during the pressure difference.
3. Conduct the water to condenser
4. Turn on the rotation of the beaker inside the heater.
5. Collect the steam produced in the receiving flask.
6. There are risks associated with simple operations such as evaporation of etheric cellulose containing peroxides. This may also occur when certain unstable compounds such as organic azides are dried.

11- GC-Mass Spectrometer

Objectives:

- GC-MS is a technique used for separating and analyzing compounds that can be vaporized without decomposition based on its molecular weight
- Used in the fields of analytical chemistry, biochemistry and industrial

Picture:

Procedures:

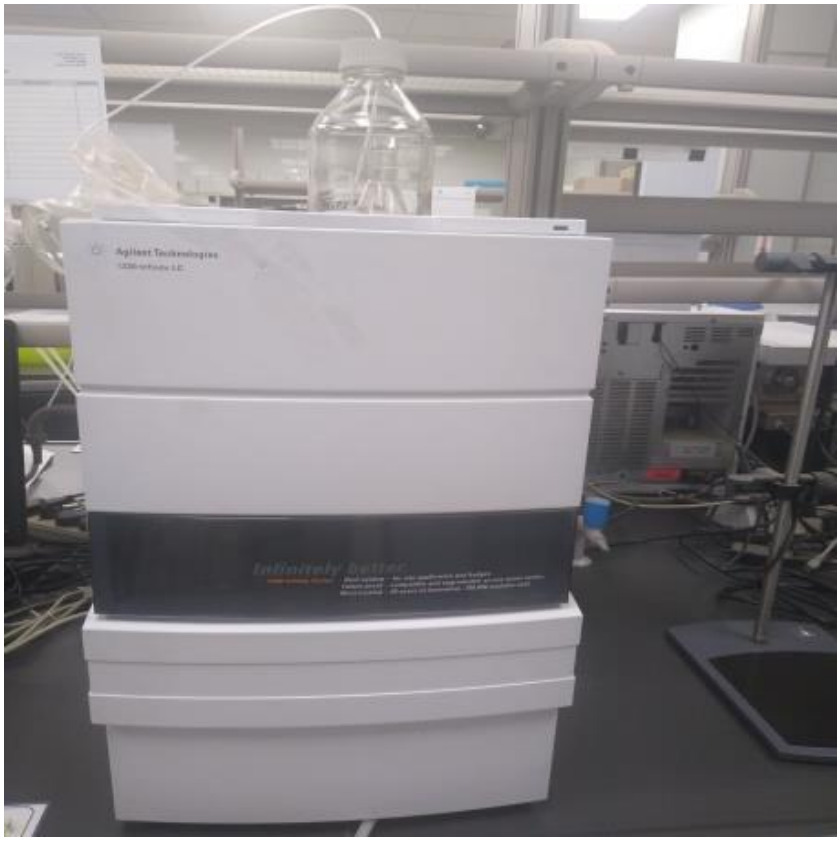
1. Turn on the computer
2. Open gas cylinders
3. Turn on the switch of autosampler unit
4. Turn on the switch of Gas Chromatography unit
5. Turn on the switch of mass spectrometry unit
6. Wait until each unit become stabilized
7. Open the GC-MS software
8. Check if all units were connected
9. Leave all units, until the pump efficiency become 100 %
10. Increase the temperature of injector and detector to appropriate temperature
11. Leaves all units for 7 to 10 hours, to reach the vacuum to optimum condition
12. Applied your method for analysis
13. When finished, start shut down the instrument as following:
    - Decrease the temperature of injector and detector to 60 °C
    - Shut down the mass spectrometry unit from software and wait until pump efficiency become 0 %
    - Shut down the mass spectrometry unit
    - Shut down the gas chromatography unit
    - Shut down the autosampler unit
    - Close gas cylinders
    - Close the GC software
    - Shut down the computer
14. Shut down all electrical sources.

12- High Performance Liquid Chromatography (HPLC)

Objectives:

- HPLC is a technique used to separate, identify, and quantify each component in a mixture
- Used in the fields of analytical chemistry, biochemistry and industrial

Picture:



Procedures:

1. Turn on the computer
2. Turn on the switch of the pump, autosampler, column compartment and detector modules
3. Wait until each modules become stabilized
4. Open the HPLC software
5. Connect each modules to software
6. Applied your method for analysis
7. When finished, start shut down the instrument as following:
   - Disconnect the pump, autosampler, column compartment and detector modules
   - Close the software
   - Shut down the pump, autosampler, column compartment and detector modules
   - Shut down the computer
8. Shut down all electrical sources.

13- Rotary Evaporator

Objectives:

- This device is used, in the chemistry labs to remove various solvents mixed samples efficiently and kindness by evaporation under reduced pressure.

Picture:

Procedures:

1. The substance to be evaporated is placed in the evaporation flask and dipped in the water bath.
2. The pump is running during the pressure difference.
3. Conduct the water to condenser
4. Turn on the rotation of the beaker inside the heater.
5. Collect the steam produced in the receiving flask.
6. There are risks associated with simple operations such as evaporation of etheric cellulose containing peroxides. This may also occur when certain unstable compounds such as organic azides are dried.

14- Water Bath

Objectives:

- A water bath is a lab constant temperature equipment, providing a heat source for varieties of devices that need heating.
- The circulating water bath is used to keep water at a constant temperature for incubating samples in a laboratory.

Picture:

Procedures:

1. Connect the power supply.
2. Ensure the water level in a water bath is sufficient to pour the heating element.
3. Switch “ON” the main power supply and instrument mains.
4. For temperature settings, Press the SET key to set the required temperature. press ↑ to increase the temperature and ↓ to reduce the temperature
5. The temp. The sensor will maintain the set temp. During use of water bath.
6. Switch “OFF” the instrument mains & main power supply after use.

15- pH Meter

Objectives:

- It is an electric device used to measure hydrogen-ion activity (acidity or alkalinity) in a solution.

Picture:

Procedures:

1. Turn on the pH meter by pressing the ON switch on the meter. After turning on the pH meter the MEAS annunciator and ATC indicator will appear on the LCD.
2. Then wash the electrodes with distilled water.
3. Maintain the sample's temperature at 25 degrees centigrade.
4. After that, immerse the electrodes within the sample and stir it to create a homogenous sample. Make sure the tip of the electrode is completed dipped into the sample.
5. Wait until the reading becomes stable.
6. When the reading is stabilized the READY indicator will be activated. After that freeze the reading by pressing on the HOLD key and then press ENTER key to save it.
7. Now record the pH and Temperature value.
8. Finally, wash the electrodes with distilled water and store them with the buffer solution.

16- Anton Paar Ball Mill BM500

Objectives:

- The main purpose of milling (as part of sample preparation) is the reduction of the sample size to receive a homogeneous and defined size distribution for subsequent analytical steps.

Picture:

Procedures:

1. The Ball Mill BM500 is an easy-to-operate instrument which does not need special user training. 2.Only one rotary knob enables all required settings for the subsequent milling procedure.
2. By pushing and rotating the rotary knob frequency and time are set. The Ball Mill BM500 can be operated in simultaneous mode.
3. Two jar holders can be filled with jars and samples in parallel.
4. This is beneficial if there is the need for a higher sample amount at once or for a backup sample for safety reasons.
5. The milling process is very quick and reproducible. Milling times between 5 seconds to 99 minutes can be set whereupon the necessary time depends on the characteristics of the original material and the required final fineness.
6. For samples containing volatile components or for soft samples milling under cryogenic conditions might be necessary. The Ball Mill BM500 can be operated under cryogenic conditions by freezing the jars with liquid nitrogen.
7. WARNING: When working with liquid nitrogen please consider the specific safety precautions.

17- Agilent 7820A Gas Chromatograph

Objectives:

- Chromatography is the separation of a mixture of compounds into individual components.

Picture:

Procedures:

Successful operation begins with a properly installed and maintained GC. The utility requirements for gases, power supply, venting of hazardous chemicals, and required operational clearances around the GC.

1. Check gas source pressures. For required pressures, see the Site Preparation Guide.
2. Turn on the carrier and detector gases at their sources and open the local shutoff valves.
3. Turn on the GC power. Wait for Power on successful to be displayed.
4. If removed, install the column.
5. Check that the column fittings are leak free.
6. Load the analytical method.
7. Wait for the detector(s) to stabilize before acquiring data. The time required for the detector to reach a stable condition depends on whether the detector was turned off or its temperature was reduced while the detector remained powered.

18- LG Microwave Oven

Objectives:

- Microwave ovens are used for heating and defrosting in laboratories.

Picture:

Procedures:

1. Connect to Ac
2. Adjust time and power
3. Start.

تابع: أجهزة المختبرات في قسم الكيمياء

Laboratory Equipment in Department of Chemistry

2- محتويات المختبر البحثي (206) من التجارب

2- Equipment of Research Lab (207)

1- Jenway7305 Spectrophotometer

Objectives:

- The 7305 spectrophotometers are suited to a wide range of applications in education, quality control, environmental and clinical analysis.
- The 7305 is a UV/Visible spectrophotometer with a wavelength range from 198nm to 1000nm. model feature measurement modes for absorbance, % transmittance and concentration.
- This instrument use icon driven software and has an improved navigation system for easy and intuitive usability.

Picture:

Procedures:

Theory and Practice of Spectroscopy Measurements

UV- spectroscopy is the measurement of the absorbance of light at a specific wavelength in a sample. This is used to identify the presence and concentration of molecular entities within the sample.

Spectroscopy Measurement

There are four main components of a spectrophotometer. These are a light source to emit a high and constant amount of energy over the full wavelength range; a method for separating the light into discreet wavelengths; a sample holder and a light detector. The light from the pre-focused tungsten halogen (7300) or pre-aligned xenon (7305) lamp is

focused onto the grating, with 1200 lines per millimeter, which separates the light into discreet wavelengths. The diffracted spectrum of light then passes through a further slit and lens arrangement before passing through the sample in the sample chamber from left to right. The light which is not absorbed by the sample is transmitted through a collecting lens and onto the signal detector. The photo-diode detector used is mounted directly onto the detector PCB and is used to calculate the % transmittance. The result is displayed either as % transmittance or absorbance on the instrument display.

Good Practice Guidelines

1. For optimum performance all spectrophotometers should be sited in a clean, dry, dust free atmosphere. When in use ambient temperature and light levels should remain as constant as possible.
2. If required adherence to Standard Operating Procedures (SOP) and Good Laboratory Practice (GLP) should be monitored with regular calibration checks and a suitable Quality Control (QC) program.
3. The sample chamber lid must be fully closed during measurement and before any readings are recorded or printed.
4. The correct selection of sample containers is imperative for accurate and reproducible results:
    a) Check that the material of the sample container is compatible with the wavelengths to be used for measurement. In general glass can only be used down to 360nm or 320nm depending on quality. Standard plastic cuvettes can be used down to 320nm. Special UV versions can be used down to 260nm. Below this level quartz cuvettes must be used.
    b) Plastic disposable cuvettes should only be used ONCE.
    c) Glass cuvettes should be thoroughly cleaned after use. Discard when scratches become evident on optical surfaces.
    d) Care should be taken when selecting semi-micro or micro cuvettes. The cuvette window on the inner chamber (the area filled with sample) must be wider than the aperture in the sample holder or light will reach the detector without passing through the sample.
    e) Glass test tubes and other sample tubes should be used with care. Where possible, matched tubes should be used and any index mark set to the correct position before measurements are made.
    f) Ensure any sample containers used are compatible with the constituents of both the samples and standards they are to hold. Plastic cuvettes are not compatible with organic solvents.

g) All sample containers must be handled with care; by the top, bottom and non-optical surfaces only. Any finger marks evident must be removed by a suitable cleaning process.

h) Flow-through cuvettes must be selected with care and consideration for the sample type, sample volume, pumping system, rinse, sample and waste handling to be used.

5. Samples and standards should not be stored in open cuvettes or sample containers as evaporation will change the value and lead to staining of the walls which may be irreversible.
6. Samples should be allowed to equilibrate to ambient temperature before measurement (unless a suitable temperature-controlled sample holder is in use). Temperature change during measurement may cause air bubbles to form on the walls of the sample holder. This is a common cause of drift during measurement.
7. In the preparation of samples and standards high grade borosilicate glass and AR grade chemicals and reagents must be used. Good quality deionized water or other suitable solvents must be used for dissolving or diluting samples, chemicals and reagents.
8. All measurements require calibration to a blank, for maximum accuracy this should be prepared with care using the same deionized water or solvent used for dissolving or diluting the sample. Where reagents are added to the sample to produce a color proportional to its concentration a 'sample based' blank should be used. In this case the blank should consist of all reagents or chemicals to be used, except the sample which will produce the color to be measured.
9. Deviations from the Beer-Lambert Law may occur at high and low concentrations giving non-linear response during sample concentration measurements. For all new methods a linear range should be defined by the preparation of a calibration curve.
10. Cuvettes and sample holders must be filled to a minimum level which covers the light path. All Jenway spectrophotometers have a beam height of 15mm.
11. The instrument must be calibrated to zero absorbance/100% transmittance prior to taking readings.

2- FT-IR Thermo Nicolet iS5 TR

Objectives:

- Thermo Scientific Nicolet iS5 TR spectrometer ideal for industrial applications – ruggedness, humidity resistance and simplicity – make it equally suited for the teaching laboratory.
- One additional requirement, met by the Nicolet iS5 TR spectrometer, is the need for high spectral resolution for gas analysis in the physical chemistry laboratory.

Picture:

Procedures:

1. Studies of gas phase spectra in physical chemistry laboratories represent the largest use of high-resolution iS5 TR spectroscopy in the educational teaching environment. By far, the most common experiment is the observation of vibrational-rotational fine structure of the linear hydrogen chloride molecule.
2. In this experiment the infrared spectrum of hydrogen chloride gas (HCl) is collected with the main objective to determine molecular bond length. The spectrum of HCl also exhibits splitting of 35Cl and 37Cl isotopes due to the different masses of the isotopes. Studies may also extend to a comparison of hydrogen chloride and deuterium chloride where 1H versus 2H (deuterium) shows the isotope effect with a much greater magnitude.
3. Spectra of HCl gas were collected in the Nicolet iS5 TR spectrometer using a 5 cm gas cell with and without an aperture card. When used, a 6 mm aperture card was placed in the sample

compartment directly adjacent to the gas cell just prior to where the incoming infrared light beam enters the cell.

4. The HCl spectrum is quite simple, with only one axis of rotation (actually two, but they are degenerate). The ammonia molecule provides a far more complex set of peaks with multiple rotation axes exhibiting different moments of inertia. Also, owing to the NH3 trigonal pyramid molecular structure, it has an inversion doubling vibration, causing two "Q" branches to appear. 4 The multiple vibrational-rotational bands around the different axes result in the infrared spectrum of ammonia.
5. The spectrum was collected in the Nicolet iS5 TR spectrometer using a 5 cm gas cell with a 6 mm aperture card. As in the HCl experiment, the ability to detect and measure the two Q-branches resulting from the inversion doubling does not require the use of an aperture card. However, in the case of the ammonia spectrum the benefit of the higher resolution obtained by using an aperture card in the Nicolet iS5 TR spectrometer is more evident, since the many narrow bands seen progressing on both sides of the large 967/931 cm-1 doublet would otherwise be obscured and overlapped.
6. This is a phenomenally interesting gas phase spectrum with exciting educational potential, coupling a very simple infrared measurement with a quantum mechanical description covering many aspects of molecular vibration and rotation.
7. Further examples of experiments that provide interesting studies of molecular vibration and rotation include:

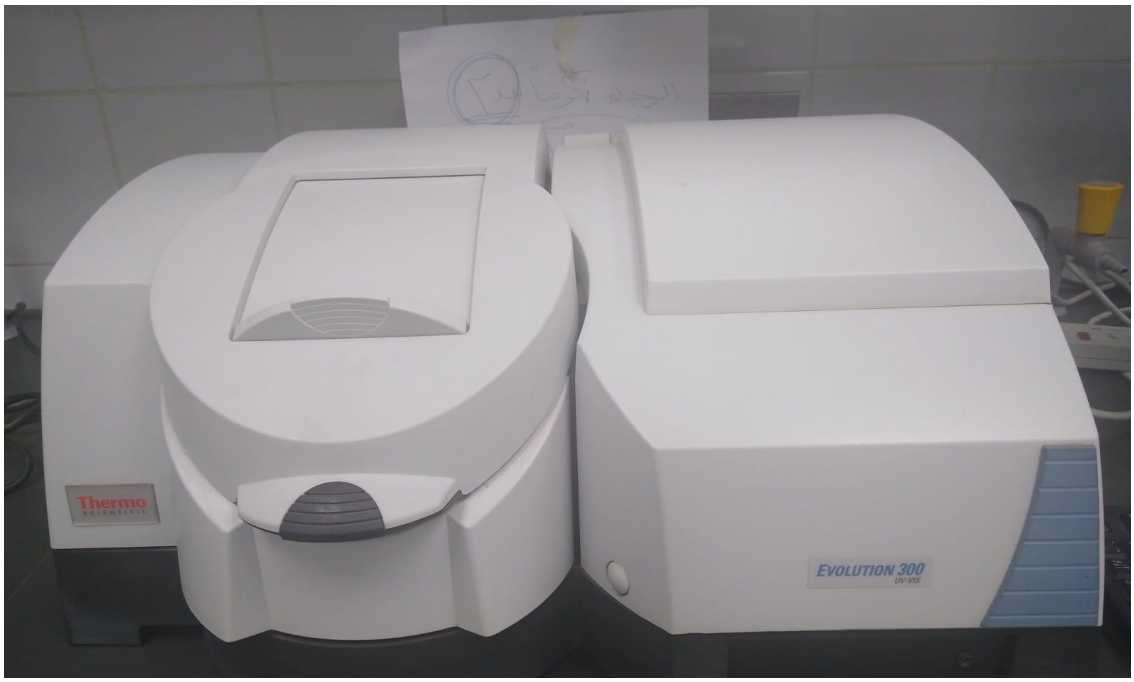
- H2O and D2O, multiple sets of peaks
- CO, at slightly lower frequency than CO2
- CH4, which displays P, Q and R branches

3- Evolution 300 UV-VIS Spectrophotometer

Objectives:

- UV-Vis Spectroscopy is an analytical technique for the quantitative determination of the absorption of analytes in the ultraviolet-visible spectral region.
- Used in the fields of analytical chemistry, biochemistry and industrial
- The Evolution 300 UV-Vis Spectrophotometer has a double beam optical design with a xenon flash lamp light source that has a spectral range of 190-1100 nm

Picture:



Procedures:

1. Turn on the computer
2. Turn on (UV-VIS) instrument,
3. Open the UV- VIS software
4. Open the Setup management
5. Select the variables (Mode, Rang, Speed
6. Applied your method for analysis
7. When finished, start shut down the instrument as following:
8. Close the software
9. Close the instrument
10. Shut down the computer
11. Shut down all electrical sources

4- MOV-112S Sterilizer (Electric Ovens Dry Heat Sterilizers)

Objectives:

- The function of the sterilizer is to kill unwanted microorganisms on instruments, in cultures, and even in liquids, because the presence of foreign microbes might negatively affect the outcome of a test, or the purity of a sample.

Picture

Procedures:

1. Accurate temperature and time — essential for dry heat sterilization.
2. Ambient temperature +5˚C to 200˚C
3. 3MOV Series models provide many advantages:
   a. PID precision temperature control is adjustable to within ±1˚C.
   b. Forced air circulation keeps cabinet temperatures even to within ±4˚C.
   c. The new microprocessor timer helps correct sterilizing time.

تابع: أجهزة المختبرات في قسم الكيمياء

Laboratory Equipment in Department of Chemistry

3- محتويات مختبر الكيمياء العامة 1 (103) من التجارب

3-Equipment of General Chemistry I Lab (103)

1- Ice Maker

Objectives:

- Laboratory ice makers are a convenient way to ensure the ice is there when it is needed.
- A laboratory ice maker can be useful in chemistry labs.
- The icemaker has a water pump, which draws water from a collection sump and pours it over the chilled ice tray.
- As the water flows over the tray, it gradually freezes, building up ice cubes in the well of the tray. When you freeze water layer by layer this way, it forms clear ice.

Picture:

Procedures:

4. Verify the water supply to the equipment and switch on the main power
5. The equipment shall start after 3 minutes delay by blinking the red color LED at TOO HI COND.
6. The first piece of ice flake shall drop into a storage bin within 3 minutes
7. When the ice bin is full, the BIN FULL icon shall glow and ice formation shall be stopped automatically.

2- Refrigerator

Objectives:

- The refrigerator in a laboratory is one of the most important equipment.
- Its function is to maintain, in a controlled environment (refrigerated space), various fluids and substances, so that they are kept in good condition the lower the temperature, the lower chemical activity.

Picture:

Procedures:

1. With the refrigerator and freezer empty, connect the power supply cord to the dedicated outlet having an appropriate rating, and turn on the power switch. The blinking refrigerator temperature is displayed on the temperature display and the alarm indicator blinks. (This is caused by high temperature alarm function and not a malfunction.) 5 minutes is needed to re-start the compressor. Keep 5 minutes before turning on the power switch when the power switch is turned off.

2. The refrigerator temperature is set to 5 0C and the freezer temperature is set to -300C at the factory. Set the temperature of refrigerator or freezer when other temperature setting is desired. The storage items may be frozen practically when the refrigerator temperature is set to 30C or lower.
3. On the temperature display check the refrigerator temperature reaches 5 0C and the freezer temperature reaches -30 0C, or reaches the desired temperature
4. Check the lamp in the refrigerator is on by opening the refrigerator door.
5. Begin slowly placing items into the refrigerator and freezer to minimize the temperature rise. Do not block the air intake vent or air exhaust vent in the refrigerator. Arrange the storage items with adequate space to keep the air circulation. Too much storage items in the refrigerator makes the temperature around the air exhaust vent at -2 °C when the refrigerator temperature is set to 2 °C. It is recommended to set the refrigerator temperature to 4 °C or 5 °C when the items that should not be frozen.

3- Water bath

Objectives:

- A water bath is a laboratory equipment that is used to incubate samples at a constant temperature over a long period of time.
- Water bath is a preferred heat source for heating flammable chemicals instead of an open flame to prevent ignition.

Picture:

Procedures:

1. Ensure the surrounding area is dry and clean.
2. Connect the power supply.
3. Make sure the water is at the desired level and high enough to cover the heating element.
4. Switch the water bath on.
5. Set the temperature controls to the desired temperature and wait until the thermostat shows it has heated enough.
6. When heating, insert your samples carefully. The temperature sensor will maintain the temperature during use.
7. After use, remove the samples and switch off the water bath.

4- Balance

Objectives:

- Balances are precision measuring instruments used in quantitative chemical analysis, to determine the mass of solid objects, liquids, powders and granular substances.

Picture:

Procedures:

1. Place the weighing container on the balance pan and close the doors.
2. Tare the container by briefly pressing the control bar. The readout will read zero with the container sitting on the pan. This allows the mass of your sample to be read directly.
3. Add the substance to be weighed. Be careful not to spill chemicals on the balance. If need be, you can remove the container from the weighing chamber while you add the sample provided that noone presses the control bar before you weigh your sample.

4. With the sample and its container sitting on the pan, close the chamber doors and read the display to find the mass of your sample.

5- Fume Hood

Objectives:

- The purpose of a chemical fume hood is to prevent the release of hazardous substances into the general laboratory space by controlling and then exhausting hazardous and/or odorous chemicals.

Picture:

Procedures:

Preparing the Fume Hood for Work

1. Check alarms and monitors to indicate proper operation
2. Observe noise and air movement to indicate proper operation
3. Close all windows and doors in the laboratory
4. Set manual controller, if the fume hood has one, to “maximum” for the 100 feet per

minute (fpm) position

5. Set sash height indicated by the sticker and arrow; when possible, set the sash at the lowest position

WARNING: If the alarm sounds or the monitor lights indicate low flow:

1. Stop working
2. Turn off the equipment
3. Lower the sash
4. Notify all individuals in the lab to leave the area if highly toxic or volatile chemicals are being used

NOTE: Although it is not the most scientific, a simple way to tell if the fume hood is working is to tape a piece of tissue to the bottom of the sash. This will act as a wind sock to indicate the direction of air flow. When the hood is operating properly, the tissue should be pulled into the fume hood.

Working in the Fume Hood

1. Monitor the fume hood when performing ongoing or reactive experiments
2. Keep pedestrian traffic in front of the hood to a minimum
3. Avoid rapid or excessive movement in front of the fume hood
4. Place:
5. Experimental materials and equipment at least 6 inches back from the face
6. Large objects two to three inches above the work surface
7. Keep rear baffle openings clear
8. Keep papers, paper towels, work surface diapers, vials, and other small objects from being drawn into the hood's ventilation system.

تابع: أجهزة المختبرات في قسم الكيمياء

Laboratory Equipment in Department of Chemistry

4- محتويات مختبر الكيمياء العامة 2 (103) من التجارب

4- Equipment of General Chemistry II Lab (104)

1- Balance (Model: S1002)

Objectives:

- Balances are precision measuring instruments used in quantitative chemical analysis, to determine the mass of solid objects, liquids, powders and granular substances.

Picture:

Procedures:

1. After having connected the balance to AC outlet, it will perform an internal circuits test, after that the balance will set itself in stand-by mode.

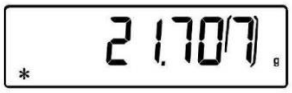
2. **From "STAND BY" mode:**

a) Press ON/OFF button to bring balance to work conditions.

b) Press again ON/OFF button to return to "STAND BY" condition.

3. **Simple weighing:**

   Load the sample to weigh on the pan and read the value on display as soon as the stability symbol ⁎ (star) appears.



4. **Calibration:**

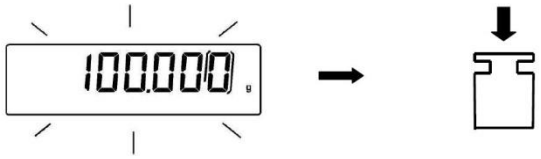
   Electronic balances take mass measurements making use of gravity (g). Difference of latitude in geographic areas and altitude will vary gravity acceleration value (g). Therefore, for accurate measurements, the balance must be adjusted to the local environment. This adjustment is accomplished by calibration function.

5. **External calibration balances:**

•Calibration is accomplished by pressing CAL button.

•Press CAL button when pan is empty, dashes are displayed on the display.

•When calibration weight value starts to flash, load the weight on the pan.

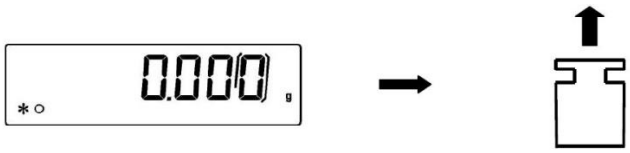


•

•The display will stop flashing, indicating calibration weight value.

•Once the calibration is effected will be shown the value of the calibrated weight and the current unit of measure.

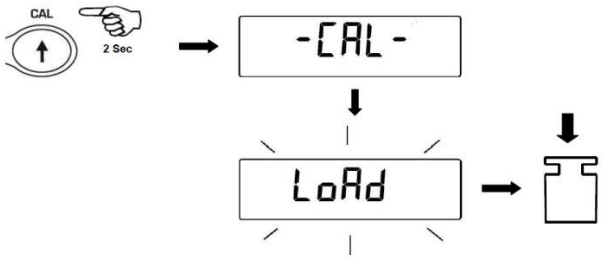
•Unload calibration weight from the pan. The balance is ready for weighing operations.



NOTE: if there is interference during calibration process, an error message will be displayed.

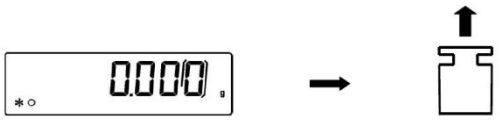
6. **Moreover, it is possible to calibrate the balance with a calibration weight higher than the one set by default:**

1. Press and keep CAL button pressed with empty pan until the acoustic alarm stops, then release the button. On display it will be visualized the string "CAL", followed by flashing string "LOAD".



2. Load on the pan a weight equal higher or lower than default calibration weight; the balance will recognize it as valid weight if equal or higher than calibration weight as long as it is a whole number in comparison with the most meaningful digit of calibration weight.
3. e.g.: if calibration weight is 200g, it will be possible to calibrate the balance with values from 100g 200g, 300g, 400g up to the highest limit of balance weighing range.

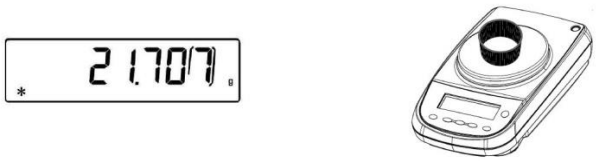
4. The message “LOAD” on display will stop flashing. Once calibration has been effected, the value of calibrated weight will be displayed.
5. Unload calibration weight. The balance is ready for weighing operations.



NOTE: if there is an interference during calibration process, an error message will be displayed.

7. Tare function:

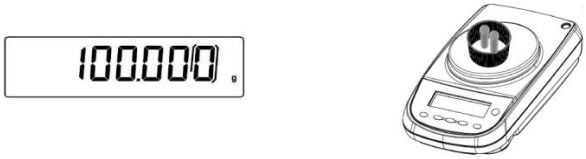
1. Load the container on the pan. The display will show the weight.



2. Press O/T button. “O-t” string will be displayed.

3. After reaching stability, the value “0.000” will be displayed. If the stability is not reached (due to air flows or vibrations or other disturbs) the dashes will remain displayed.

4. Load the objects to weigh in the container. Read net weight value on display.



2- Water Bath (Model: LWB-211A)

Objectives:

- A water bath is laboratory equipment that is used to incubate samples at a constant temperature over a long period of time. Water bath is a preferred heat source for heating flammable chemicals instead of an open flame to prevent ignition.

Picture:

Procedures:

1. Ensure the surrounding area is dry and clean.
2. Make sure that the plug is plugged into the electrical socket.
3. Make sure the water is at the desired level and high enough to cover the heating element.
4. Switch the water bath on.
5. Set the temperature controls to the desired temperature and wait until the thermostat shows it has heated enough.
6. When heating, insert your samples carefully. The temperature sensor will maintain the temperature during use.
7. After use, remove the samples and switch off the water bath.

3-Hotplate Stirrer

Objectives:

- Used to mix aqueous solutions of a large variety of reactions with heating.

Picture:

Procedures:

1. Make sure that the plug is plugged into the electrical socket.
2. Rotate the heat wheel clockwise until it reaches the right temperature.
3. Rotate the stir wheel clockwise until it reaches the right range.

تابع: أجهزة المختبرات في قسم الكيمياء

Laboratory Equipment in Department of Chemistry

5- محتويات مختبر الكيمياء الغير عضوية (102) من التجارب

5-Equipment of Inorganic Chemistry Lab (102)

1- Water bath

Objectives:

- Water bath is laboratory equipment made from a container filled with heated water. It is used to incubate samples in water at a constant temperature over a long period of time.
- Most water baths have a digital or an analogue interface to allow users to set a desired temperature, but some water baths have their temperature controlled by a current passing through a reader.

Picture:

Procedures:

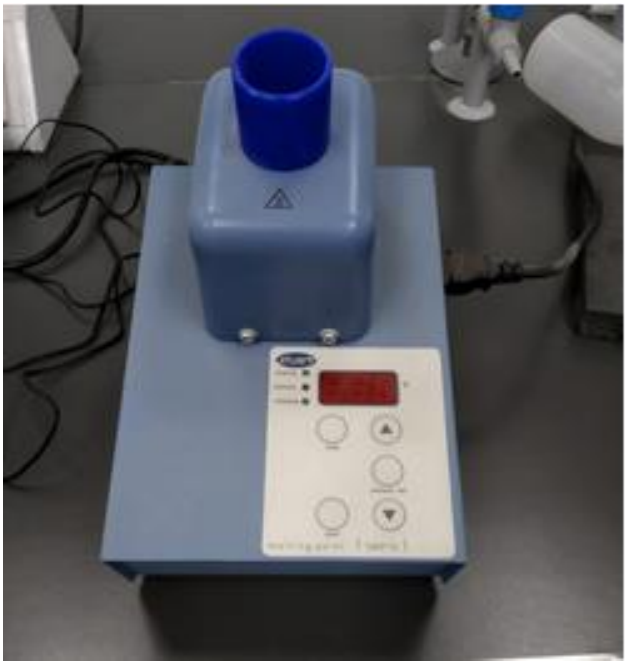
1. Fill the trough with dist. Water (to prevent salt from leaching) until it completely covers the heater and sensor.
2. Connect the plug to the mains.
3. Turn on the power key.
4. The temperature safety switch is set, preferably slightly higher than the required temperature.
5. Sets the running time.
6. It is necessary to check the discharge level constantly, to turn off the device after use, and to unplug the plug.

2- Melting point

Objectives:

- This device is usually, used in chemistry and physics labs to measure melting points of certain solid.

Picture:



Procedures:

1. A small amount of solid material is taken by the capillary tube, and the solid substance is lowered to the bottom of the capillary tube.
2. The capillary tube shall be fixed in the place designated for this.
3. Take the reading of the device.
4. If the difference between the temperatures taken is 1-2 degrees Celsius, that is, the solid material is pure and free of impurities.
5. And if the difference is 3-4 degrees Celsius, this means that the material is impure and has impurities.
6. Take a small amount, should be dry, heat gradually.

3- Vacuum pump

Objectives:

- Vacuum pumps are combined with chambers and operational procedures into a wide variety of vacuum systems.
- vacuum is used for many standard appli- cations in the preparation and processing of samples.
- Design features:
- Lightweight, compact and portable
- Covers most standard applications
- Economically priced but with high performance
- Quick and simple to use with stylish design

Picture:

Procedures:

1. Be sure to only use oil meant for vacuum pumps. Using other mechanical oils could impact the quality and performance of your vacuum.
2. Make sure the gauges and gauge hoses are connected tightly. Loose seals can compromise your vacuum.
3. In your car, your high-pressure port will generally be physically higher than the low-pressure port.

4. If you are trying to start the pump in cold weather, open the intake ports until the pump reaches normal running speed.
5. Shut off the vacuum pump. When you are satisfied with how long your system held the vacuum, shut the pump off using the same switch mechanism you used to turn it on. Let your vacuum disengage completely before you disconnect the system.

4- Magnetic susceptibility balance

Objectives:

- Analytical applications in the research laboratory and industrial quality control. Both balances are exclusively manufactured by Sherwood Scientific in Cambridge, UK.
- Magnetic Susceptibility is defined as "The ratio of the intensity of magnetism induced in a substance to the magnetizing force or intensity of field to which it is subject."
- Based on their magnetic properties, all substances can be classified into one of three groups:
- Those attracted by a strong magnetic field; known as paramagnetic,
- Those repelled; designated diamagnetic and finally, the most recognized class,
- Ferromagnetic: unique in their ability to retain their own magnetic field. Ferromagnets can retain a permanent magnetic field since their free electrons are in close proximity and remain aligned even after the external magnetic field is removed. Unlike the ferromagnets, the magnetic properties of the diamagnetic or paramagnetic materials may only be observed and measured when they are held within a magnetic field applied externally.

Picture:

Procedures:

Instrument Set-up 1.

1. Be sure that there are no ferromagnetic or metallic materials near the balance and that the balance is level.
2. Turn the Range knob to the x1 setting and allow the balance to warm up for at least 10 minutes before it is used. Be sure that the balance reads close to 000 when the Zero knob is set to the center of its range. The Zero knob is a high-precision ten-turn potentiometer and can be set to the middle of its range by gently turning it either clockwise or counterclockwise until it stops and then turning it in the opposite direction for five turns.
3. Adjust the Zero knob so that the display reads 000. When this cannot be done, check that there are no metallic objects nearby, that there are no air currents blowing on the balance and that it is level. If these steps do not fix the problem, the balance will need to be re-zeroed per the instructions found in the balance's user's manual.
4. Determine the calibration constant for the balance, C balance, by inserting the calibration tube into the balance's tube guide and recording the instrument reading, R. The calibration constant can then be calculated from the following equation where C st and R0 are printed in the label attached to the calibration tube (the current calibration tube has C st = 1151 and R0 = -33).

Instrument Shutdown 1.

1. When no additional measurements will be made, remove the sample and turn the Range knob to Off.
2. Carefully remove the sample from the tube. You may need to gently tap it on a wooden surface (protected by a weigh boat or weigh paper to catch the dislodged material). Do not damage the sample tube's rim and do not use solvents or acids to remove any recalcitrant material, except under faculty supervision. Do NOT immerse a sample tube in any solvent, acid bath or base bath as this will damage the seal near the tube's top. If a fine coating of sample remains on the inside of the tube, it may be carefully washed out with small rinses of methanol.
3. The solid sample may be kept for additional measurements or other uses. The methanol rinses should be collected and properly disposed of
4. Invert the sample tube in a beaker with a Kim-Wipe layering the bottom. Allow the tube to air dry, then return it to the storage box and return the box and its contents to its storage location in MG 1026.

5- Ice Maker

Objectives:

- To make ice fast with the whole process takes only around 180 seconds.
- Standard condition: Dry ball temperature is 33℃ and water inlet temperature is 20℃. On-time

Picture:

Procedures:

1. The ice maker pumps water from a collection sump and slowly pours it over the ice tray.
2. This gradually freezes the water in layers making clear ice.
3. If you freeze the water all at once it makes cloudy ice.
4. After several minutes the ice maker activates a solenoid valve that is connected to the heat exchanging pipes.

6- Oven

Objectives:

- Laboratory ovens, also referred to as laboratory furnaces, are used to sterilize biohazard waste, dissecting instruments or media/reagents for aseptic assays.
- They are also used for drying, heating, testing environmental stresses, such as changes in temperature, light and humidity.

Picture:

Procedures:

1. Ensure that the oven is not in operation by another user.
2. If the oven is not on, but has samples in them, ensure that nobody has left a note stating their
3. intentions and then empty the oven. Be sure to leave a note if you have any concerns and to let someone know when you will be done with the oven.
4. Never grease the door seal. It will cause the seal to slide and ruin the sealing capability of the Oven

7-Balance

Objectives:

- Accurate and reliable analytical balances and micro-analytical balances for the precise weighing of small, valuable and samples.

Picture:

Procedures:

1. The samples are weighed using an appropriate weighing container weighing paper/beaker
2. Ensure the analytical balance is set to the proper units grams (g), milligrams (mg)
3. Place the weighing container on the balance pan and close the doors.
4. Tare the container (Press 'T'). The readout will read zero with the container sitting on
5. the pan. This allows the mass of your sample to be read directly.
6. Add the sample to the container; avoid spilling on to the balance. With the sample inside the vessel, close the balance doors and read the display when the mass stabilizes.

تابع: أجهزة المختبرات في قسم الكيمياء

Laboratory Equipment in Department of Chemistry

6- محتويات مختبر الكيمياء الغير عضوية (106) من التجارب

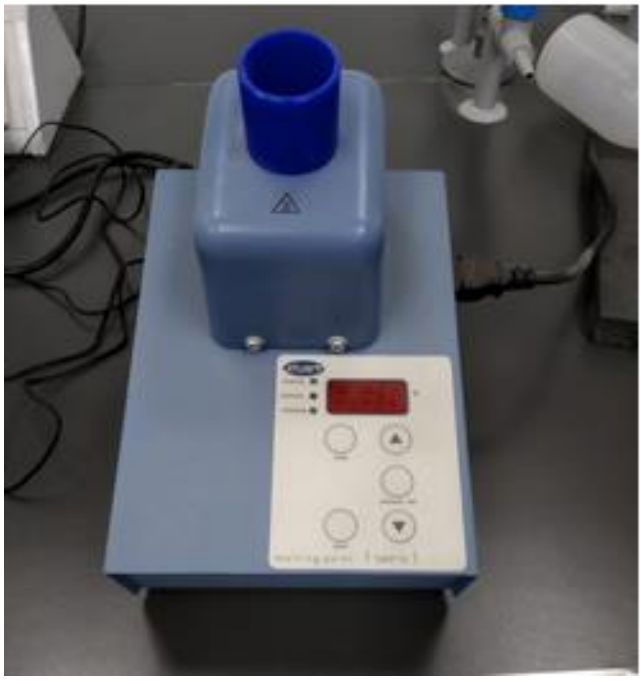
6-Equipment of Organic Chemistry I Lab (106)

1- Melting point

Objectives:

- This device is usually, used in chemistry and physics labs to measure melting points of certain solid.

Picture:



Procedures:

1. A small amount of solid material is taken by the capillary tube, and the solid substance is lowered to the bottom of the capillary tube.
2. The capillary tube shall be fixed in the place designated for this.
3. Take the reading of the device.
4. If the difference between the temperatures taken is 1-2 degrees Celsius, that is, the solid material is pure and free of impurities.
5. And if the difference is 3-4 degrees Celsius, this means that the material is impure and has impurities.
6. Take a small amount, should be dry, heat gradually.

تابع: أجهزة المختبرات في قسم الكيمياء

Laboratory Equipment in Department of Chemistry

7- محتويات مختبر الكيمياء عضوية 2 (107) من التجارب

7- Equipment of Organic Chemistry II Lab (107)

1- Water Bath

Objectives:

- A reservoir containing an electric heater that raises the temperature of the water to different degrees as needed.
- In addition, it is used for heating combustible materials, which are damaged by the direct heat.

Pictures:

Procedures:

1. A small amount of solid material is taken by the capillary tube, and the solid substance is lowered to the bottom of the capillary tube.
2. The capillary tube shall be fixed in the place designated for this.
3. Take the reading of the device.
4. If the difference between the temperatures taken is 1-2 degrees Celsius, that is, the solid material is pure and free of impurities.
5. And if the difference is 3-4 degrees Celsius, this means that the material is impure and has impurities.
6. Take a small amount, should be dry, heat gradually.

2- Rotary Evaporator

Objectives:

- This device is used, in the chemistry labs to remove various solvents mixed samples efficiently and kindness by evaporation under reduced pressure.

Pictures:

Procedures:

1. The substance to be evaporated is placed in the evaporation flask and dipped in the water bath.
2. The pump is running during the pressure difference.
3. Conduct the water to condenser.
4. Turn on the rotation of the beaker inside the heater.
5. Collect the steam produced in the receiving flask.
6. There are risks associated with simple operations such as evaporation of etheric cellulose containing peroxides. This may also occur when certain unstable compounds such as organic azides are dried.

3- pH meter

Objectives:

- This device is an electric device used to measure hydrogen-ion activity (acidity or alkalinity) in a solution.
- widely used in the following industries: Food & beverage, Pharmaceutical, Oil & gas, Agriculture and Water treatment plant

Picture:

Procedures:

1. A pH meter consists of three different parts: an internal electrode, a reference electrode, and a high input impedance meter. Glass probe often contains two electrodes – an internal electrode and a reference electrode. The internal electrode is a silver wire covered with Silver Chloride (Ag/AgCl wire), and the reference electrode is often made up of the same materials. Inside the probe is a buffer solution at a pH of 7. Measured pH is the difference in [H+] between the reference buffer inside the probe and the sample solution.
2. Turn on the pH meter by pressing the ON switch on the meter. After turning on the pH meter the MEAS annunciator and ATC indicator will appear on the LCD.
3. Then wash the electrodes with distilled water.
4. Maintain the sample's temperature at 25 degrees centigrade.
5. After that, immerse the electrodes within the sample and stir it to create a homogenous

sample. Make sure the tip of the electrode is completed dipped into the sample.

6. Wait until the reading becomes stable.
7. When the reading is stabilized the READY indicator will be activated. After that freeze the reading by pressing on the HOLD key and then press ENTER key to save it.
8. Now record the pH and Temperature value.
9. Finally, wash the electrodes with distilled water and store them with the buffer solution.

4- Hotplate magnetic stirrer

Objectives:

- This device is an electric device used to stir the solution on cold or hot.
- This device is used to heating solutions that need to raise the temperature and move materials to be dissolved in a given solution. The device is a metal cylinder under a flat spin that cause the rotation of magnet pieces covered by Teflon placed in the vessel

Picture:

Procedures:

1. Ensure that the instrument is clean.
2. Connect the three-pin plug to power supply and switch on the instrument.
3. Prepare the solution as specified in specification and insert the magnet.
4. Place it on the magnetic stirrer.
5. Switch ON the magnetic stirrer.
6.

5- Balance

Objectives:

- This device is an electric device used to weigh the substances

Picture:

Procedures:

1. Make sure that the balance is kept clean.
2. Ensure that the calibration status is valid.
3. Ensure that spirit level is in the center of the circle.
4. Connect the power cable to the mains and switch 'ON'.
5. Automatically self-checking starts from "che-3" & ends with OFF.
6. Press ON/OFF key, all the display will glow.
7. Press "TARE KEY", 0.00000 mark appears on the display.
8. The stability of the reading is obtained which is indicated by an arrow mark on the left side of the display.
9. Once the stability is attained, the balance is ready for weighing.
10. Place the material to be weighed on the pan & note down the reading after the arrow mark appears on the left side of the display.
11. After completion of weighing press, "ON/OFF" key. "STAND BY" light glows.
12. Clean the balance immediately after weighing.

6- UV Lamp- UV Light Box

Objectives:

- This device commonly used for visualizing nucleic acids
- , this “box-shaped” piece of equipment contains an ultraviolet lamp.
- The clear, glass face allows the light to illuminate the gel while potentially exposing the user.
- To reduce risk of injury, most models come equipped with a shield to filter excess light.
- UV rays are commonly broken down into the following three main sections:
- UVA Lowest 315-400
- UVB Mid-High 280-315
- UVC Highest 100-280

Picture:

Procedures:

1. A UV lamp is different from a regular lamp because it's typically made of quartz instead of glass.
2. Inside, there is an inert gas mixed with mercury.
3. When the lamp is plugged in, electricity reacts with the mercury, and the lamp produces UV light.
4. The type of UV light emitted depends on the pressure inside the lamp.

تابع: أجهزة المختبرات في قسم الكيمياء

Laboratory Equipment in Department of Chemistry

8- محتويات مختبر الكيمياء التحليلية (101) من التجارب

8- Equipment of Analytical Chemistry Lab (101)

1- Thermo iCE 3500 (Atomic absorption spectrophotometer) (AAS)

Objectives:

- AAS is an analytical technique used for analysis of metals in an aqueous solution to determine how much of certain elements are in a sample.
- It uses the principle that atoms (and ions) can absorb light at a specific, unique wavelength. When this specific wavelength of light is provided, the energy (light) is absorbed by the atom

Picture:

Procedures:

1. **Sample Preparation:**

a) Sample preparation and introduction involve rendering a liquid or solid sample into a state that the instrument can process for elemental analysis. In the case of flame AAS, this involves atomizing the sample, which involves the creation of a fine mist dispersion. Afterwards, this mist is fed into a flame to break up any remaining molecular bonds. This is known as atomization. In graphite furnace AAS, the liquid sample is introduced into the cuvette directly, where it is transformed into a fine mist.

b) The sample is then exposed to a source of radiation, which typically originates from a light source. This light source has been set to defined wavelengths, and the metal atoms in the sample absorb these wavelengths (or not). When absorption occurs, the result is a light spectrum that has reduced light intensity in one or more of its areas. This reduced intensity is characteristic of a given element and helps to identify it, as well as to determine its concentration.

c) AAS takes advantage of different radiation wavelengths that are absorbed by different atoms. Atomizer and monochromator instruments are key to making the AAS device work.

d) Afterwards, the analyte is excited by different light sources and emits a mixture of wavelengths. Following dispersion of these wavelengths (including the characteristic wavelength of the analyte), the AAS instrument detector measures wavelength intensity. Because element concentration is a function of its wavelength intensity, the concentration of the target element can be determined. Also, by establishing a reference system from standards of known concentration, unknown samples can be analyzed quantitatively.

2. **Flame Atomic Absorption Spectrometry (FAAS)**

a) Flame atomic absorption spectrometry (FAAS) is a globally recognized analytical technique used for analyzing over 60 elements including sodium, potassium, calcium, magnesium, zinc, and iron. It is widely accepted in many industries, which continue to utilize the unique and specific benefits of this technology.

b) During the analysis, liquid samples are aspirated and introduced into the flame via a spray chamber, which breaks the aspirated liquid into fine droplets. The flame is typically created using air/acetylene or nitrous oxide/acetylene gases, and this results in desolation, vaporization, and atomization of the sample.

c) Hollow cathode lamps emit light that is specific to the element, and this light is directed through the flame to allow for measurement during atomization. High-performance optics and precise monochromator operation ensure that the light path is always perfectly aligned for analysis.

3. Graphite furnace atomic absorption spectrometry (GFAAS)

a) Graphite furnace atomic absorption spectrometry (GFAAS) is an established analytical technology that is used for measuring a large number of elements at parts-per-billion levels, including chromium, nickel, arsenic, lead, cadmium, copper, and manganese. Sample consumption is incredibly low, and typically only a few microliters of sample are directly injected into a graphite cuvette. Controlled electrical heating of the cuvette dries the sample and removes the matrix prior to atomization. Hollow cathode lamps provide specific elemental light output, which is directed through the center of the cuvette to enable measurement during atomization.

4. FAAS and GFAAS Solid sample preparation

b) Sample digestion process with acids.

c) Many different kinds of samples from diverse industries can be analyzed by using either FAAS and GFAAS following simple preparation procedures. The five major application areas are the environmental and clinical/pharmaceutical, food and beverage, mining/metallurgy, and petrochemical industries.

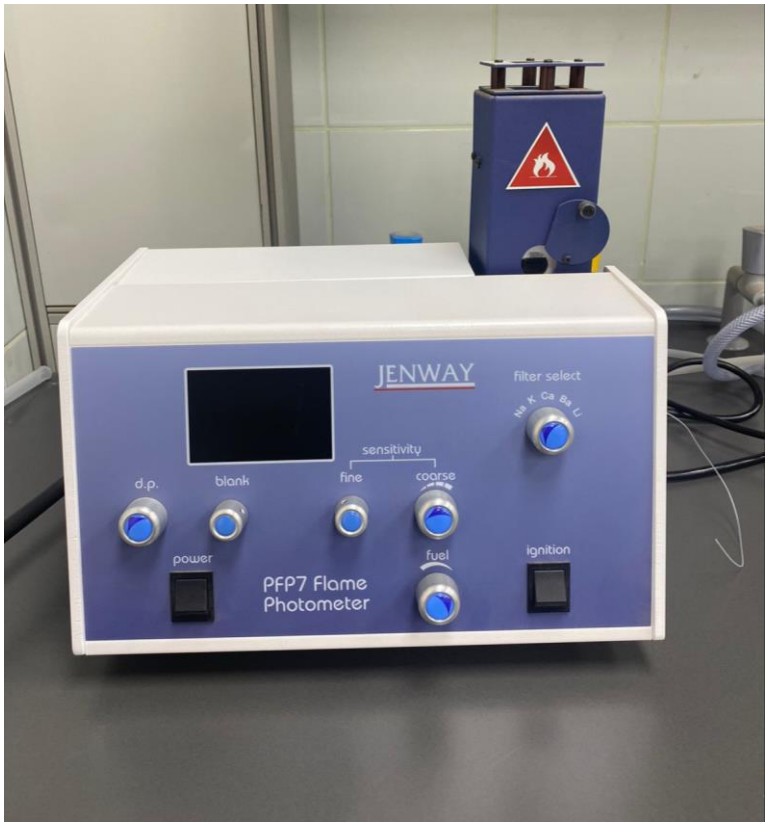
d) A typical sample preparation procedure for solid and viscous liquid samples involves digestion with a concentrated acid; for example, HNO3, HCl, or H2SO4. After dilution of the digested solutions, samples can be directly injected into flame AAS as well as graphite furnace AAS. Other sample preparation methods, including microwave and high-pressure digestion, are also used to break up samples.

2- Jenway PFP7 (Flame photometer)

Objectives:

- Flame photometer is an analytical instrument used in Analytical and clinical laboratories for determining of sodium, potassium, lithium and calcium ions

Picture:



Procedures:

1. **Principles of operation**

a) Flame photometry relies upon the fact that the compounds of the alkali and alkaline earth metals can be thermally dissociated in a flame and that some of the atoms produced will be further excited to a higher energy level. When these atoms return to the ground state they emit radiation which lies mainly in the visible region of the spectrum. Each element will emit radiation at a wavelength specific for that element.

*Note: Calcium is measured by using the calcium hydroxide band emission at 622nm as the Calcium main atomic emission occurs at 423nm.

b) Over certain ranges of concentration the intensity of the emission is directly proportional to the number of atoms returning to the ground state. This is in turn proportional to the absolute quantity of the species volatized in the flame, i.e. light emitted is proportional to

sample concentration.

c) It can be seen that if the light emitted by the element at the characteristic wavelength is isolated by an optical filter and the intensity of that light measured by a photodetector, then an electrical signal can be obtained proportional to sample concentration. Such an electrical signal can be processed and the readout obtained in a digital form.

2. A simple flame photometer consists of the following basic components:

a) The burner: a flame that can be maintained in a constant form and at a constant temperature.

b) Nebuliser and mixing chamber: a means of transporting a homogeneous solution into the flame at a steady rate.

c) Simple colour filters (interference type): a means of isolating light of the wavelength to be measured from that of extraneous emissions.

d) Photodetector: a means of measuring the intensity of radiation emitted by the flame.

3. Good practice guidelines

e) It is most important that the nebuliser, mixing chamber and burner are kept clean by carrying out the correct shutdown procedure and by periodic maintenance. If high salt solutions are aspirated, correspondingly longer periods should be spent aspirating deionised water prior to shut down.

f) It is recommended that blank and standard solutions should have a wetting agent (e.g. Triton X-1001 or Decon 90) added to promote good stability and self-cleaning. Any such wetting agent should be non-ionic and used at a concentration of less than 3ppm. It should be added to the blank, standards and samples at the same concentration.

g) Take care when preparing standards. The performance of the instrument depends upon the accuracy and purity of the calibration standards.

h) If standard solutions are required to be stored for any length of time or at an elevated temperature, a suitable mould inhibitor e.g. azide should be added. However if this contains the element to be measured (e.g. sodium) it is important that the samples also contain an equivalent amount.

i) Always sample from the top half of the sample container. The bottom half may contain sediment or particulate matter which could easily block the fine tubing used in the nebuliser.

j) Always use recommended spares. Even where an alternative part may be obviously suitable there may be good reasons for not using it.

k) Never use glass containers to store calibration standards.

3- DR 6000 UV-Vis Spectrophotometer

Objectives:

- The DR6000 is the industry's most advanced lab spectrophotometer.
- This device create a system that could fulfill any water testing needs using one spectrophotomer.
- It offers high-speed wavelength scanning across the UV and Visible Spectrum, and comes with over 250 pre-programmed methods including the most common testing methods used today

Picture:

Procedures:

This instrument is programmed to take absorbance readings of a single sample at different wavelengths or over a specific period of time and allows high speed wavelength scanning across the UV and visible spectrum.

1. **Switch on the instrument, startup process:**

a) Connect the power cable to a power socket.
b) Switch on the instrument via the power switch on the back.
c) The device automatically starts an approximately 45-second-long startup process. The display shows the logo of the manufacturer. At the end of the startup process, a startup melody is heard.

Note: Wait approximately 20 seconds before switching on again so as not to damage the electronics and mechanics of the instrument.

2. Language selection:

The DR 6000 software includes several language options. The first time the instrument is switched on, the language selection screen will be shown automatically after the startup process.

a) Select the required language.

b) Press OK to confirm the language selection. The self-check will then start automatically.

3. Change the language setting:

The device works in the selected language until the option is changed.

a) Turn the instrument on.

b) During the startup process, touch the display at any point until (approximately 45 seconds) the list for the selection of a language is shown.

c) Select the required language.

d) Press OK to confirm the language selection. The self-check will then start automatically.

4. Self-check

a) Each time the instrument is powered up, a test program begins. This procedure, which takes approximately two minutes, checks the system, lamp, filter adjustment, wavelength calibration and voltage.

b) Each checked function is marked accordingly on the display. The Main Menu is displayed when diagnostics are completed.

5. Startup:

A. Sleep mode

The instrument can be put into sleep mode.

a) Press the power save key beneath the display. The "Sleep mode" message is shown. The display will then switch off automatically.

b) Press the power save key again to switch back on. The self-check will start automatically. After that, the instrument is ready to use.

6. Power off the instrument

a) Press the power switch on the back of the instrument.

4- Jenway7305 Spectrophotometer

Objectives:

- The 7305 spectrophotometers are suited to a wide range of applications in education, quality control, environmental and clinical analysis.
- The 7305 is a UV/Visible spectrophotometer with a wavelength range from 198nm to 1000nm. model feature measurement modes for absorbance, % transmittance and concentration.
- This instrument use icon driven software and has an improved navigation system for easy and intuitive usability.

Picture:

Procedures:

1. **Theory and Practice of Spectroscopy Measurements**

   UV- spectroscopy is the measurement of the absorbance of light at a specific wavelength in a sample. This is used to identify the presence and concentration of molecular entities within the sample.

2. **Spectroscopy Measurement**

   There are four main components of a spectrophotometer. These are a light source to emit a high and constant amount of energy over the full wavelength range; a method for separating the light into discreet wavelengths; a sample holder and a light detector. The light from the pre-focused tungsten halogen (7300) or pre-aligned xenon (7305) lamp is

focused onto the grating, with 1200 lines per millimeter, which separates the light into discreet wavelengths. The diffracted spectrum of light then passes through a further slit and lens arrangement before passing through the sample in the sample chamber from left to right. The light which is not absorbed by the sample is transmitted through a collecting lens and onto the signal detector. The photo-diode detector used is mounted directly onto the detector PCB and is used to calculate the % transmittance. The result is displayed either as % transmittance or absorbance on the instrument display.

3. Good Practice Guidelines

1. For optimum performance all spectrophotometers should be sited in a clean, dry, dust free atmosphere. When in use ambient temperature and light levels should remain as constant as possible.
2. If required adherence to Standard Operating Procedures (SOP) and Good Laboratory Practice (GLP) should be monitored with regular calibration checks and a suitable Quality Control (QC) programme.
3. The sample chamber lid must be fully closed during measurement and before any readings are recorded or printed.
4. The correct selection of sample containers is imperative for accurate and reproducible results:
5. Check that the material of the sample container is compatible with the wavelengths to be used for measurement. In general glass can only be used down to 360nm or 320nm depending on quality. Standard plastic cuvettes can be used down to 320nm. Special UV versions can be used down to 260nm. Below this level quartz cuvettes must be used.
6. Plastic disposable cuvettes should only be used ONCE.
7. Glass cuvettes should be thoroughly cleaned after use. Discard when scratches become evident on optical surfaces.
8. Care should be taken when selecting semi-micro or micro cuvettes. The cuvette window on the inner chamber (the area filled with sample) must be wider than the aperture in the sample holder or light will reach the detector without passing through the sample.
9. Glass test tubes and other sample tubes should be used with care. Where possible, matched tubes should be used and any index mark set to the correct position before measurements are made.
10. Ensure any sample containers used are compatible with the constituents of both the samples and standards they are to hold. Plastic cuvettes are not compatible with organic solvents.
11. All sample containers must be handled with care; by the top, bottom and non-optical surfaces only. Any finger marks evident must be removed by a suitable cleaning process.

12. Flow-through cuvettes must be selected with care and consideration for the sample type, sample volume, pumping system, rinse, sample and waste handling to be used.
13. Samples and standards should not be stored in open cuvettes or sample containers as evaporation will change the value and lead to staining of the walls which may be irreversible.
14. Samples should be allowed to equilibrate to ambient temperature before measurement (unless a suitable temperature-controlled sample holder is in use). Temperature change during measurement may cause air bubbles to form on the walls of the sample holder. This is a common cause of drift during measurement.
15. In the preparation of samples and standards high grade borosilicate glass and AR grade chemicals and reagents must be used. Good quality deionised water or other suitable solvents must be used for dissolving or diluting samples, chemicals and reagents.
16. All measurements require calibration to a blank, for maximum accuracy this should be prepared with care using the same deionised water or solvent used for dissolving or diluting the sample. Where reagents are added to the sample to produce a colour proportional to its concentration a 'sample based' blank should be used. In this case the blank should consist of all reagents or chemicals to be used, except the sample which will produce the colour to be measured.
17. Deviations from the Beer-Lambert Law may occur at high and low concentrations giving non-linear response during sample concentration measurements. For all new methods a linear range should be defined by the preparation of a calibration curve.
18. Cuvettes and sample holders must be filled to a minimum level which covers the light path. All Jenway spectrophotometers have a beam height of 15mm.
19. The instrument must be calibrated to zero absorbance/100% transmittance prior to taking readings.

تابع: أجهزة المختبرات في قسم الكيمياء

Laboratory Equipment in Department of Chemistry

9- محتويات مختبر الكيمياء التحليلية (108) من التجارب

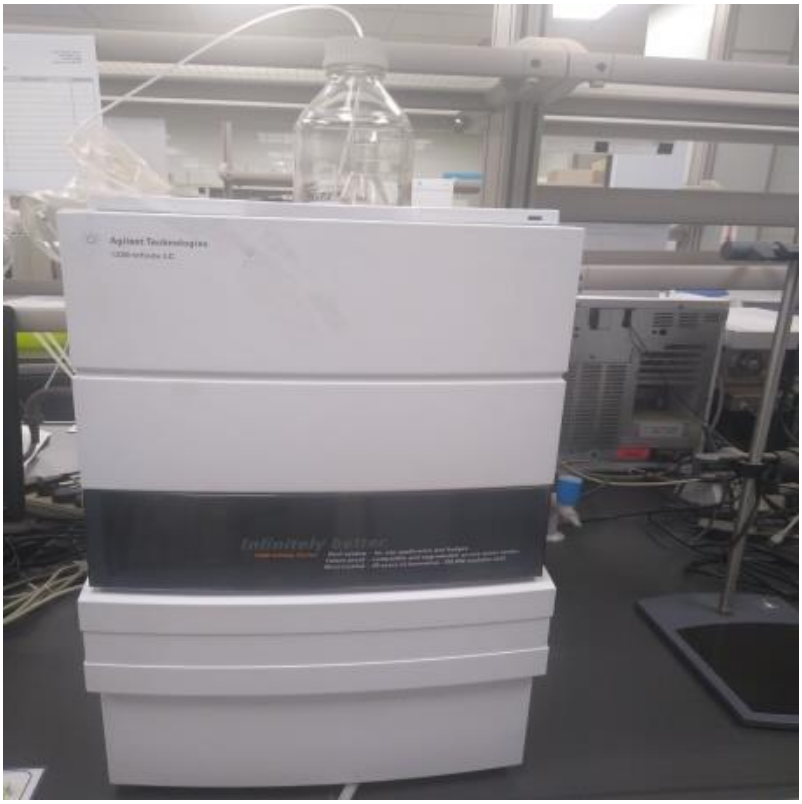
9- Equipment of Analytical Chemistry Lab (108)

1- High Performance Liquid Chromatography (HPLC)

Objectives:

- HPLC is a technique used to separate, identify, and quantify each component in a mixture
- Used in the fields of analytical chemistry, biochemistry and industrial

Picture:



Procedures:

1. Turn on the computer
2. Turn on the switch of the pump, autosampler, column compartment and detector modules
3. Wait until each modules become stabilized
4. Open the HPLC software
5. Connect each module to software
6. Applied your method for analysis
7. When finished, start shut down the instrument as following:
   - Disconnect the pump, autosampler, column compartment and detector modules
   - Close the software
   - Shut down the pump, autosampler, column compartment and detector modules
   - Shut down the computer
8. Shut down all electrical sources

2- Water Desalination Plant

Objectives:

- A desalination plant is used for: Desalination process which helps to remove salts from sea water to make it drinkable

Picture:

Procedures:

9. A desalination plant is reverse osmosis (RO) plant, where the process of reverse osmosis takes place. It is a common process to purify or desalinate contaminated water by forcing water through a membrane.
10. During this process, the contaminants are filtered out and flushed away, leaving pure, safe, and high-quality drinking water.

تابع: أجهزة المختبرات في قسم الكيمياء

Laboratory Equipment in Department of Chemistry

10- محتويات مختبر الكيمياء الفيزيائية (105) من التجارب

10- Equipment of Physical Chemistry Lab (105)

1- Jenway 6850 Spectrophotometer

Objectives:

- Use to measure the absorbance and % transmittance of liquid samples.
- To determine the λmax absorption of samples.
- Use to construct calibration curve for analytical study.

Picture:

Procedures:

1. Turn on the instrument.
2. Wait until the instrument becomes stabilized.
3. Choose your method of analysis.
4. Insert the cuvette containing the blank and the sample in their respective position.
5. Go to control display and adjust the wavelength range.
6. Click on start to take the measurement.
7. Record / save the readings.
8. Put off the instrument.

2- FT-IR-ATR Nicolet iS10

Objectives:

- Use to measure the vibrational frequency of functional groups.
- Use for vibrational assignments.
- To record IR absorption intensity in term of absorbance or % transmittance.
- To determine the structure of molecules.

Picture:

Procedures:

1. Turn on the computer system
2. Turn on the instrument.
3. Open the OMNIC software on the computer system.
4. Go to method and select “collect background”
5. After the process, a message would pop up and click on ok.
6. Go to “Edit” and select “clear”.
7. Put the sample on the ATR sampler.
8. Go to method and select “collect sample”
9. After the process, a message would pop up and click on save.
10. Go to “process” and select “smooth”, then choose the desired scale.
11. Click on a triangle icon at the top of the page to highlight noise.
12. Go to “Edit” and select “clear”
13. Go to “process” and select “smooth” % Transmittance.
14. Then click on “find peak” to assign peaks.
15. Then click on “Replace” to make the peak assignment permanent.
16. Go to file and select “Save” to save the spectrum.

3- Top load Balance

Objectives:

- To determine mass of samples using tared method.
- To determine mass of samples using weight by difference.

Picture:

Procedures:

Tared Method

1. Turn on the balance
2. Place the weighting bottle / paper on the balance.
3. Click on Tare option, to zero the reading.
4. Put the sample on the weighting bottle / paper.
5. Take the reading of the balance.

Weighing by difference

1. Turn on the balance
2. Place the weighting bottle / paper on the balance.
3. Record the weight of the weighting bottle / paper.
4. Add the sample to the weighting bottle / paper and record the total weight
5. Subtract the mass of the weighting bottle / paper from the total weight to obtain the mass of the sample.
6. Put the balance after the measurement.

4- Oven

Objectives:

- For drying of samples.
- To determine moisture content of samples.

Picture:

Procedures:

1. Turn on the oven.
2. Set the desired temperature and time.
3. Put the sample in the oven, close the door and allow the temperature to rise to the desired value.

5- Digital hotplate stirrer

Objectives:

- For agitation of reaction mixture.
- For heating of reaction mixture.

Picture:

Procedures:

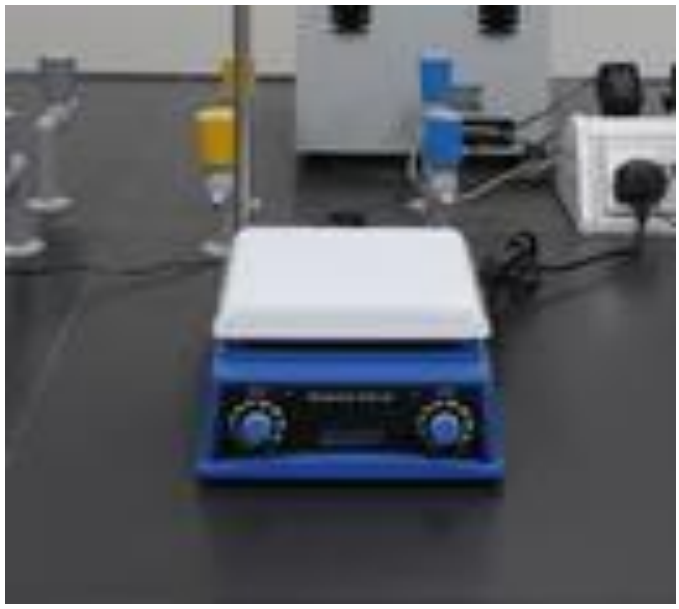
1. Turn on the stirrer.
2. Set the desired revolution rate, temperature and time.
3. Insert magnetic bar in the sample and place it on stirrer for agitation for the desired time.
4. Turn off the stirrer after the experiment.

6- Hotplate stirrer

Objectives:

- For agitation of reaction mixture.
- For heating of reaction mixture.

Picture:



Procedures:

1. Turn on the stirrer.
2. Set the desired revolution rate, temperature and time.
3. Insert magnetic bar in the sample and place it on stirrer for agitation for the desired time.
4. Turn off the stirrer after the experiment.

7- Water bath

Objectives:

- Use to incubate samples in water at constant temperature over a long period of time.

Picture:

Procedures:

1. Fill the tank with water.
2. Turn on the water bath.
3. Set the desired temperature.
4. Place the sample in the hot water for the desired period.
5. Turn off the water bath after use.

8- Ice maker machine

Objectives:

- To produce ice used for various experiments.

Picture:

Procedures:

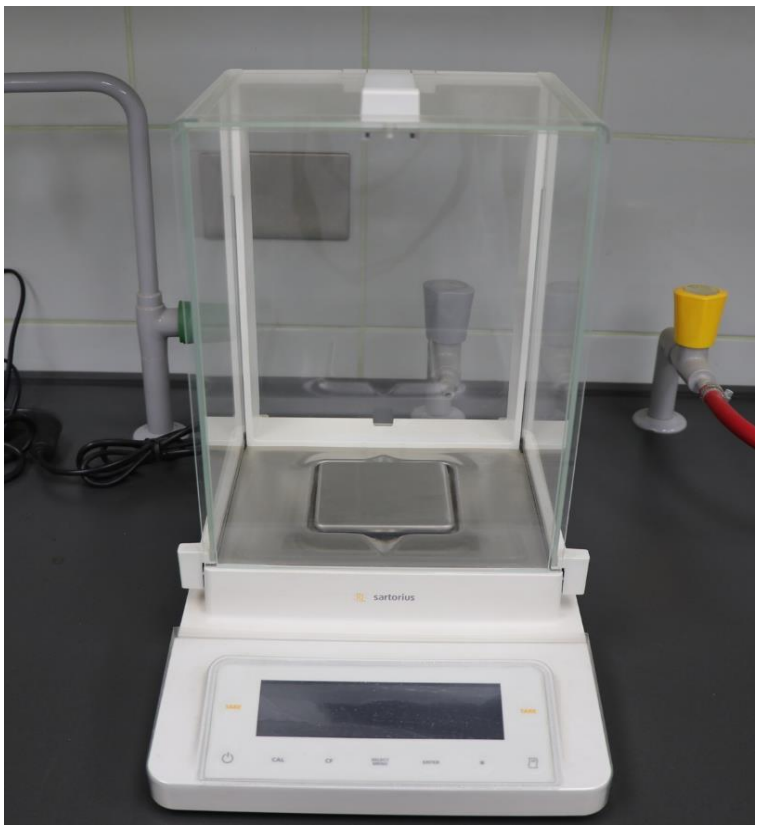
1. Connect the water inlet to the tap and make sure that the tap is open.
2. Turn on the ice maker.
3. Collect the ice slurry from the thank after 1 hour.
4. Turn off the ice after use.

9- Sensitive Balance

Objectives:

- To determine very small mass of samples using tared method.
- To determine very small mass of samples using weight by difference.

Picture:



Procedures:

Tared Method

1. Turn on the balance
2. Place the weighting bottle / paper on the balance.
3. Click on Tare option, to zero the reading.
4. Put the sample on the weighting bottle / paper.
5. Take the reading of the balance.

Weighing by difference

1. Turn on the balance
2. Place the weighting bottle / paper on the balance.
3. Record the weight of the weighting bottle / paper.

4. Add the sample to the weighting bottle / paper and record the total weight
5. Subtract the mass of the weighting bottle / paper from the total weight to obtain the mass of the sample.
6. Put the balance after the measurement.

10- Refrigerator

Objectives:

- To cool down sample.
- To produce ice used for reactions.

Picture:

Procedures:

1. Turn on the refrigerator.
2. Adjust the temperature to the desired value.
3. Put the sample in the refrigerator for the desired time.

ثالثا: أجهزة المختبرات في قسم علوم الأحياء

Third: Laboratory Equipment in Department of Biological Sciences

مختبرا ت قسم علوم الأحياء

Labs of Biological Sciences Department

يحرص قسم علوم الأحياء بكلية العلوم في الجامعة الإسلامية على تزويد الطالب بجميع المعارف الضرورية والعلوم المتعلقة بهذا المجال. يهتم علم الأحياء بدراسة التركيب الخلوي لجميع أشكال الحياة؛ الدقيقة منها كالبكتيريا التي تتكون من خلية واحدة، والمعقدة التي تتكون من عدة خلايا، كما يهتم بدراسة تصنيف الكائنات الحية، وهياكلها، ووظائفها، ونموها، وسلوكها، وتطورها. حاليا يدرس الطالب بالقسم مقرر الأحياء العامة (1) فقط، وفي المستقبل القريب هناك توجه لدى الكلية لاعتماد إحدى برامج البكالوريوس في علوم الأحياء، ويحتوي القسم على مختبر للطلاب ومختبر لأبحاث الأحياء التي تستخدم في تدريس الطلاب ويستفيد منها طلاب جميع الأقسام في كلية العلوم وكذلك قسم الهندسة المدنية في كلية الهندسة وهي-:

1. مختبر الأحياء العامة (1) (مختبر علوم الأنسجة – (Histology))
2. مختبر أبحاث الأحياء (مختبر الأبحاث البيولوجية)

No.	Lab Name	Lab No.	Floor	Lab supervisor	Lab Technician
1	General Biology Lab (1) (Microscopes, Histology Slides) Preparatory Year Building	206	2nd	Dr. Abdelaziz El-Sayed	Mr. Saleh Alsenani M.Sc.
2	Biology Research Lab (2) Faculty of Science Laboratory Building	005	1st	Dr. Abdelaziz El-Sayed	Mr. Saleh Alsenani M.Sc.

List of Slides for each of the practical courses in the Biology Department

No.	Name of Practical Course	List of Slides
1	General Biology (1)	6. Squamous Epithelium
		7. Paramaecium
		8. Bacteria From Mouth
		9. Euglena Viridis
		10. Simple Animal Cells
		11. Epidermal Cells of Allium Cepa (Onion)
		12. Sperm Smear of Bull
		13. Amoeba Proteus
		14. Hydra
		15. Artery of Rabbit
		16. Vein of Rabbit
		17. Meiotic (Maturation)
		18. Mitotic Stages
		19. Testis of Rabbit
		20. Seminal Vesicle
		21. Ovary of Rabbit
		22. Zea Mays, Corn, Root

		23. Zea Mays, Typical Monocot Stem with Scattered Bundles
		24. Zea Mays, Corn, Monocot Gramineous Leaf
		25. Ranunculus, Buttercup
		26. Helianthus, Sunflower, Typical Dicot Herbaceous Stem
		27. Syringa, Lilac
		28. Tilia, Lime, Older Woody Stem
		29. Sclerenchyma Fibres of Phloem
		30. Angular Collenchyma
		31. Parenchyme Cells
		32. Stone Cells
		33. Mitosis
		34. Areolar Connective Tissue
		35. White Fibrous Tissue
		36. Adipose Tissue of Pig
		37. Reticular Tissue
		38. Mucous Tissue
		39. Hyaline Cartilage
		40. Yellow Elastic Cartilage
		41. White Fibrous Cartilage
		42. Compact Bone, T.S.
		43. Compact Bone, L.S.
		44. Human Blood Smear
		45. Rana, Blood Smear
2	Biology Research Lab (2)	1. Smooth (Involuntary) Muscle, L.S. and T.S.
		2. Striated (Skeletal) Muscle L.S.
		3. Heart Muscle, L.S. And T.S.
		4. Spinal Cord of Rabbit, T.S.
		5. Spinal Cord, Human, T.S.
		6. Peripheral Nerve of Cow or Pig, T.S.
		7. Squamous Epithelium
		8. Cuboidal Epithelium
		9. Simple Columnar Epithelium, in T.S.
		10. Simple Ciliated Columnar Epithelium
		11. Pseudostratified Columnar Epithelium
		12. Pseudostratified Ciliated Columnar Epithelium

1- محتويات مختبر الأحياء العامة (1) من الأجهزة والشرائح النسيجية:

1- Contents of General Biology Lab (1) of Devices and Histology Slides

The Contents of General Biology Lab (1) of Devices

No.	Description	Qty.
1	**TRINOCULAR MICROSCOPE 1000X.** Description: Educational and laboratory microscope for routine applications. Dye-cast frame, with high stability and Ergonomy, for transmitted light observation. **MODEL: B-193** SUPPLIER: OPTIKA S.R.L., ITALY.	10
2	**BINOCULAR MICROSCOPE IOS E-PLAN OBJECTIVES** Description: Educational and laboratory microscope for routine applications. Dye-cast frame, with high stability and ergonomy, for transmiitted light observation. **MODEL: B-383PLI** SUPPLIER: OPTIKA S.R.L., ITALY.	10
3	**BINOCULAR MICROSCOPE IOS E-PLAN** OBJECTIVES Description: Educational and laboratory microscope for routine applications. Dye-cast frame, with high stability and Ergonomy, for transmitted light observation. **MODEL: B-382PLI-ALC** SUPPLIER: OPTIKA S.R.L., ITALY.	10

No.	Description	Picture of device
1	**MODEL: B-193** Educational and laboratory microscope for routine applications. Dye-cast frame, with high stability and Ergonomy, for transmitted light observation.	
2	**MODEL: B-383PLI** Educational and laboratory microscope for routine applications. Dye-cast frame, with high stability and Ergonomy, for transmitted light observation.	
3	**MODEL: B-382PLI-ALC** Educational and laboratory microscope for routine applications. Dye-cast frame, with high stability and Ergonomy, for transmitted light observation.	

Procedure

How to operate the microscope

1. A. Slide Preparation:
2. Connect the microscope to an electrical outlet
3. Rotate the lens disc on the weakest objective lens
4. Place the sample on the platform with the help of its metal clips
5. Rotate the large adjuster until the objective lens is above the slide

B Adjustment of light and focus:

1. Move the slide until it rests in the center
2. Adjust the large and small adjustments to focus the image
3. Move to the next objective lens in terms of power and make the final adjustments
4. Examine the slide now under the microscope

The Contents of General Biology Lab (1) Histology Slides

NO.	Description of Tissue Slides	QTY.
1	STRATIFIED, NON-CORNIFIED SQUAMOUS EPITHELIUM, IN SECTION OF OESOPHAGUS.	10
2	PARAMAECIUM, MACRO- AND MICRONUCLEI STAINED. THE TYPICAL SLIDE FOR GENERAL STUDY OF THIS COMMON CILIATE.	10
3	BACTERIA FROM MOUTH, GRAM POSITIVE AND NEGATIVE BACTERIA CAN BE OBSERVED IN THIS SLIDE, IDEAL FOR DEMONSTRATION.	10
4	EUGLENA VIRIDIS, A COMMON GREEN FLAGELLATE WITH EYESPOT AND FLAGELLUM, W.M.	10
5	SIMPLE ANIMAL CELLS IN SEC. OF SALAMANDER LIVER SHOWING NUCLEI, CELL MEMBRANES AND CYTOPLASM. FOR GENERAL STUDY OF THE ANIMAL CELL.	10
6	EPIDERMAL CELLS OF ALLIUM CEPA (ONION), FLAT MOUNT SHOWS TYPICAL PLANT CELLS WITH NUCLEI, CYTOPLASM AND CELL WALLS ALTERNATIVE.	10
7	SPERM SMEAR OF BULL.	10
8	AMOEBA PROTEUS, SHOWING NUCLEUS, ENDOPLASM, ECTOPLASM, FOOD VACUOLES, PSEUDOPODIA W.M.	10
9	HYDRA, EXTENDED SPECIMEN CAREFULLY STAINED FOR GENERAL BODY STUDY, W.M. SHOWING ALL DETAILS.	10
10	ARTERY OF RABBIT, T.S. ROUTINE STAINED.	10
11	VEIN OF RABBIT, T.S. ROUTINE STAINED.	10
12	MEIOTIC (MATURATION) STAGES IN TESTIS OF MOUSE, SEC. IRON HEMATOXYLINE STAINED AFTER HEIDENHAIN.	10
13	MITOTIC STAGES IN SEC. OF WHITEFISH BLASTULA SHOWING SPINDLES.	10
14	TESTIS OF RABBIT, T.S. SHOWING SPERMATOGENESIS ALTERNATIVE.	10
15	SEMINAL VESICLE (GL. VESICULOSA) OF PIG, T.S. ALTERNATIVE.	10
16	OVARY OF RABBIT, T.S. ALTERNATIVE.	10
17	ZEA MAYS, CORN, ROOT T.S., A POLYARCH ROOT.	10
18	ZEA MAYS, TYPICAL MONOCOT STEM WITH SCATTERED	10

	BUNDLES, T.S., A STANDARD SLIDE FOR GENERAL STUDY.	
19	ZEA MAYS, CORN, MONOCOT GRAMINEOUS LEAF T.S.	10
20	RANUNCULUS, BUTTERCUP, T.S. OF A TYPICAL DICOT ROOT FOR GENERAL STUDY SHOWING ALL STRUCTURES VERY CLEARLY.	10
21	HELIANTHUS, SUNFLOWER, TYPICAL DICOT HERBACEOUS STEM T.S. SHOWING OPEN VASCULAR BUNDLES AND ALL STRUCTURES VERY CLEARLY.	10
22	SYRINGA, LILAC, T.S. OF A TYPICAL MESOPHYTIC DICOT LEAF FOR GENERAL. STUDY, SHOWING ALL STRUCTURES VERY CLEARLY.	10
23	TILIA, LIME, OLDER WOODY STEM T.S.	10
24	SCLERENCHYMA FIBRES OF PHLOEM, T.S. AND L.S. OF STEM OF LINUM (FLAX).	10
25	ANGULAR COLLENCHYMA, T.S. STEM OF LAMIUM OR SALVIA.	10
26	PARENCHYME CELLS, T.S. OF MARROW OF SAMBUCUS NIGER (ELDERBERRY).	10
27	STONE CELLS, T.S. FRUIT OF PYRUS COMMUNIS (PEAR).	10
28	MITOSIS, L.S. FROM ALLIUM ROOT TIPS SHOWING ALL STAGES OF PLANT MITOSIS CAREFULLY STAINED WITH IRON-HEMATOXYLINE AFTER HEIDENHAIN.	10
29	AREOLAR CONNECTIVE TISSUE, W.M. AND STAINED FOR FIBRES AND CELLS.	10
30	WHITE FIBROUS TISSUE, L.S. OF TENDON OF COW.	10
31	ADIPOSE TISSUE OF PIG, SIECTION FAT REMOVED TO SHOW THE CELLS.	10
32	RETICULAR TISSUE T.S.	10
33	MUCOUS TISSUE, T.S. OF NAVEL STRING (UMBILICAL CORD).	10
34	HYALINE CARTILAGE, T.S.	10
35	YELLOW ELASTIC CARTILAGE, SECTION SPECIALLY STAINED FOR EILASTIC FIBRES.	10
36	WHITE FIBROUS CARTILAGE, SECTION.	10
37	COMPACT BONE, T.S. SPECIALLY PREPARED TO SHOW THE CELLS AND CANALICULI.	10
38	COMPACT BONE, L.S. SPECIALLY PREPARED TO SHOW THE CELLS AND CANALICULI.	10

39	HUMAN BLOOD SMEAR, WRIGHT'S STAIN.	10
40	RANA, BLOOD SMEAR.	10
41	SMOOTH (INVOLUNTARY) MUSCLE, L.S. AND T.S.	10
42	STRIATED (SKELETAL) MUSCLE L.S.	10
43	HEART MUSCLE, L.S. AND T.S.	10
44	SPINAL CORD OF RABBIT, T.S.	10
45	SPINAL CORD, HUMAN, T.S. FOR GENERAL STRUCTURE.	10
46	PERIPHERAL NERVE OF COW OR PIG, T.S. ROUTINE STAINED.	10
47	SQUAMOUS EPITHELIUM, ISOLATED CELLS FROM HUMAN MOUTH, SMEAR.	10
48	CUBOIDAL EPITHELIUM, IN SEC. OF KIDNEY PAPILLA.	10
49	SIMPLE COLUMNAR EPITHELIUM, IN T.S. OF SMALL INTESTINE.	10
50	SIMPLE CILIATED COLUMNAR EPITHELIUM, IN T.S. OF OVIDUCT.	10
51	PSEUDOSTRATIFIED COLUMNAR EPITHELIUM, IN SEC. THROUGH EPIDIDYMIS.	10
52	PSEUDOSTRATIFIED CILIATED COLUMNAR EPITHELIUM, IN T.S. OF TRACHEA.	10

تابع: أجهزة المختبرات في قسم علوم الأحياء

Laboratory Equipment in Department of Biological Sciences

2- محتويات مختبر أبحاث علوم الأحياء من الأجهزة:

2 -Devices of Biological Research Lab

1- Laboratory Incubator

Objectives:

- It is used to grow and maintain microbial colonies or cell colonies

Pictures

Procedure

1. Press the PROG function key.
2. In the PROG screen that appears, press the desired function key, TEMP, O_2 or CO_2, then use the ◄and► direction keys to adjust the value.
3. If the incubator is supplied with the option of oxygen control, the set point for the oxygen level can be selected and changed like the temperature and CO_2 set points.
4. When the desired set point is displayed, press the ENTER function key.
5. After making adjustments (if any were made), allow the incubator to stabilize at the set points before continuing.
6. If the chamber temperature goes above the temperature set point by 1°C, the Over-temperature system will activate.
7. Program the required oxygen level in the PROG screen, following the onscreen instructions.
8. If you are running an O_2 level programmed between 0.1 - 0.9 %, you should know that the control system is set to operate in the following way to minimize N_2 consumption after the glass door has been opened:
9. The N_2 valve is switched on continuously until the O_2 level is within 0.1 % of set point.

10. The CO_2 valve is then switched on to allow the CO_2 level to reach set point. If the O_2 level is above set point 15 minutes after the N2 valve has been switched off, it is switched back on for 40 seconds and the CO_2 valve is switched on for 20 seconds. The CO_2 valve will then pulse until set point is reached.
11. The process described above will repeat itself until the O_2 set point is reached.
12. The same process will also repeat if the O_2 level rises above set point, and if the O_2 level should rise toward 0.2 % above set point, the N2 valve will open again continuously until the O_2 level returns to set point.
13. The CO_2 auto zero, which would normally take place after a CO_2 alarm, will be cancelled to avoid the introduction of additional O_2 into the chamber. For the same reason, we recommend canceling the programmed CO_2 auto zero.

2- Microplate Reader

Objectives:

- It is used for determination of nucleic acids and proteins in microplates.

Pictures

Procedure

14. These instructions briefly describe how to create a protocol in Gen5. See the Gen5
15. Help system for complete instructions.
16. In the Gen5 Task Manager, select Protocol > Create New.

17. Open the Procedure dialog. If prompted to select a reader, select Epoch and click OK.
18. Select a Plate Type.
19. Add steps to the procedure for reading the plate. Click Validate to verify that the reader supports the defined steps, and then click OK.
20. Optionally, perform any of these steps to analyze and report the results:
21. Open the Plate Layout dialog and assign blanks, samples, controls, and/or standards to the plate.
22. Open the Data Reduction dialog to add data reduction steps. Categories include Transformation, Well Analysis, Curve Analysis, and Qualitative Analysis.
23. Create a report or export template via the Report/Export Builders.
24. Select File > Save and give the file an identifying name.
25. These instructions briefly describe how to create an experiment and then read a plate in Gen5. See the Gen5 Help system for complete instructions.
26. In the Gen5 Task Manager, select Experiment > Create using an existing protocol.
27. Select the desired protocol and click OK.
28. Select a plate in the menu tree and click the button
29. 4When the read is complete, measurement values appear in Gen5. Select the desired data set from the Data list.
30. Select File > Save and give the file an identifying name.

3- Centrifuge

Objectives:

- It is used to separate liquids, gases or liquids based on density.

Pictures

Procedure

1. **Power switch**

   The power switch is located on the bottom, left side of the unit.

2. **Lid release :**

   Once the centrifuge lid is closed the display shows “rpm/rcf“ and “close“ . At the same time the preselected rotor type is indicated. During the run you can call up the rotor type at any time by pressing the key “lid”. By pressing the key “lid“ you can release the lid of centrifuge. As soon as the electronic lid is completely released, it appears the word “open“. Now you can open the lid of the centrifuge.

3. **Lid lock**

   Attention: Before closing the lid, please ensure that the rotor is tight.

   As a sign that the centrifuge is ready for operation the display reads ‘rpm/rcf“ the word “close“. Simultaneously it appears in that display the word “rotor“, as well as the code number of the rotor, which is in the centrifuge.

4. **Pre-selection of speed / RCF-value**

   By pressing the key “rpm/rcf“ the pre-selection of the speed is activated. By pressing the key once the word “rpm“ flashes. By pressing the key once again the pre-selection of the centrifugal forces may be chosen. Flashing the word “rcf“. You can set the desired values with the adjusting knob. In the display the regulated value is shown permanently, before, during and after the run. The speed is adjustable between 200 rpm and maximum revolution of the centrifuge resp. the maximum permissible revolution of the pre-selected rotor. It is the same with the pre-selection of the RCF-value. The setting range is between 20 xg and the maximum permissible centrifugal force of the rotor. The maximum speed of the Z 206 A is 6000 rpm resp. 4180 xg.

5. **Pre-selection of running time**

   The running time can be pre-selected in three different ranges from 10 seconds up to 99 hours 59 minutes.

   5.1. Range from 10 seconds up to 59 minutes 50 seconds in steps of 10 seconds.

   5.2. Range from 1 hour up to 99 hours 59 minutes in steps of 1 minutes.

   5.3. Range continuous run “cont”, which can be interupted by the key “stop”. The running time can be pre-selected with the lid opened or closed. To activate the setting of the running time press the key “time“ . In the display “time“ flashes the indication “m : s“ or “h : m“ , depending on the previous setting. To set the desired value use the adjusting knob. After exceeding of 59 min 50 sec the indication changes automatically to “h : m“. After exceeding of 99 hours 59 min the word “cont” appears in the display “time”. That

continuous run can only be interrupted by pressing the key “stop” . The display shows always the remaining running time.

6. **Pre-selection of brake intensity and acceleration**

   By pressing the key “accel/decel“ this function is activated.

   By pressing the key once the word “accel“ flashes in the display “acc/dec“. The desired acceleration can be pre-selected by the adjusting knob. The value 0 is equivalent to the lowest and the value 9 to the highest acceleration.

   By pressing the key “accel/decel“ twice, in the display “acc/dec“ indicates the word “decel“ . Now the desired brake intensity can be pre-selected by the adjusting knob. The value 9 is equivalent to the shortest and the value 0 to longest possible brake time.

7. **Starting the centrifuge**

   After closing the lid you can start the centrifuge with the key “start“.

   By pressing the key “start“ you can start runs with manually pre-selected parameters. When the respective pre-selected running time has ended then the centrifuge will stop automatically or you can interrupt the run in the mode “cont” with the key “stop”.

8. **The “STOP“ key**

   By the “stop“ key you can interrupt the run at any time. After pressing the key the centrifuge decelerates with the respective pre-selected intensity down to stand still.

4- Autoclave

Objectives:

- A machine that uses steam under pressure to kill harmful bacteria, viruses, fungi and germs on objects placed inside the pressure vessel.

Pictures

Procedure

A. Usage Instruction:

1. When turning ON the power of this product, please turn ON the Main Power Switch, after necessarily turning ON the Leakage Breaker located at the bottom of the rear panel of this product.
2. When the power is turned on, press the "OPEN" Button, and open the Door by pulling the Lever.
3. Check the level of distilled water in the pressure vessel, and please regulate to the level that Heater Cover can be sunk.

B. Operation method for Autoclave

1. Autoclave can be manipulated for the setting in each mode by Turning and Push motion.
2. If turning the Autoclave knob to clockwise or counter-clockwise, the setting values can be adjusted, and if briefly pressing once the PUSH button, the Start or the Stop operation is performed.
3. The Turning of the Autoclave knob does not manipulated during operating, and if resetting the set value, it can be adjusted by the Autoclave knob after stopping the product by pressing briefly once the PUSH button.
4. If pressing for 2 or 3 seconds the PUSH button, the set value is saved, and even if the power is turned on again, that value is maintained. (If “0” value is saved, the setting value is initialized.)

5- Drying Oven

Objectives:

- The drying oven is used to place temperature-sensitive samples, instruments and chemicals into the drying oven to remove moisture slowly and evenly.

Pictures

Procedures:

1. Make sure that the plug is plugged into the electrical socket.
2. Determine the temperature range by rotating the wheel next to the device.
3. Press the power key.
4. Pressing the mode key, choosing the temperature, choosing the time.
5. Press the start key to start the process.

6- Analytical Balance

Objectives:

- The sensitive scale for measuring small quantities in weighing materials.

Pictures

Procedure

1. Make sure that the plug is plugged into the electrical socket.
2. Turn on the button.

7- Hotplate Stirrer

Objectives:

- Used to mix aqueous solutions of a large variety of reactions with heating.

Pictures

Procedure

1. Make sure that the plug is plugged into the electrical socket.
2. Rotate the heat wheel clockwise until it reaches the right temperature.
3. Rotate the stir wheel clockwise until it reaches the right range.

8- pH Meter

Objectives:

- It is used to measure the pH of solutions.

Pictures

Procedure

1. Make sure that the plug is plugged into the electrical socket.
2. Press the red Power key.
3. Place the rod in the liquid whose pH is to be measured.

9- Water Bath

Objectives:

- It is used to incubate the samples in water at a constant temperature over a long period of time.

Pictures

Procedure

1. Make sure that the plug is plugged into the electrical socket.
2. Ensure that there is sufficient distilled water in the tank of the device.
3. Determine the right temperature.
4. Press the power key.

10- Vortex

Objectives:

- It is used for mixing small bottles of liquids.

Pictures

Procedure

31. Make sure that the plug is plugged into the electrical socket.
32. Press the power button.
33. Choose the number of rpm you want.
34. Choose the time.
35. Press the start button.

11- Freezer

Objectives:

- A device for freezing samples and for storing biological waste.

Pictures