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SCIENCE DEPARTMENT

Separate Science (Triple)

Y10 to Y11 Summer Holiday Homework

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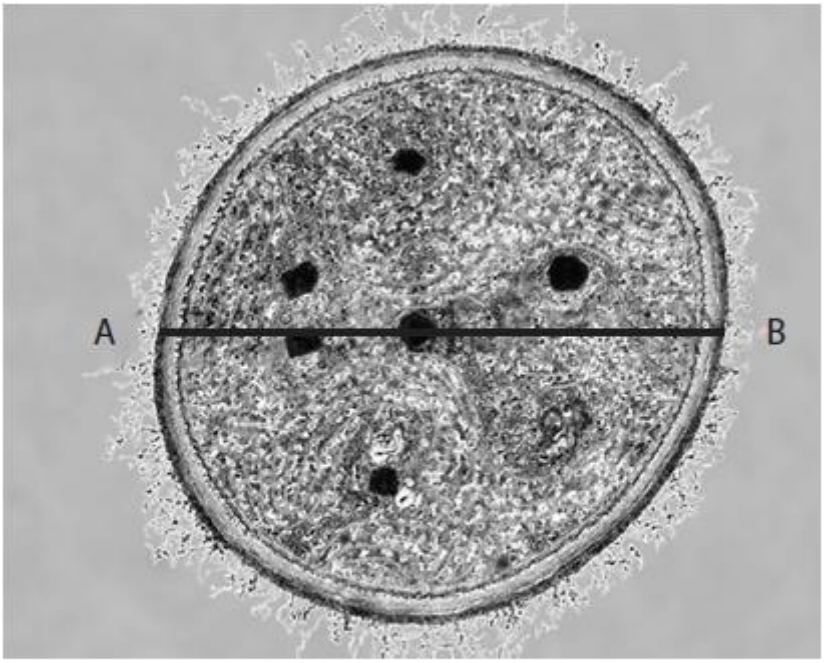
Biology Questions Paper 1 (Separate)

Q1. Figure 7 shows a cyanobacterium magnified 50 000 times.

The line AB shows the diameter of the bacterial cell.



(Source: © The Christian Science Monitor)

Figure 7

(i) Calculate the actual diameter of the cyanobacterium.

Give your answer in micrometres (μm).

(3)

..... μm

(ii) Bacterial cells contain plasmids.

Describe **three** other features of a bacterial cell.

(3)

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(Total for question = 6 marks)

Q2. Phenolphthalein is an indicator. It is pink in alkaline solutions and turns colourless as the pH decreases.

It can be used to measure the activity of the enzyme lipase on the breakdown of lipids.

Samples of milk containing phenolphthalein were incubated with lipase at different temperatures.

The time taken for the phenolphthalein to turn colourless was recorded and used to calculate the rate of enzyme activity.

Figure 10 shows these results.

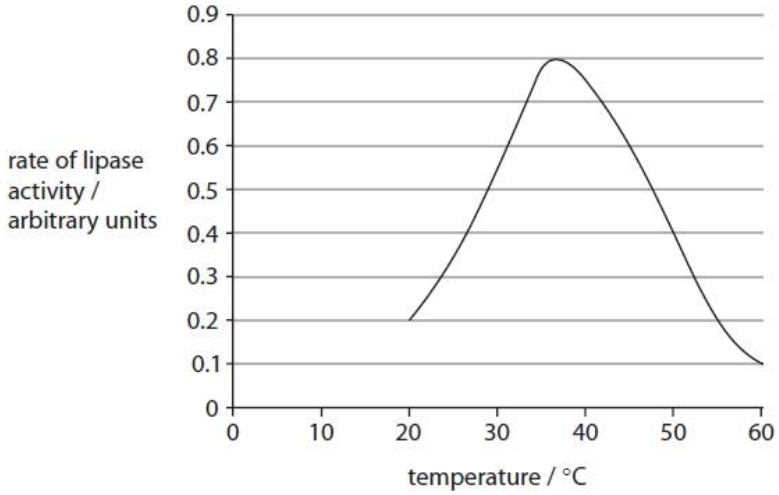

Figure 10

(i) Explain why phenolphthalein turns colourless when lipase breaks down the lipids in milk.

(2)

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(ii) Describe the effect of temperature on the activity of lipase, as shown in Figure 10.

(2)

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(iii) Explain why the activity of lipase changes above a temperature of 40°C.

(2)

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(Total for question = 6 marks)

Q3. Figure 16 shows the number of neurones in the brain of different animals.

animal	number of neurones in the brain
lobster	1.0×10^5
frog	1.6×10^7
rat	2.0×10^8
human	8.6×10^{10}

Figure 16

(i) Calculate the difference between the number of neurones in the brain of the rat and the brain of the frog.

Give your answer in standard form.

(2)

..... neurones

(ii) Most neurones in the brain are unmyelinated whereas motor neurones are myelinated.

Explain why myelination is needed on motor neurones but not on neurones in the brain.

(3)

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(Total for question = 5 marks)

Q4. Lactase is an enzyme that breaks down lactose into glucose and galactose.

A student made some alginate beads containing lactase.

The student added 10 beads to 20 cm^3 of a solution of lactose, as shown in Figure 9.

The student timed how long it took for glucose to be produced.

The experiment was repeated using 15, 20 and 25 beads.

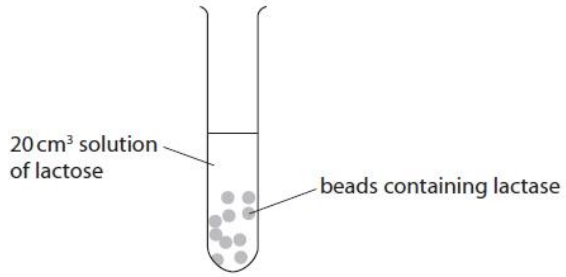

Figure 9

The results are shown in Figure 10.

number of beads containing lactase	time taken to produce glucose in seconds
10	240
15	210
20	150
25	120

Figure 10

(i) What is the rate of reaction for 25 beads?

(1)

☒ **A** 0.008 s^{-1}

☒ **B** 0.04 s^{-1}

☒ **C** 0.21 s^{-1}

☒ **D** 4.8 s^{-1}

(ii) Explain the conclusion that can be made from these results.

(3)

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(iii) Explain why the same volume of lactose solution was used for each test.

(2)

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(Total for question = 6 marks)

Q5. A student had solutions of four different foods labelled W, X, Y and Z.
Each solution was tested for starch and protein.

The colour of the solutions after the tests are shown in Figure 1.

solution	colour after testing for starch	colour after testing for protein
W	orange	purple
X	blue/black	purple
Y	blue/black	blue
Z	orange	blue

Figure 1

(i) Which solution contains starch but not protein?

(1)

☒ **A** solution W

☒ **B** solution X

☒ **C** solution Y

☒ **D** solution Z

(ii) Describe how a solution of food can be tested for reducing sugars.

(2)

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(Total for question = 3 marks)

Q6. One cause of colour blindness is a change in the DNA sequence of a gene.

This results in the production of a different protein in cone cells in the retina of the eye.

Explain how a change in the DNA sequence of a gene can result in the production of a different protein.

(4)

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Q7. Gregor Mendel used pea plants in plant breeding experiments. He discovered the basis of genetic inheritance.

He cross-bred tall pea plants with short pea plants.

All the offspring were tall, as shown in Figure 4.

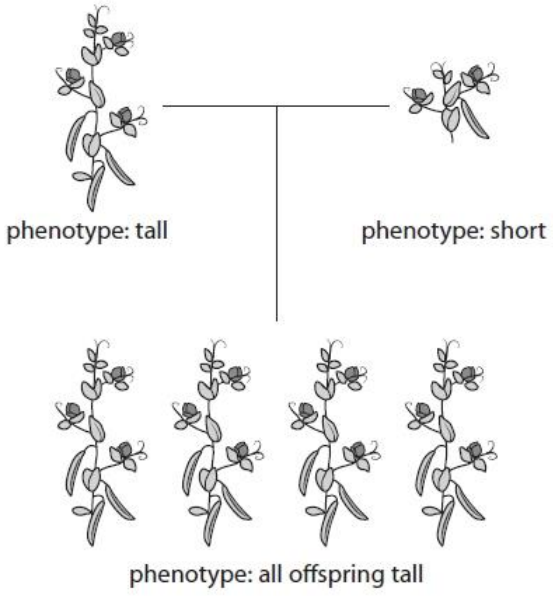

Figure 4

(i) Explain why the offspring are all tall.

(2)

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(ii) In this investigation, the parent pea plants were grown in a warm, closed greenhouse.

Give **two** reasons why the parent pea plants were grown in a warm, closed greenhouse.

(2)

1 .....

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2 .....

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(Total for question = 4 marks)

Q8. Figure 5 shows light rays entering the eye of a person with normal vision.

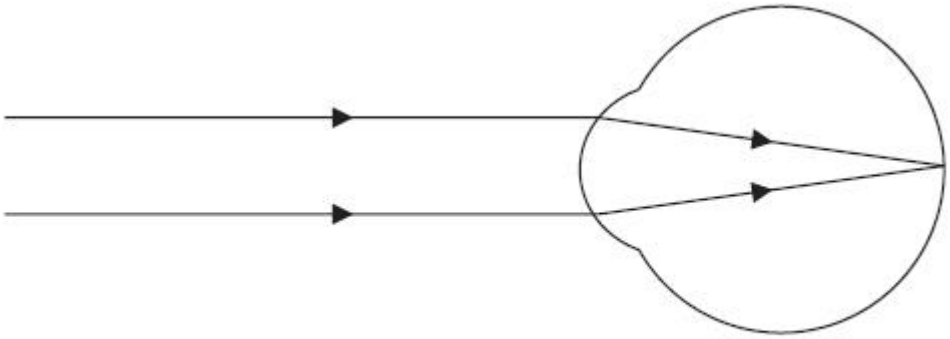

Figure 5

(i) Describe how light rays are focused to give normal vision.

(2)

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(ii) Figure 6 shows light rays entering the eye of a person with an eye defect and two lenses that can be used to correct eye defects.

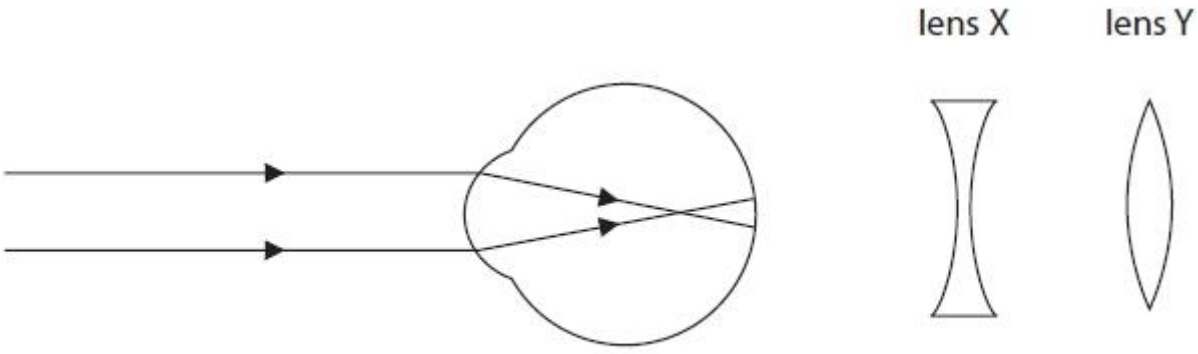

Figure 6

Explain which lens would correct the eye defect shown in Figure 6.

(2)

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Q9. Information in a DNA strand can be transcribed to make a strand of mRNA.

Describe how this mRNA strand is then used to make proteins.

(4)

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Q10. Organisms can be classified by the five kingdom or three domain method.

(i) What is the name of the domain that plants belong to?

(1)

- ☒ **A** Eukarya
- ☒ **B** Archaea
- ☒ **C** Monera
- ☒ **D** Protista

(ii) Plant cells contain chloroplasts.

What happens in a chloroplast?

(1)

☒	**A**	oxygen produced	sunlight absorbed by chlorophyll
☒	**B**	carbon dioxide produced	sunlight absorbed by mitochondria
☒	**C**	oxygen produced	sunlight absorbed by mitochondria
☒	**D**	carbon dioxide produced	sunlight absorbed by chlorophyll

(iii) Give a reason why the three domain method of classification has been suggested.

(1)

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Q11. A scientist was planning to compare the effectiveness of the antibiotic myxopyronin on two different species of bacteria.

Figure 18 shows the equipment the scientist can use.

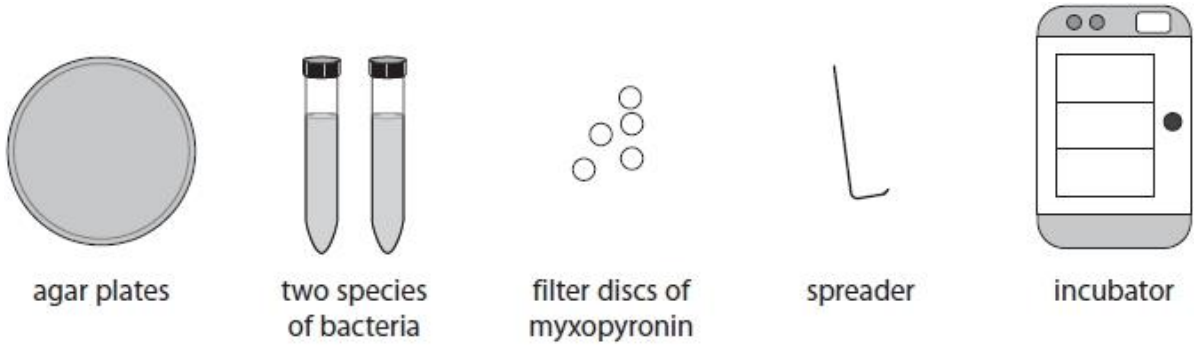

Figure 18

* Infections can also be caused by viruses.

Describe the lytic pathway of a virus and how this causes the spread of infection through a population.

(6)

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(Total for question = 6 marks)

Q12. Gregor Mendel used pea plants in plant breeding experiments. He discovered the basis of genetic inheritance.

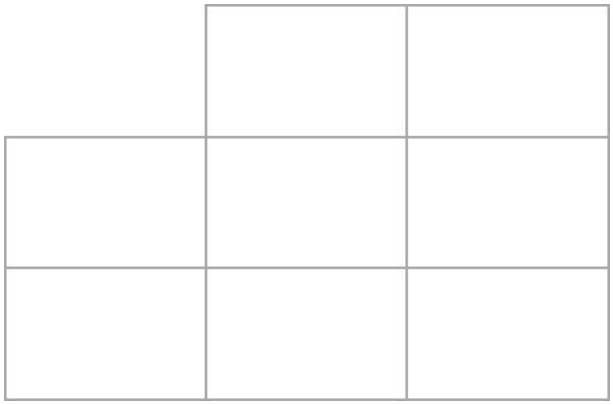
Pea plants produce different coloured peas.

The allele for yellow-coloured peas (A) is dominant to the allele for green-coloured peas (a).

Two heterozygous parent plants were used in a genetic cross.

(i) Predict, using the Punnett square, the percentage probability that this cross will have offspring that produce
green-coloured peas.

(3)



percentage probability of green-coloured peas =.....%

(ii) Explain **one** advantage to pea plants of using sexual reproduction to produce offspring.

(2)

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(Total for question = 5 marks)

Q13. A scientist was planning to compare the effectiveness of the antibiotic myxopyronin on two different species of bacteria.

Figure 18 shows the equipment the scientist can use.

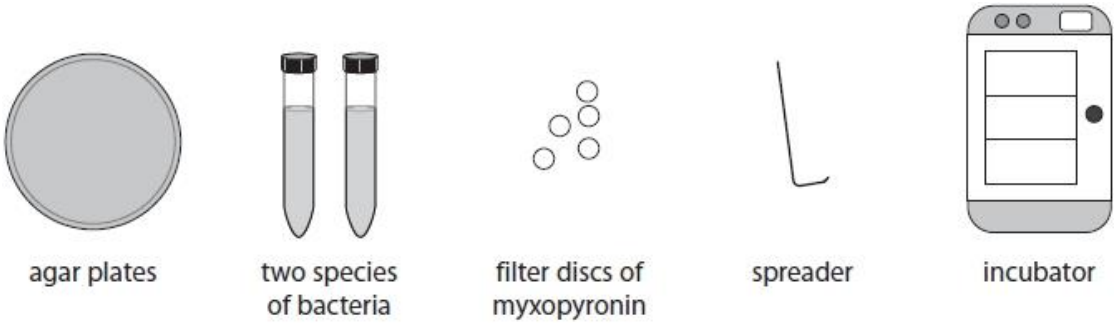

Figure 18

(i) Describe how the scientist could determine the effectiveness of myxopyronin on the two species of bacteria.

(2)

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(ii) Myxopyronin inhibits bacterial RNA polymerase.

Explain why the antibiotic myxopyronin can be used to treat bacterial infections in humans.

(4)

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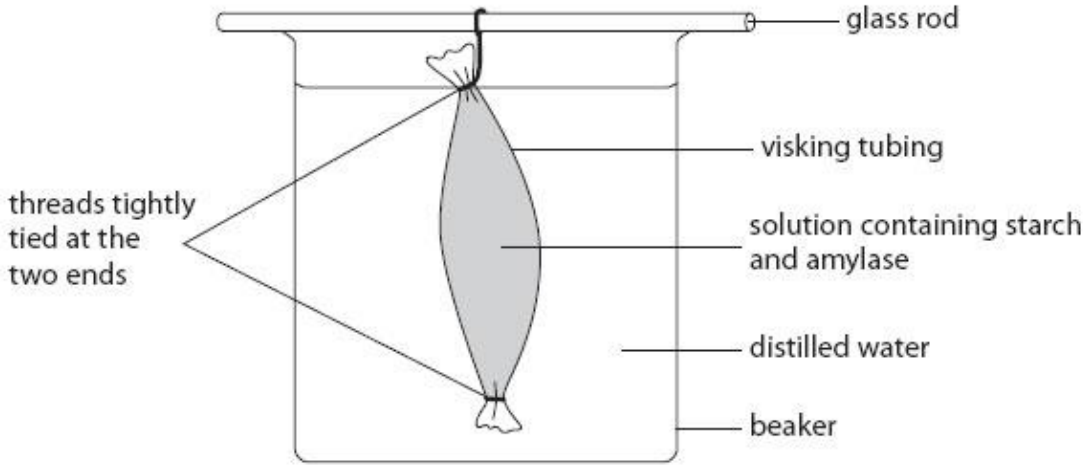
Q14.
Visking tubing is made of a plastic material through which small molecules can pass. The diagram shows how the equipment for an investigation using visking tubing was set up.



(a) In this investigation, the concentration of glucose in the distilled water was measured at the start and then every five minutes. The results are shown in the table.

time of measuring the glucose concentration in the distilled water / mins	concentration of glucose in the distilled water / g cm^{-3}
0	0.00
5	0.07
10	0.39
15	0.52
20	0.79
25	0.79

(i) Describe the results of this investigation.

(2)

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(ii) Explain the results of this investigation

(3)

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*(iii) The diagram shows how visking tubing can be used to model the small intestine.
This model does not fully represent the structure and functions of the small intestine.
Evaluate the strengths and weaknesses of this model.

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(b) Complete the sentence by putting a cross (☒) in the box next to your answer. The function of the gall bladder is to

(1)

☒ **A** make bile
☒ **B** make lipase
☒ **C** store bile
☒ **D** store lipase

Q15. Mitosis and meiosis are processes that produce new cells.

Compare the outcomes of mitosis and meiosis.

(3)

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Q16.

(ii) An allele starts with the DNA sequence ATGCATGTACCG.

Give the sequence of the complementary DNA sequence.

(1)

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(iii) The length of one DNA nucleotide was measured at 3.3×10^{-10} metres.

Calculate the approximate length of a gene containing 250 nucleotides in nanometres.

(2)

..... nm

Q17.

Figure 12 shows the times when *Homo sapiens* and some of their ancestral species are thought to have lived.

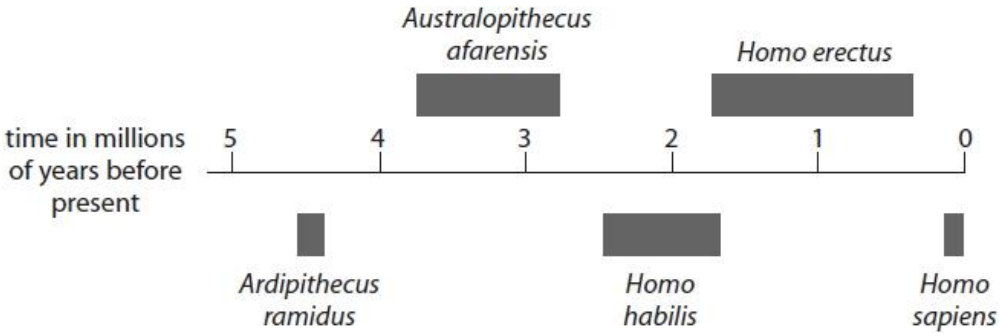

Figure 12

Fossil remains of *Ardipithecus ramidus* were discovered in Ethiopia.

(i) Calculate the number of years *Ardipithecus ramidus* is thought to have inhabited the Earth.

(2)

Answer .....

(ii) Describe the evidence that scientists might have used to show that *Ardipithecus ramidus* inhabited the Earth earlier than *Homo habilis*.

(2)

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(iii) Suggest an explanation for the extinction of *Homo habilis*.

(2)

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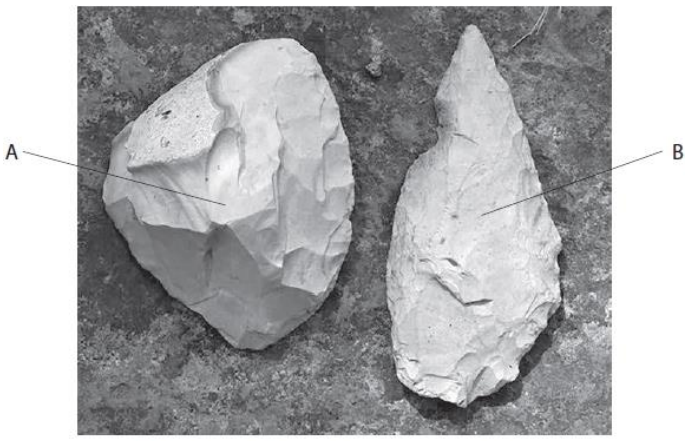
(iv) Figure 13 shows two stone tools, one used by *Homo habilis* and one used by *Homo erectus*.



(Source: Frederic Surmely/look at sciences/Science Photo Library)

Figure 13

Explain which stone tool was most likely to be used by *Homo erectus*. Use information from Figure 12 and Figure 13.

(2)

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Q18. Figure 5 shows a great tit on a bird feeder.

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Figure 5

Scientists have found that great tits living now have longer beaks than great tits living 50 years ago.

Genetic analysis shows changes in the sequence of the bird's DNA.

Scientists think that great tits living now have longer beaks because of the increased use of bird feeders during the last 50 years.

Explain how natural selection could have caused an increase in beak length because of the use of bird feeders.

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Q19. Colistin is an antibiotic used to treat infections in the bloodstream. Some bacteria are resistant to Colistin.

Explain how these bacteria have become resistant to Colistin.

(4)

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Q20. The human immune system helps defend the body against disease.

In 1796, the work of Edward Jenner led to the development of a vaccine used to immunise people against a disease called smallpox. Describe how the body responds to immunisation.

(3)

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Q21. *Streptococcus* bacteria can cause a sore throat or skin infection.

An illness called scarlet fever can also develop during an infection with this bacterium.

(i) Give **two** precautions a doctor should take when treating a patient who is infected with *Streptococcus*.

(2)

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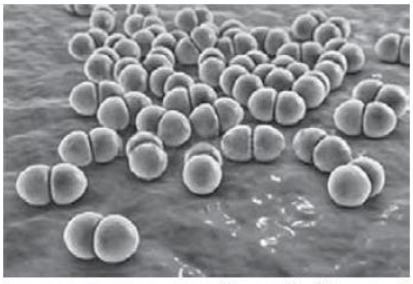
(iii) Figure 10 shows some *Streptococcus* bacteria.



© Kateryna Kon/Shutterstock

Some bacteria are motile, meaning they can move themselves.

Why is a *Streptococcus* bacterium not motile?

(1)

- ☒ **A** it does not have flagella
- ☒ **B** it does not have plasmids
- ☒ **C** it does not have ribosomes
- ☒ **D** it does not have acrosomes

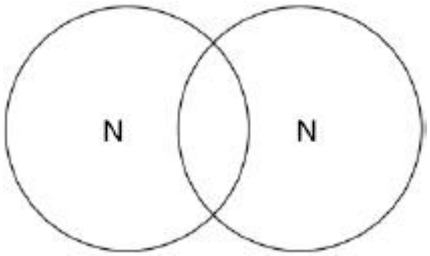
TOPIC 1 Key concepts in chemistry CGP – p17-57

Q2. This question is about structure and bonding.

(a) Complete the dot and cross diagram to show the covalent bonding in a nitrogen molecule, N_2

Show only the electrons in the outer shell.

(2)



(b) Explain why nitrogen is a gas at room temperature.

Answer in terms of nitrogen's structure.**3)**

(c) Graphite and fullerenes are forms of carbon.

Graphite is soft and is a good conductor of electricity.

Explain why graphite has these properties.

Answer in terms of structure and bonding.

(4)

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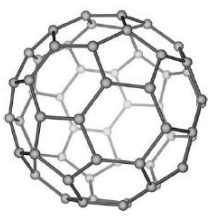
(d) **Figure 1** shows a model of a Buckminsterfullerene molecule.

Figure 1



A lubricant is a substance that allows materials to move over each other easily.

Suggest why Buckminsterfullerene is a good lubricant.

Use **Figure 1**.

(2)

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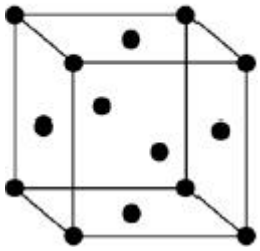
Silver can form cubic nanocrystals.

Figure 2 represents a silver nanocrystal.

Figure 2



(e) A silver nanocrystal is a cube of side 20 nm

Calculate the surface area to volume ratio of the nanocrystal.

(3)

Surface area to volume ratio = ...

(f) Silver nanoparticles are sometimes used in socks to prevent foot odour.

Suggest why it is cheaper to use nanoparticles of silver rather than coarse particles of silver.

(2)

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Q3. This question is about magnesium and magnesium chloride.

(a) Magnesium chloride contains magnesium ions (Mg^{2+}) and chloride ions (Cl^-).

Describe, in terms of electrons, what happens when a magnesium atom reacts with chlorine atoms to produce magnesium chloride.

(4)

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TOPIC 2 – States of matter and mixtures CGP – p58-72

Q1. A student is investigating the maximum mass of sodium chloride that can be dissolved in 100 cm^3 water at room temperature.

The student has been given 1.0 g samples of solid sodium chloride to dissolve in the water.

The method the student uses is

*step **1** fill a 100 cm^3 beaker with tap water*
*step **2** add 1.0 g sodium chloride and see if it dissolves*
*step **3** keep adding 1.0 g portions of sodium chloride until a portion of solid does not dissolve completely*

In step **3**, some sodium chloride remains undissolved.

(i) State what would you **see** in the beaker when this step is complete.

(1)

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(ii) State the name of the method that could be used to separate the undissolved sodium chloride from the mixture.

(1)

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Q2.

Figure 9 shows some mixtures to be separated and possible methods of separation.

Place a tick (✓) in one box in each row of the table to show the best method to separate the first named substance from each of the mixtures.

(3)

substance to separate	method of separation			
	crystallisation	filtration	simple distillation	fractional distillation
sand from a mixture of sand and sodium chloride solution				
copper sulfate crystals from copper sulfate solution				
useful liquids from crude oil				

Figure 9

Q3.

Some food colourings are a mixture of soluble, coloured substances. Mixtures of soluble substances can be separated by paper chromatography.

Paper chromatography was used to try to separate the coloured substances in five food colourings, **V**, **W**, **X**, **Y** and **Z**.

Figure 10 shows the spots for the five food colourings on the chromatography paper at the start of the experiment.

The paper was placed in a beaker with the bottom of the paper in the solvent.

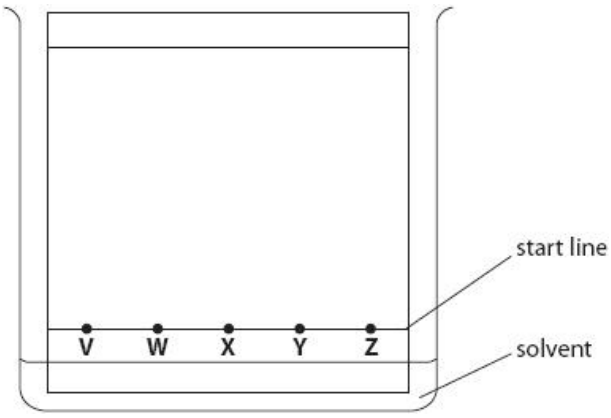

Figure 10

(i) Identify the stationary phase in this experiment

(1)

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(ii) Give a reason why the spots of the food colourings must be above the level of the solvent, when the paper is placed in the solvent.

(1)

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(iii) Figure 11 shows the chromatogram at the end of the experiment.

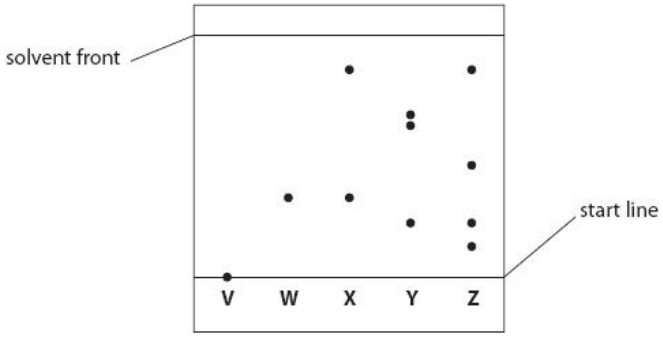

Figure 11

Give the reason why the spot of food colouring **V** has not moved during the chromatography experiment.

(1)

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(iv) Explain, by referring to Figure 11, which food colouring contained the greatest number of soluble, coloured substances.

(2)

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(v) One coloured substance in food colouring **X** moved 5.8 cm when the solvent front moved 6.6 cm.

Calculate the R_f value for this substance, giving your answer to two significant figures.

(2)

R_f value = ...

Topic 3: ACID BASE REACTIONS Questions- CGP Page number- 73-86

Q1. A strong acid reacts with a strong alkali to form a neutral solution.

Write the ionic equation for this reaction. **(2)**

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Q2. (i) Complete the sentence by putting a cross (☒) in the box next to your answer.

Acids are neutralised by metal hydroxides to form **(1)**

☐ **A** salt only

☐ **B** salt and hydrogen only

☐ **C** salt and oxygen only

☐ **D** salt and water only

(ii) Acids can also be neutralised by metal carbonates.

Dilute sulfuric acid is neutralised by copper carbonate as shown in the word equation.

copper carbonate + sulfuric acid → copper sulfate + carbon dioxide + water

Copper carbonate is a green powder.

Describe what you would **see** when copper carbonate powder is added to dilute sulfuric acid.

(2)

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Q3. Calcium nitrate solution can be made by adding solid calcium carbonate to dilute nitric acid in a beaker.

The solid calcium carbonate is added until some remains at the bottom of the beaker.

(i) After this reaction the liquid in the beaker is

(1)

☐ **A** acidic

☐ **B** alkaline

☐ **C** neutral

☐ **D** pure water

(ii) Explain why the calcium carbonate is added until some solid remains at the bottom of the beaker.

(2)

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(iii) Write the balanced equation for the reaction between calcium carbonate and nitric acid to form calcium nitrate, $Ca(NO_3)_2$.

(3)

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Q4. Metal oxides react with acids to produce salts and water.
Dilute sulfuric acid was added to magnesium oxide.
State the name of the salt formed.

(1)

.....

Q5. Nitric acid can be titrated with a solution of ammonia.

(i) State the type of reaction occurring when nitric acid reacts with ammonia.

(1)

.....

(ii) What salt is formed in this reaction?

(1)

- ☒ **A** ammonia nitric
- ☒ **B** ammonia nitrate
- ☒ **C** ammonium nitric
- ☒ **D** ammonium nitrate

Q6.

Dilute hydrochloric acid reacts with silver nitrate solution to form silver chloride and nitric acid.

(i) Complete the sentence by putting a cross (☒) in the box next to your answer.
The reaction produces silver chloride as a precipitate.
In an equation this would be shown as

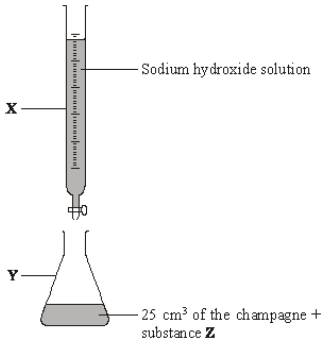
(1)

- ☒ **A** AgCl(aq)
- ☒ **B** AgCl(g)
- ☒ **C** AgCl(l)
- ☒ **D** AgCl(s)

Topic 3 and 5: Titration Questions- CGP Page number- 80 and 113-114

Q1. In 1916 a ship was sunk by a German submarine. The ship was carrying bottles of champagne. The wreck was discovered in 1997 and the champagne was brought to the surface and analysed.

The diagram shows the apparatus used to find the amount of acid in 25 cm^3 of the champagne.



(a) Choose the correct words from the box to name apparatus **X** and **Y**.

beaker	**burette**	**conical flask**	**measuring cylinder**

(i) Apparatus **X** is a ..... **(1)**

(ii) Apparatus **Y** is a ..... **(1)**

(b) Sodium hydroxide solution was added to this champagne until substance **Z** showed that the reaction was complete. The volume of sodium hydroxide used was recorded. The result was used to calculate the amount of acid present.
Complete these sentences by drawing a ring around the correct answer.

(3)

(i) Substance **Z** is

a catalyst
a conductor
an indicator

(ii) The reaction was complete when substance **Z**

changed colour
formed a gas
gave a precipitate

(iii) The name of this method of analysis is

distillation
filtration
titration

(c) 250 cm^3 of this champagne were found to contain 1 g of acid.
Calculate the mass of acid in 750 cm^3 of this champagne.

(2)

Mass = ...g

(d) (i) Which **one** of the following ions makes champagne acidic?
Draw a ring around your answer.

(1)

chloride **hydrogen** **sodium**

(ii) The acid in champagne is a *weak* acid.
Complete this sentence by drawing a ring around the correct answer.

(1)

The word *weak* means that the acid

has a low boiling point
is dilute
is partially ionised

Q2. This question is about acids and alkalis.

(a) Dilute hydrochloric acid is a strong acid.

Explain why an acid can be described as both strong and dilute.

(2)

.....

.....

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.....

(b) A 1.0×10^{-3} mol/dm^3 solution of hydrochloric acid has a pH of 3.0

What is the pH of a 1.0×10^{-5} mol/dm^3 solution of hydrochloric acid?

(1)

pH = ...

A student titrated 25.0 cm^3 portions of dilute sulfuric acid with a 0.105 mol/dm^3 sodium hydroxide solution.

(c) The table below shows the student's results.

	Titration 1	**Titration 2**	**Titration 3**	**Titration 4**	**Titration 5**
Volume of sodium hydroxide solution in cm^3	23.50	21.10	22.10	22.15	22.15

The equation for the reaction is:

$$2\ NaOH + H_2SO_4 \longrightarrow Na_2SO_4 + 2\ H_2O$$

Calculate the concentration of the sulfuric acid in mol/dm^3

Use only the student's concordant results.

Concordant results are those within 0.10 cm^3 of each other.

(5)

Concentration of sulfuric acid = ... mol/dm^3

(d) Explain why the student should use a pipette to measure the dilute sulfuric acid and a burette to measure the sodium hydroxide solution.

(2)

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.....

(e) Calculate the mass of sodium hydroxide in 30.0 cm^3 of a 0.105 mol/dm^3 solution.

Relative formula mass (M_r): NaOH = 40

(2)

Mass of sodium hydroxide = ...g

(i) The student had a solution of sodium hydroxide with a concentration of 0.100 moles per dm^3.

She wanted to check the concentration of a solution of hydrochloric acid.

She used a pipette to transfer 5.00 cm^3 of the hydrochloric acid into a conical flask.

She filled a burette with the 0.100 moles per dm^3 sodium hydroxide solution.

Describe how she should use titration to obtain accurate results.

(4)

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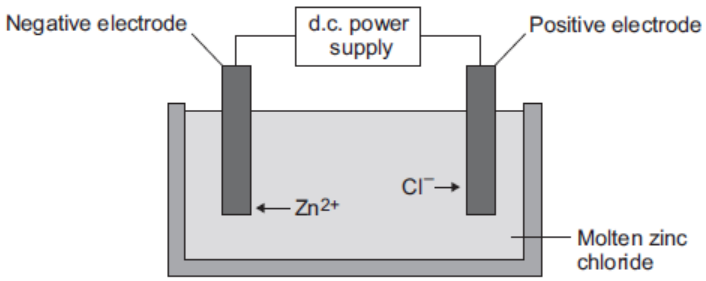
Topic 3- Electrolysis- CGP Page number- 82-86

Q1. This question is about zinc.

Figure 1 shows the electrolysis of molten zinc chloride.

Figure 1



(a) Zinc chloride is an ionic substance.

Complete the sentence.

(1)

When zinc chloride is molten, it will conduct ..... .

(b) Zinc ions move towards the negative electrode where they gain electrons to produce zinc.

(i) Name the product formed at the positive electrode.

(1)

.....

(ii) Explain why zinc ions move towards the negative electrode.

(2)

.....

.....

(iii) What type of reaction occurs when the zinc ions gain electrons?

(1)

Tick **one** box.

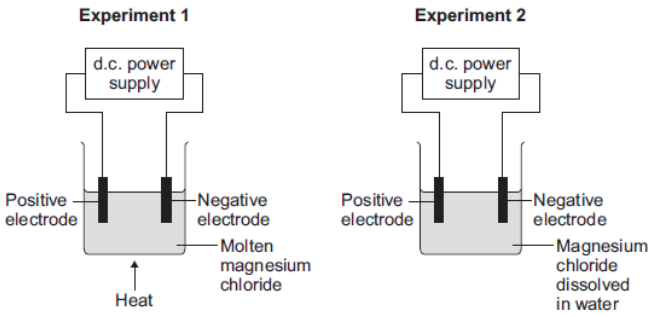
Neutralisation ☐

Oxidation ☐

Reduction ☐

Q2. (b) Magnesium chloride can be electrolysed.

The diagram below shows two experiments for electrolysing magnesium chloride.



(i) Explain why magnesium chloride must be molten or dissolved in water to be electrolysed.

(2)

.....

.....

(ii) Explain how magnesium is produced at the negative electrode in **Experiment 1**.

(3)

.....

.....

.....

.....

(iii) In **Experiment 2** a gas is produced at the negative electrode.

Name the gas produced at the negative electrode.

(1)

.....

(iv) Suggest why magnesium is **not** produced at the negative electrode in **Experiment 2**.

(1)

.....

.....

(v) Complete and balance the half equation for the reaction at the positive electrode.

(1)

..... Cl^- → Cl_2 + ...

Topic 4 and 5- Extracting metals, Equilibria and Haber process- CGP page number 89-104 and Pg123-124

Q1.

In industry, ammonia is produced by the Haber process.

$$\text{nitrogen} + \text{hydrogen} \rightleftharpoons \text{ammonia}$$

(i) What is the source of the hydrogen used in the Haber process?

Put a cross (☒) in the box to show your answer.

(1)

☐ **A** air

☐ **B** reaction of zinc with dilute sulfuric acid

☐ **C** electrolysis of water

☐ **D** natural gas

(ii) When nitrogen reacts with hydrogen, the amount of ammonia gradually increases until it becomes constant.

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$$

Explain why the amount of ammonia remains constant.

(2)

.....

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Q2.

When nitrogen and hydrogen react to form ammonia, the reaction can reach a dynamic equilibrium.

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$$

(a) Explain what is meant by a **dynamic equilibrium**.

(2)

(b) In industry, the reaction between nitrogen and hydrogen is affected by the conditions used.

(i) The pressure used is 250 atmospheres.
Explain how the use of a higher pressure would affect the equilibrium yield of ammonia.

(2)

(ii) The reaction between nitrogen and hydrogen to form ammonia is exothermic.
The temperature used is 450 °C.

Explain how the use of a lower temperature would affect the equilibrium yield of ammonia.

(2)

(iii) Even at 450 °C, the reaction is very slow.

State what is used in industry to overcome this problem.

(1)

(c) (i) Calculate the minimum volume of hydrogen required to completely convert 1000 dm^3 of nitrogen into ammonia.

(1)

volume of hydrogen = ... dm^3

(ii) Ammonia is reacted with excess nitric acid, HNO_3, to make ammonium nitrate, NH_4NO_3.

$$NH_3 + HNO_3 \rightarrow NH_4NO_3$$

Calculate the mass of ammonium nitrate produced by the complete reaction of 34 g of ammonia.

(Relative atomic masses H = 1.0, N = 14, O = 16)

(3)

mass of ammonium nitrate produced = ... g

Topic 5 Separate chemistry

Q1.

Transition elements and their compounds have many uses.

Iron oxide and cobalt oxide have been added to the glazes on pottery for hundreds of years.

*(c) The reaction between nitrogen and hydrogen is exothermic.

$$N_2 + 3H_2 \rightleftharpoons 2NH_3$$

If nitrogen and hydrogen were reacted at 150 atm pressure and 300 °C, without a catalyst, some ammonia would be formed.

In the Haber process a pressure of 150 atm and a temperature of 450 °C are used, in the presence of an iron catalyst.

Explain why the conditions used in the Haber process are better than the first set of conditions for the manufacture of ammonia.

(6)

(a) State why transition metal oxides are added to pottery glazes.

(1)

.....

(b) Cobalt oxide is reacted with hydrogen to form cobalt.

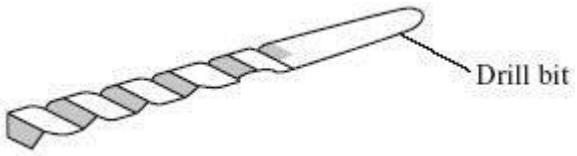
(i) Balance the equation for this reaction.

(1)

$$Co_3O_4 + \ldots\ldots H_2 \rightarrow 3\,Co + \ldots\ldots H_2O$$

(ii) Cobalt is mixed with other transition metals to make alloys.

These alloys are used to make cutting tools which remain sharp at very high temperatures. They can cut through other metals.



Suggest **two** properties of transition metals that make them suitable for making cutting tools.

(2)

1 .....

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2 .....

.....

Physics Questions Paper 1 (Separate)

Q1.
A student lifts a toy car from a bench and places the toy car at the top of a slope as shown in Figure 2.

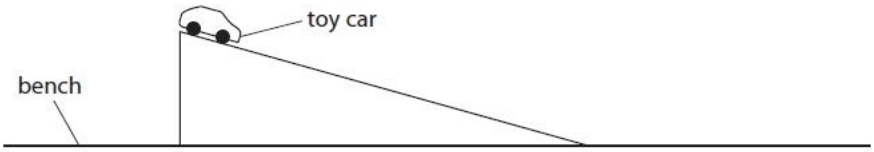


Figure 2

When the toy car rolls down the slope, some energy is transferred to the surroundings as thermal energy.

State how the student could calculate the amount of energy transferred to the surroundings.

(1)

.....

.....

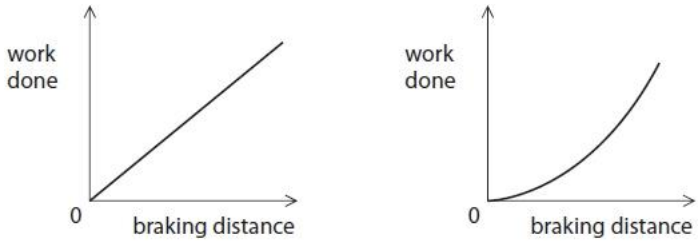
Q2.

The work done to bring a car to rest is given by the equation

work done = braking force × braking distance

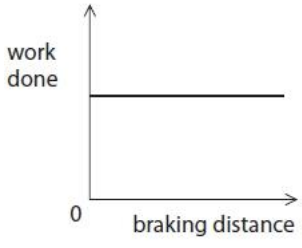
Which of these graphs is correct for the car if a constant braking force is applied?

(1)

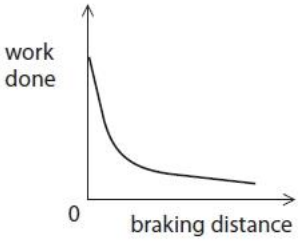


☒ **A**

☒ **B**



☒ **C**



☒ **D**

(Total for question = 1 mark)

Q3.
Figure 9 represents a decay that can happen inside the nucleus of an atom.

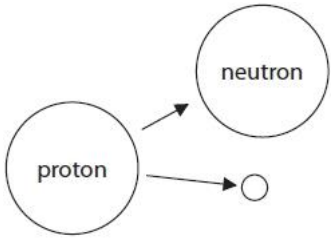


Figure 9

Which decay is represented in Figure 9?

(1)

- ☒ **A** alpha
- ☒ **B** beta minus
- ☒ **C** beta plus
- ☒ **D** gamma

Q4.

(i) A star with a mass very much larger than the Sun

(1)

- ☒ **A** has a longer main sequence than the Sun and ends as a white dwarf
- ☒ **B** has a longer main sequence than the Sun and ends as a black hole
- ☒ **C** has a shorter main sequence than the Sun and ends as a white dwarf
- ☒ **D** has a shorter main sequence than the Sun and ends as a black hole

(ii) Which row has two correct statements about black holes?

(1)

	the gravitational field of a black hole	a black hole is formed when
☐ **A**	allows only electromagnetic radiation to escape	a nebula collapses
☐ **B**	allows nothing to escape	a very large star collapses
☐ **C**	allows nothing to escape	a nebula collapses
☐ **D**	allows only electromagnetic radiation to escape	a very large star collapses

Q5.

Two theories about the Universe are the Steady State Theory and The Big Bang Theory.

(i) The table shows some ideas about the Universe.

Which row of the table applies to the Steady State Theory?
Put a cross (☒) in the box next to your answer.

(1)

	the Universe.....	the Universe.....
☐ A	... is not expanding	... had a beginning
☐ B	... is expanding	... had a beginning
☐ C	... is not expanding	... did not have a beginning
☐ D	... is expanding	... did not have a beginning

(ii) State the name of the discovery that persuaded most scientists to prefer the Big Bang Theory to the Steady State Theory.

(1)

.....

Q6.

Figure 14 shows the hearing responses of a human, a mouse and a bird over a range of frequencies of sound.

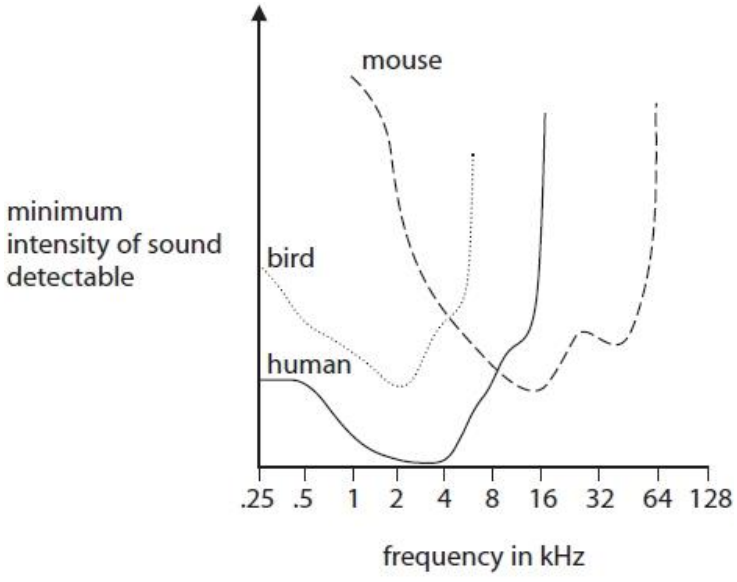


Figure 14

(i) Describe **two** differences between the hearing responses of the human and the mouse.

(2)

1 .....

.....

2 .....

.....

(ii) A farmer wants to use an alarm to scare away these birds.

State which frequency would be most effective.
Give the appropriate units.

(1)

frequency .....

(iii) State the reason for your choice of frequency in (ii).

(1)

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Q7.

A G-M tube is connected to a counter.
A teacher places the G-M tube near to a radioactive source.
A student starts the counter and clock at the same time and writes down the readings shown on the counter every 15 s.
The student plots the readings with a line of best fit, as shown in Figure 10.

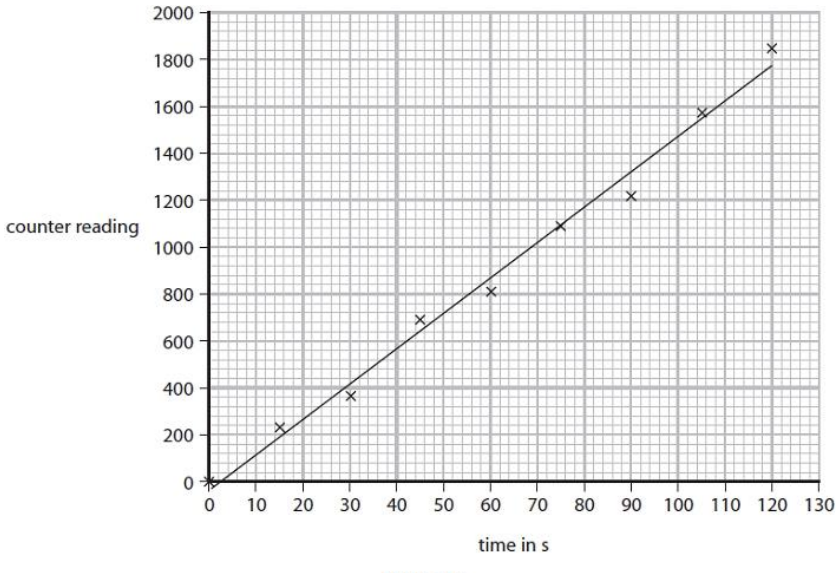

Figure 10

(i) Calculate the average count rate, in counts / s, from the graph.

Show your working on the graph.

(2)

average count rate = ... counts / s

(ii) The student says that the experiment must have been done carelessly because the data seemed quite scattered
away from the best fit line.

The teacher claims such results should be expected in radioactivity experiments.
Justify the teacher's claim.

(2)

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.....

.....

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Q8.

Carbon-13 and carbon-14 are isotopes of carbon.

Nuclei of carbon-13 and carbon-14 can be represented by these symbols

$^{13}_{6}C$ and $^{14}_{6}C$

Complete the table for an atom of carbon–13 and an atom of carbon–14.

(2)

	number of neutrons in the nucleus	number of electrons in orbit around the nucleus
carbon-13		
carbon-14		

(Total for question = 2 marks)

Q9.
To investigate refraction in a rectangular glass block a student uses the apparatus shown in Figure 5.

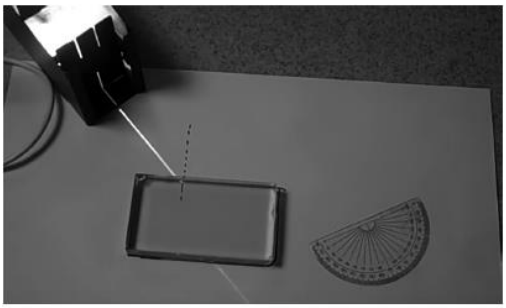

Figure 5

Describe how the student should measure the angle of refraction.

(2)

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Q10.
Nuclear fusion provides the energy source for stars including the Sun.

Describe what happens during nuclear fusion.

(3)

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Q11.
Microwaves are used to send and receive television signals from high orbit geostationary satellites.

Describe why microwaves rather than radio waves are used.

(2)

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Q12.

Carbon–14 decays into nitrogen–14.

The symbol for nitrogen–14 is $^{14}_{7}N$

Explain what happens in a carbon-14 nucleus when it decays to a nitrogen-14 nucleus.

(2)

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Q13.

Figure 11 shows an object moving in a circular path.

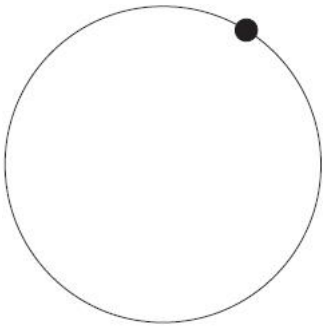

Figure 11

(i) Draw an arrow on Figure 11 to show the direction of the force that keeps the object moving in a circular path.

(1)

(ii) The object in Figure 11 is moving at constant speed.
Explain why it is not moving with constant velocity.

(2)

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Q14.
Figure 1 is a diagram of a nuclear reactor, used in the generation of electricity.

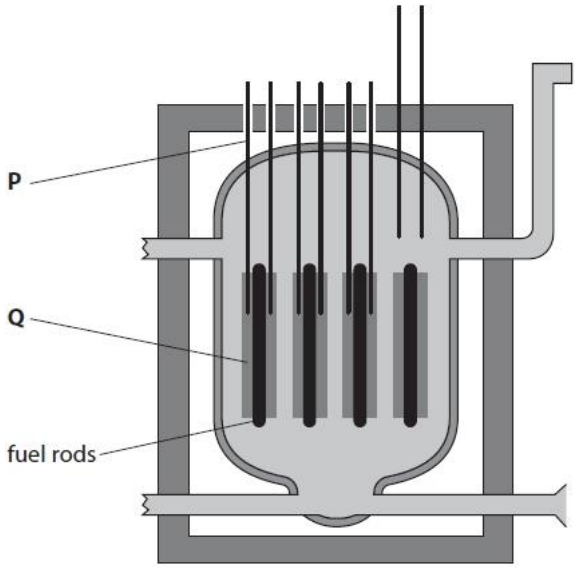

Figure 1

P may be used to shut down the reactor when necessary.
Q slows down neutrons to enable a chain reaction to take place.

State the name of the two parts labelled **P** and **Q**.

(2)

P .....

Q .....

Q15.

Energy from the nuclei of atoms can be used in medical diagnosis and treatment.

(i) Fluorine-18 is a radioactive isotope used in PET scanners for medical diagnosis.
Explain why fluorine-18 must be produced close to the hospital where it is used.

(2)

.....

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(ii) Some tumours inside the body can be treated by using either alpha radiation or gamma radiation.

Explain why the source of alpha radiation is usually inside the body but the source of gamma radiation can be outside the body.

(4)

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Q16.

A transducer can transmit and detect ultrasonic waves.

Figure 15 shows ultrasonic waves transmitted by the transducer on the bottom of a ship.

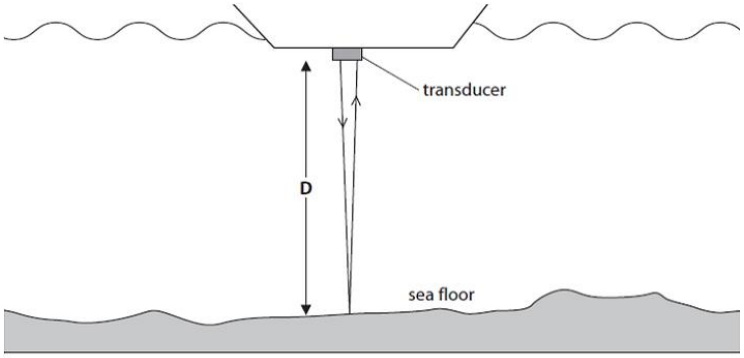

Figure 15

The waves reflect off the sea floor and are received back at the transducer.
The waves travel at 1500 m / s.
The time between transmission and reception is 48 milliseconds.
Calculate the depth of water, D, shown in Figure 15.

(2)

depth of water, D = ... m

Q17.

A radio station transmits on 97.4 MHz.

To receive the waves an aerial needs a length equal to half the wavelength of the radio waves being transmitted.

Calculate the length of the aerial needed.

The speed of the radio waves is 3.00×10^8 m / s.

(3)

length of aerial = ... m

Q18.
The half-life of cobalt-60 is 5 years.

A school cobalt source had an activity of 38.5 kBq in the year 2000.

Estimate the activity of this source in the year 2020.

(3)

activity = ... kBq

Q19.
Figure 4 is a diagram giving some information about main sequence stars.
Luminosity is a measure of how bright something is.
An increase in luminosity means an increase in brightness.

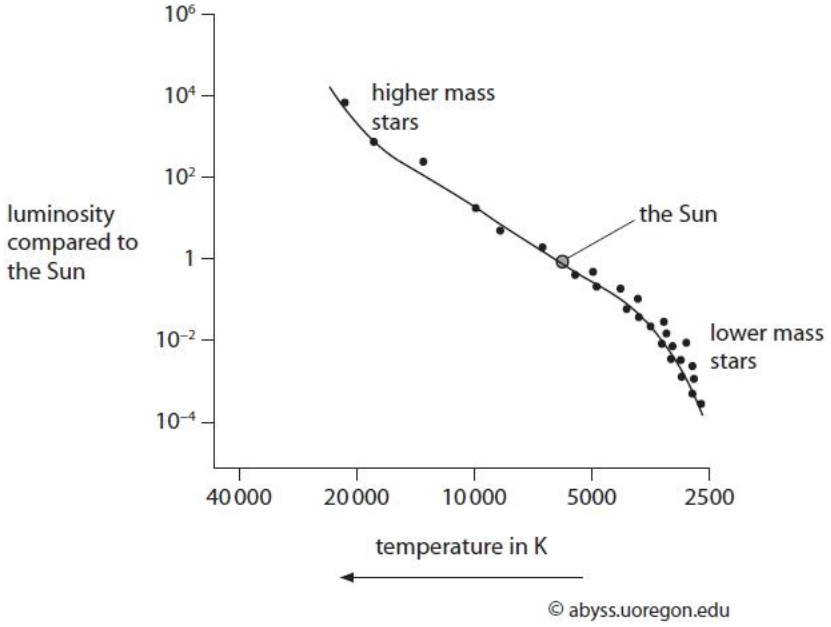

Figure 4

(i) Estimate the temperature of the Sun.

(1)

temperature of the Sun = ... K

(ii) State how the brightness of a main sequence star changes with its temperature.

(1)

.....

.....

(iii) State how the brightness of a main sequence star changes with its mass.

(1)

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Q20.

Figure 3 is a velocity / time graph for 15 s of a cyclist's journey.

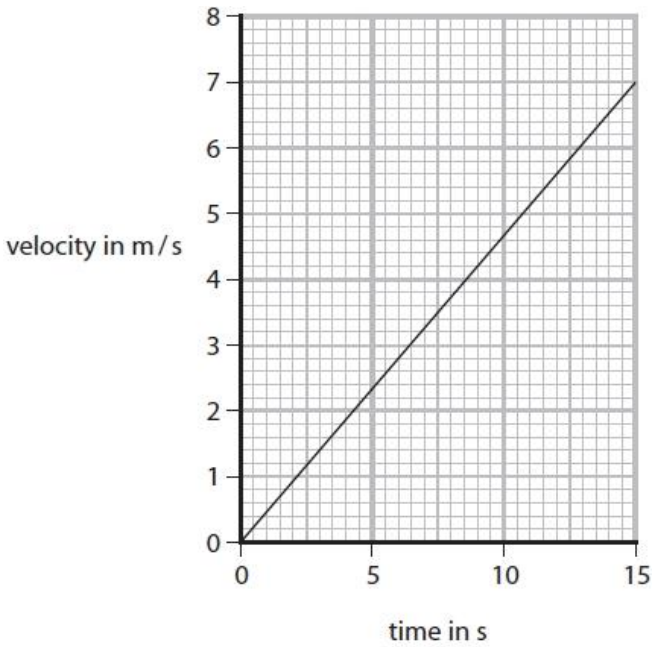

Figure 3

(i) Calculate the distance the cyclist travels in the 15 s.

(3)

distance = ... m

(ii) Another cyclist starts from rest, but his acceleration decreases as time increases.

Sketch the velocity / time graph for this cyclist on Figure 3.

(2)

Q21.

A student lifts a toy car from a bench and places the toy car at the top of a slope as shown in Figure 2.

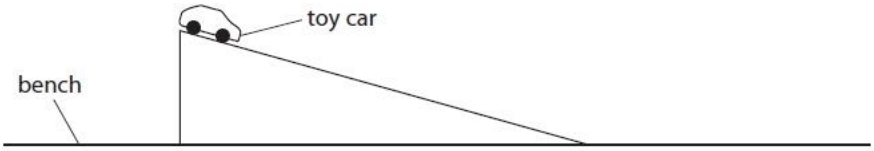

Figure 2

The student lets the toy car roll down the slope.

Describe how the student could find, by experiment, the speed of the toy car at the bottom of the slope.

(4)

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Q22.

Figure 6 is a simplified diagram to show radio waves from a transmitter moving upwards, then meeting a boundary between lower and upper layers of the atmosphere.

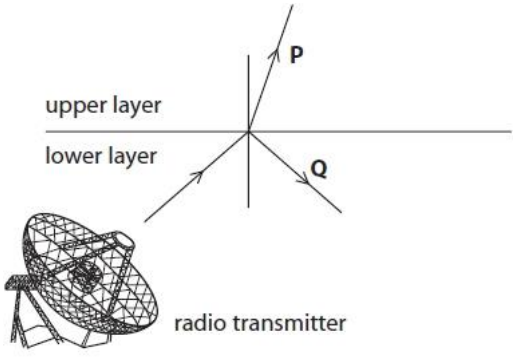

Figure 6

Explain what happens to the radio waves after they meet the boundary between the lower and upper layers as shown in Figure 6.

Your explanation should refer to changes in direction and speed of the waves.

(4)

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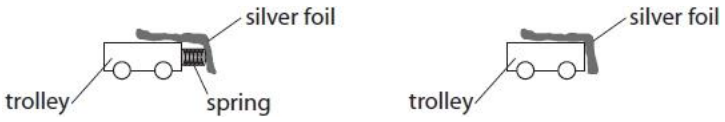
Q23.

A student investigates the effect of a crumple zone on the force exerted during a collision.

The student has one trolley with a spring at the front and another trolley without a spring.



The student uses the arrangement in Figure 13.

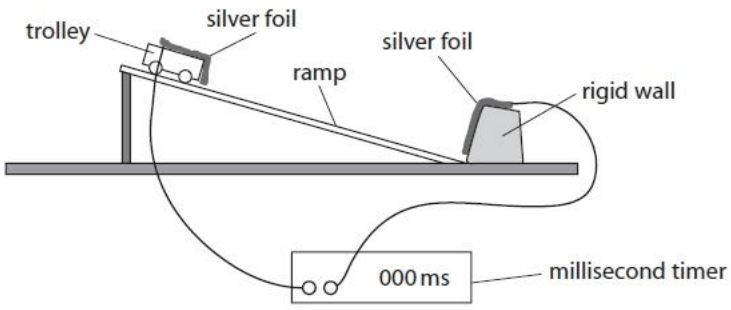


Figure 13

After a trolley is released, it accelerates down a slope and bounces off a rigid wall.

The speed of a trolley can be measured just before a collision with the wall and just after a collision with the wall.

The silver foils are connected to a millisecond timer.

The silver foils make contact with each other during the collision, so the time they are in contact can be read from the millisecond timer.

Explain how the student could investigate the effect of a crumple zone on the average force exerted during the collision.

Your explanation should include:

how to determine the force (you may wish to refer to an equation from the list of equations at the end of this paper)
how the effect of crumple zones may be shown in the investigation
precautions that may be necessary to achieve accurate results. **(6)**

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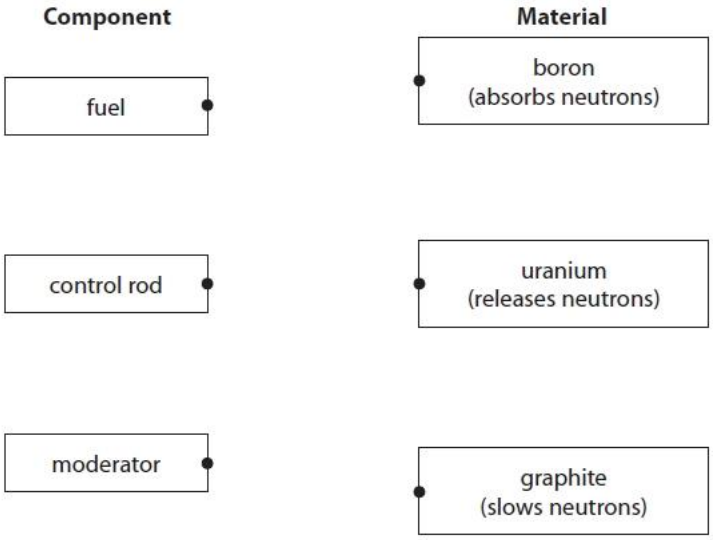
Q24.

(a) Fast neutrons are released during nuclear fission.

(i) Three different components of a nuclear fission reactor are shown. Three different materials used in a nuclear fission reactor are also shown.

Draw one line from each component to the material it contains.

(2)



(ii) Another type of nuclear reactor is a fusion reactor.

Nuclear fusion also releases fast neutrons.

Suggest why a nuclear fusion reactor does not need anything to slow these neutrons down.

(1)

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(b) Both nuclear fission and nuclear fusion release thermal energy.

Describe how the thermal energy released could be converted into electrical energy in a power station.

(3)

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*(c) Scientists and engineers are still trying to build a practical and economic nuclear fusion reactor.

They have not been able to sustain the extreme conditions needed for controlled nuclear fusion. Explain what these conditions are and why they are needed.

(6)

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Q25.

Figure 7 shows a submarine being propelled forward underwater.

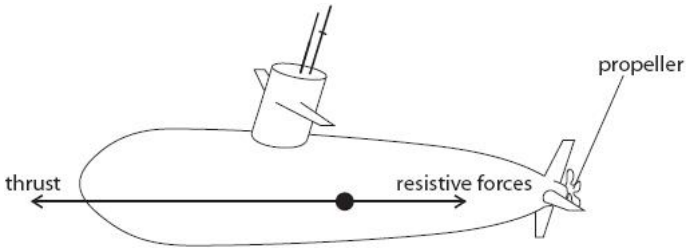

Figure 7

The thrust and the resistive forces are represented in magnitude and direction by the arrows in Figure 7.

* A submerged submarine is stationary.
The engines are put on maximum power.
The submarine moves forward.
The engines maintain maximum power.
The forces resisting the movement of the submarine increase as its speed increases.

The submarine remains horizontal. Explain how the forces acting on the submarine affect its acceleration up to and after it reaches its maximum possible speed.

(6)

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Q26.

The Big Bang theory gives an explanation for the origin of the Universe.

Explain how evidence supports the ideas that

the Universe is expanding
the Universe began at a single point.

(6)

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Mark Scheme

Q1.

Question number	Answer	Additional guidance	Mark
(i)	**Measurement** 65 (mm) / 6.5 cm (1) **Conversion** 65 mm = 65 000 µm (1) or 6.5 cm x 10 000 = 65 000 µm (1) **Division** 65 000 ÷ 50 000 (1) 1.3 (µm)	 accept 63 mm – 66 mm ecf from incorrect measurement 0.0013 x 1000 (1) ecf from incorrect conversion accept 6.5 ÷ 50 000 (1) 65 ÷ 50 000 (1) correct answer on answer line with no working 3 marks accept 1.26/1.28/1.32 (µm) for 3 marks	**(3)** AO1(2)

Question number	Answer	Additional guidance	Mark
(ii)	An answer including three of the following: • no nucleus /chromosomal DNA (1) • cell wall (1) • flagellum (1) • presence of ribosomes (1) • no membrane bound organelles / no mitochondria (1)	List rule applies: reject nucleus reject mitochondria accept DNA is in the cytoplasm accept: pilli (1) slime {coat / capsule / layer}(1) ignore: cell membrane / cytoplasm / chloroplast	**(3)** **exp** AO1 (1)

Q2.

Question number	Answer	Mark
(i)	An explanation that combines identification – application of knowledge (1 mark) and reasoning/justification – application of understanding (1 mark): • fatty acids are formed when the lipids are broken down by lipase (1) • and fatty acids are acidic (so the pH decreases) (1)	**(2)**

Question number	Answer	Mark
(ii)	An answer that combines up to a maximum of **two** points to provide a logical description: • as the temperature increases from 20 °C to 37 °C the rate of lipase activity increases (from 0.2 to 0.8) (1) • the rate of lipase activity is optimal at 37 °C (1) • above 37 °C the rate of lipase activity decreases (from 0.8 to 0.1) (1)	**(2)**

Question number	Answer	Mark
(iii)	An explanation that combines identification – application of knowledge (1 mark) and reasoning/justification – application of understanding (1 mark): • an increase in temperature above 40 °C causes changes in the shape of the active site of the enzyme (1) • therefore the enzyme becomes denatured and no longer functions (1)	(2)

Q3.

Question number	Answer	Additional Guidance	Mark
(i)	$2.0 \times 10^8 - 1.6 \times 10^7$ / 200 000 000 – 16 000 000 /184 000 000 (1) 1.84×10^8 / 1.8×10^8	award full marks for correct answer accept 18.4×10^7 or 18×10^7 for 1 mark	**(2)** AO2(1)

Question number	Answer	Additional guidance	Mark
(ii)	An explanation linking: • (myelination) speeds up impulses (1) • insulates the {axon/neurone} (1) • motor neurones transmit information from the CNS / motor neurones transmit information to effectors / neurones in the brain connect to other neurones in the brain (1) • (motor neurones) transmit information over a greater distance (than neurones in the brain) (1)	accept signals/messages for impulses accept brain/spinal cord/relay neurone for CNS accept muscles/ glands for effectors accept idea that motor neurones can be part of a reflex so need quick impulses (1)	**(3)** AO2(1)

Q4.

Question number	Answer	Mark
(i)	A 0.008 s^{-1} **The only correct answer is A** ***B*** *is not correct because 1 ÷ 25 is not a rate calculation* ***C*** *is not correct because 25 ÷ 120 is not a rate calculation* ***D*** *is not correct because 120 ÷ 25 is not a rate calculation*	**(1)** AO2(2)

Question number	Answer	Additional guidance	Mark
(ii)	An explanation including: • increasing the {beads /enzyme/lactase} {decreases the time taken for glucose to be produced / increases the rate of reaction} (1) and two of the following: • more beads increases the concentration of enzyme / more {enzyme / **lactase**} present (1) • increased chance of collisions (1) • with the active site (1) • which means more enzyme-substrate complexes are formed (1)	accept reverse argument increasing the amount of lactase/enzyme {decreased the time for glucose to be produced/increases the rate of reaction} is worth 2 marks	(3) **AO3 2a+2b**

Question number	Answer	Additional guidance	Mark
(iii)	An explanation linking the following: • lactose is the substrate (1) • to control a **variable** / it is a controlled **variable** (1) • allow results to be compared (1) • to allow a valid conclusion to be drawn /to make the experiment valid /to make the results valid (1)	ignore it is a control accept so that only **enzyme** (concentration) affects the reaction ignore: references to fair test / accurate / reliable results	**(2)** AO2(2)

Q5.

Question number	Answer	Mark
(i)	C solution Y **i. The only correct answer is C** ***A*** *is not correct because the solution does not contain starch and contains protein* ***B*** *is not correct because the solution contains protein* ***D*** *is not correct because the solution does not contain starch*	**(1)** AO3(1a)

Question number	Answer	Additional Guidance	Mark
(ii)	An answer including: • add Benedict's (reagent) (1) • heat the solution / the solution turns (brick) red (1)	accept use a water bath accept colour in the range from green-yellow- orange to red	**(2)** AO1 (2)

Q6.

Question number	Answer	Additional guidance	Mark
	An explanation linking four of the following: • changes the sequence of the mRNA (1) • produced in transcription (1) • leads to a different amino acid (in the polypeptide sequence) (1) • which is added {by tRNA/during translation/at the ribosome} (1) • changes the **shape/function** of the protein / a cone cell does not detect the coloured light correctly (1)	accept mRNA produced from the DNA sequence accept the (mRNA) determines the amino acid sequence ignore a different protein is produced	**(4)** **AO2 1**

Q7.

Question number	Answer	Additional guidance	Mark
(i)	An answer that links the following • tall is dominant (1) • they are heterozygous / have one tall allele (1)	accept short is recessive accept one of each allele ignore genes accept they have inherited one tall dominant allele for 2 marks	**(2)** **AO3** **(2a+2b)**

Question number	Answer	Additional Guidance	Mark
(ii)	Any two from: • provide {optimal/identical /best/ideal/controlled} growth conditions (1) • reduce chances of disease/ pests/pathogens (1)	 accept all grown under the same conditions accept examples of optimal conditions. accept prevent unwanted pollination	**(2)** **AO2 1**

Q8.

Question number	Answer	Additional guidance	Mark
(i)	An answer including: • light rays {refracted / bent} {at the cornea /by the lens} (1) • (light rays) {converge / focus} on the retina / focal point is on the retina (1)	 reject for references to light going through/refracted by the iris accept (refracted) onto the retina accept rods / cones for retina ignore back of the eye/optic nerve	**(2)** AO1

Question number	Answer	Additional guidance	Mark
(ii)	An explanation linking two from: • lens X which is a {diverging/concave lens} (1) • {lens X/a diverging lens/a concave lens} will {diverge/spread} out the light rays (1)	accept a {concave /diverging} lens reject lens Y	(2) Exp AO2

Q9.

Question Number	Answer	Acceptable answers	Mark
	A description including four of the following: (the process is) translation (1) (mRNA) leaves the nucleus / enters the cytoplasm (1) (mRNA joins to) ribosomes(1) tRNA carries amino acids (1) tRNA joins to mRNA / bases on tRNA matches bases on mRNA (1) (bases read as) {sets of three / triplets / idea of codons} (1) (ribosome / mRNA holds tRNA so) amino acids are joined together / to make polypeptides (1)		(4)

Q10.

Question number	Answer	Mark
(i)	A Eukarya **i. The only correct answer is A** ***B*** *is not correct because plants are not single celled prokaryotic organisms* ***C*** *is not correct because plants are not single celled prokaryotic organisms and Monera is a kingdom* ***D*** *is not correct because Protista is a kingdom and not a domain*	**(1)** **comp** AO1 (1) 4.7, 1.1

Question number	Answer	Mark
(ii)	A oxygen produced sunlight absorbed by chlorophyll **ii. The only correct answer is A** ***B*** *is not correct because photosynthesis doesn't produce carbon dioxide and sunlight is not absorbed by mitochondria* ***C*** *is not correct because sunlight is absorbed by chlorophyll not mitochondria* ***D*** *is not correct because photosynthesis doesn't produce carbon dioxide it produces oxygen*	**(1)** AO1 (1)

Question number	Answer	Mark
(iii)	Any one from: • (improved) genetic analysis (1) • DNA/RNA {screening/sequencing} (1) • domain theory is based on genetics (1) • differences between coding and non-coding DNA (1)	(1) AO1 (1)

Q11.

Question Number	Indicative content	Mark
	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are therefore not required to include all the material that is indicated as relevant. Additional content included in the response must be scientific and relevant. **Lytic lifecycle** • viruses cannot replicate outside a host • virus binds to host cells • inserts genetic material into the host cell • use the cells machinery to produce viral proteins • use the cells machinery to produce nucleic acids • components assemble into new viral particles • viruses exit the cell through the host cell membrane • or causes lysis of the host cell • allows production of many virus particles **Spread of infection** • virus particles leave the host • virus released into body fluids • spread through airborne droplets/contact • allowing spread to another host	(6) AO 1 1

Level	Mark	Descriptor
	0	No rewardable material.
Level 1	1–2	• Demonstrates elements of biological understanding, some of which is inaccurate. Understanding of scientific ideas lacks detail. (AO1) • Presents an explanation with some structure and coherence. (AO1)
Level 2	3–4	• Demonstrates elements of biological understanding, which is mostly relevant but may include some inaccuracies. Understanding of scientific ideas is not fully detailed and/or developed. (AO1) • Presents an explanation that has a structure which is mostly clear, coherent and logical. (AO1)
Level 3	5–6	• Demonstrates accurate and relevant biological understanding throughout. Understanding of the scientific ideas is detailed and fully developed. (AO1) • Presents an explanation that has a well-developed structure which is clear, coherent and logical. (AO1)

Q12.

Question number	Answer	Additional guidance	Mark
(i)	One mark for gametes One mark for the offspring 25 (%) (1)	accept aA accept ecf from the Punnett square	(3) AO3 2a+2b Exp

	A	a
A	AA	Aa
a	Aa	aa

Question number	Answer	Additional guidance	Mark
(ii)	An answer linking the following: • genetic variation increase / (offspring) show variation (1) • more likely to survive {a disease / environmental change / selection pressure} / allows evolution/survival of the fittest (1)	accept different combination of alleles accept allows dispersal of offspring through seeds accept other examples of a survival reason e.g natural disaster	(2) AO2 1

Q13.

Question Number	Answer	Additional guidance	Mark
(i)	• spread {each bacterial species/the bacteria} on a different agar plate, add myxopyronin discs and incubate the plates (1) • {measure / compare} the zone of inhibition (1)	accept filter discs for myxopyronin discs accept descriptions of a zone of inhibition	(2) AO 1 2

Question Number	Answer	Additional guidance	Mark
(ii)	An explanation that links four of the following: • antibiotics destroy bacteria / prevent them reproducing (1) • doesn't affect {eukaryotic cells/host cells/human cells/human RNA polymerase} (1) • prevents production of mRNA /prevents RNA polymerase binding (1) • during transcription /prevents transcription (1) • prevents proteins being produced /no protein synthesis (1)	ignore inhibit the bacteria/inhibit cell processes accept does not harm humans accept RNA polymerase produces mRNA	(4) AO 2 1

Q14.

	Answer	Acceptable answers	Mark
(a)(i)	A description including the following points: • increase in concentration of glucose / glucose diffused into water/eq (1) • levels off after 20 mins / at 0.79 g/cm^3(1)	small increase, followed by greater increase / eq	(2)
(a)(ii)	An explanation including **three** of the following points: • starch broken down into glucose (1) • by enzymes / amylase / carbohydrase (1) • glucose passes through visking tubing / eq (1) • by diffusion (1) • down the (glucose) concentration gradient (1) • (net) diffusion stops when all starch is broken down / concentration of glucose is equal inside and outside the tubing	reject: references to osmosis or active transport accept: from area of high concentration to area of low concentration	(3)

		Indicative Content	Mark
QWC	*(a)(iii)	An evaluation including some of the following points: Strengths • thin membrane • permeable membrane • presence of amylase	(6)

		• presence of (large) starch molecules • digestion into glucose • glucose diffuses out • concentration gradient • water represents the blood weaknesses • membrane not one cell thick • not a large surface area • shorter length / not same size • no villi /micro villi • only carbohydrate digestion • no other enzymes present • no peristalsis • no blood movement • other factors e.g. pH	

	Answer	Acceptable answers	Mark
(b)	**C** store bile		**(1)**

Question Number		Indicative Content	Mark
QWC	* **(c)**	A explanation to include some of the following points • active transport requires energy • (active transport moves mineral ions) from the soil • into root (hair cells) • reference to pumps (in the cell membranes) • from a low concentration to a high concentration/against their concentration gradient • reference to mineral ions / mineral salts accept named minerals eg nitrates • diffusion is a passive process • gases diffuse from high to low concentration/down their concentration gradient • gas exchange in the leaf occurs by diffusion • carbon dioxide diffuses in • to air spaces in leaves / into cells • for photosynthesis / produces glucose • oxygen diffuses in • for respiration	**(6)**

Q15.

Question number	Answer	Additional Guidance	Mark
	Any three from: • mitosis produces 2 cells and meiosis produces 4 cells (1) • mitosis produces **genetically** identical cells and meiosis produces **genetically** different cells (1) • mitosis produces diploid cells and meiosis produces haploid cells (1) • mitosis produces body cells and meiosis produces {gametes /sex cells} (1)	accept offspring for cells mitosis is involved in asexual reproduction and meiosis is involved in sexual reproduction (1)	AO1 1 **(3)**

Q16.

Question number	Answer	Mark
(ii)	TACGTACATGGC	**(1)**

Question number	Answer	Additional guidance	Mark
(iii)	• 3.33×10^{-10} equals 0.33 nm (1) • $0.33 \times 250 = 82.5$ (nm) (1)	maximum one mark if no conversion to nm award full marks for correct numerical answer without working	**(2)**

Q17.

Question number	Answer	Mark
(i)	• 4.6 million – 4.4 million (1) • 0.2 million years/200 000 years (1)	**(2)**

Question number	Answer	Additional guidance	Mark
(ii)	An answer that combines knowledge (1 mark) and understanding (1 mark) to provide a logical description: • (scientists might look for) differences in the structural features of the fossil (1) • and *Ardipithecus ramidus* would be deeper in the rock layer than *Homo* {*habilis*/stone tools} (1)	e.g. *Ardipithecus ramidus* smaller cranial capacity	**(2)**

Question number	Answer	Additional guidance	Mark
(iii)	An explanation that combines identification – application of knowledge (1 mark) and reasoning/justification – application of understanding (1 mark): • likely to be out-competed by *Homo erectus* (1) • {for resources essential for survival/due to the presence of a new selection pressure} (1)	accept: named resources accept: named selection pressure, e.g. climate change, environmental change, disease	(2)

Question number	Answer	Additional guidance	Mark
(iv)	An explanation that combines identification via a judgement (1 mark) to reach a conclusion via justification/reasoning (1 mark): • stone tool B because it is more {sophisticated/worked} (1) • and *Homo erectus* lived more recently than *Homo habilis* (1)	accept: data quoted from the timeline	(2)

Q18.

Question number	Answer	Additional guidance	Mark
	An explanation linking four of the following:		(4) AO2 1
	• the population of great tits shows variation (1)	accept there is a mutation that leads to some birds having longer beaks	
	• bird feeders provide a selection pressure (1)		
	• birds with longer beaks {can feed from bird feeders/get more food} (1)	accept there is competition for food / birds with longer beaks outcompete accept birds with shorter beaks can't get food	
	• these birds are more likely to {survive/ reproduce} / survival of the fittest (1)	accept birds with shorter beaks die out	
	• pass the {allele/gene /characteristic} for long beaks to their offspring (1)	accept offspring have long beaks	
	• over many generations the beak length of the bird population increases (1)	accept the process continues/repeats itself	

Q19.

Question number	Answer	Additional guidance	Mark
	An explanation linking four of the following: • people do not finish their course (of Colistin) (1) • natural selection /evolution (occurs) (1) • some bacteria have a mutation/ (genetic) variation (1) • (these) resistant bacteria survive /resistant bacteria reproduce (1)	 accept overuse / repeated exposure (to the antibiotic) accept they have evolved accept some bacteria have a {**gene/allele**} for resistance accept the non-resistant bacteria die / the fittest bacteria survive ignore immune bacteria	**(4)** AO2 1

Q20.

Question number	Answer	Mark
	An answer that combines knowledge (1 mark) and understanding (2 marks) to provide a logical description: • white blood cells (1) • produce antibodies (1) • memory lymphocytes/cells produced (that provide immunity) (1)	**(3)**

Q21.

Question Number	Answer	Additional guidance	Mark
(i)	Any two from: • wash hands after contact (1) • avoid direct contact / wear {gloves/protective clothes} (1) • wear a (protective) mask (1) • **sterilise** equipment {before /after} use (1)	 accept hand gels accept protect your face be immunised (1)	**(2)** AO 2 2

Question Number	Answer	Mark
(iii)	A it does not have flagella **1. The only correct answer is A** ***B*** *is not correct because plasmids do not allow motility.* ***C*** *is not correct because it does have ribosomes.* ***D*** *is not correct because acrosomes are not found in bacteria.*	**(1)** AO 2 1

TOPIC 1 Key concepts in chemistry Mark schemes

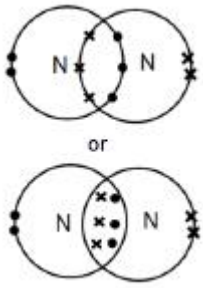
Q2.

(a) six electrons in the overlap
allow dots, crosses or $e^{(-)}$ for electrons

1

2 non-bonding electrons on each nitrogen atom
***2** marks for an answer*

1



(b) weak forces *of:*

between molecules
or
intermolecular
do not allow references to between molecules

1

covalent bonding

(which) need little energy to overcome

1

(c) each (carbon) atom forms three covalent bonds

1

forming layers (of hexagonal rings)

1

(soft)
(because) layers can slide over each other

1

(conducts electricity)
(because of) delocalised electrons

1

(d) molecules are spherical

1

(so molecules) will roll

1

(e) surface area (= 20 × 20 × 6) = 2400 (nm^2)

1

volume (= 20^3) = 8000 (nm^3)

1

ratio = 0.3 (nm^3): 1 (nm^3)
ratio = 0.3 (nm^3): 1 (nm^3)
or
1 (nm^3): 3.33 (nm^3)

1

(f) (nanoparticles) have a larger surface area to volume ratio

1

so less can be used for the same effect

Q3.

(a) magnesium loses two electrons **and** chlorine gains one electron
*accept magnesium loses electrons **and** chlorine gains electrons for 1 mark*
ignore oxidation and reduction

2

one magnesium and two chlorines
accept $MgCl_2$

1

noble gas structure
or
eight electrons in the outer shell
accept full outer shell (of electrons)
or
(electrostatic) attraction between ions
or
forms ionic bonds
*do **not** accept covalent bonds*

1

*reference to incorrect particles **or** incorrect bonding **or** incorrect structure = **max 3***

TOPIC 2 – States of matter and mixtures Mark Scheme

Q1.

Question Number	Answer	Additional guidance	Mark
(i)	(white/colourless) solid/crystals	ignore reference to colourless solution	**(1)**

Question Number	Answer	Mark
(ii)	filtration	**(1)**

Q2.

Question number	Answer	Mark
	One mark for each correct row.	(3)

substance to separate	method of separation: crystallisation	filtration	simple distillation	fractional distillation
sand from a mixture of sand and sodium chloride solution		✓		
copper sulfate crystals from copper sulfate solution	✓			
useful liquids from crude oil				✓

Q3.

Question number	Answer	Additional guidance	Mark
(i)	water (in the paper) (1)	allow (chromatography/filter) paper	**(1)**

Question number	Answer	Additional guidance	Mark
(ii)	EITHER so that the solvent will run through the spots OR otherwise the spots transfer into the solvent	ignore spots will smudge allow water in place of solvent allow spots {soak/mix/dissolve/wash} into water allow spots will not rise up the paper/ spots will not separate allow (food) colourings/dyes/colours/dots for spots throughout	(1)

Question number	Answer	Additional guidance	Mark
(iii)	(V is) insoluble (in the solvent)	ignore immiscible allow doesn't contain any soluble substances	(1)

Question number	Answer	Additional guidance	Mark
(iv)	An explanation that combines identification via a judgement (1 mark) to reach a conclusion/reasoning (1 mark): • (mixture) Z (1) • because it gives {the greatest number of / the most / 4} spots (1)	ignore 'greatest number of soluble coloured substances' allow dots for spots 2nd mark dependent on 1st	(2)

Question number	Answer	Additional guidance	Mark
(v)	• R_f = 5.8 (1) (=0.8787..) 6.6 • = 0.88 (1) (to 2 sig fig)	award full marks for correct numerical answer to 2 sig figs without working. 0.87878787 rounded to any other no of sig figs (1) any manipulation of the 2 numbers with working rounded to 2sf (1) ignore any units	(2)

Topic 3: ACID BASE REACTIONS Mark Scheme

Q1.

Question Number	Answer	Mark
	$H^+ + OH^- \rightarrow H_2O$ (2) left hand side (1) right hand side (1)	(2)

Q2.

Question Number	Answer	Acceptable answers	Mark
(i)	**D** salt and water only		(1)

Question Number	Answer	Acceptable answers	Mark
(ii)	A description to include two from • (green) solid {disappears / dissolves} (1) • effervesces / bubbles (of colourless gas) given off (1) • blue (solution) forms (1)	 ignore references to names of products fizz goes blue ignore incorrect colours of solution ignore temperature rise	(2)

Q3.

Question Number	Answer	Additional guidance	Mark
(i)	**C** neutral (1)		(1)

Question Number	Answer	Mark
(ii)	An explanation that combines identification - application of knowledge (1 mark) and reasoning/justification - application of understanding (1 mark) • to react all the (nitric) acid in the solution (1) • so that the calcium nitrate solution is pure (1)	(2)

Question Number	Answer	Mark
(iii)	$CaCO_3 + 2HNO_3 \rightarrow Ca(NO_3)_2 + H_2O + CO_2$ (3) left hand side formulae (1) right hand side formulae (1) balancing correct formulae (1)	(3)

Q4.

	Answer	Acceptable answers	Mark
	magnesium sulphate	accept magnesium sulphate	(1)

Q5.

Question number	Answer	Additional guidance	Mark
(i)	neutralisation OR exothermic	allow exothermic	(1)

Question number	Answer	Mark
(ii)	**D** ammonium nitrate is the only correct answer **A** is incorrect because the cation is ammonium and the anion is nitrate **B** is incorrect because the cation is ammonium **C** is incorrect because anion is nitrate	(1)

Q6.

	Answer	Acceptable answers	Mark
	D AgCl(s)		(1)
	same/no change		(1)
	$HCl + AgNO_3 \rightarrow AgCl + HNO_3$ • reactant formulae (1) • product formulae (1)	$Ag^+ + Cl^- \rightarrow AgCl$ max 1 if any incorrect attempt to balance reject incorrect use of cases and non-subscripts	(2)

Topic 3 and 5 – Titration Mark scheme:

Q1.(a) (i) burette **1**

(ii) conical flask

accept conical / flask **1**

(b) (i) an indicator **1**

(ii) changed colour **1**

(iii) titration **1**

(c) 3

*correct answer = **2** marks*

*(1 × 3) or (1 × 750/250) = **1** mark* **1**

(d) (i) hydrogen **2**

(ii) is partially ionised **1**

Q2.(a) (strong because) completely ionised (in aqueous solution)

ignore pH

allow dissociated for ionised

*do **not** accept hydrogen is ionising*

*do **not** accept H^+ are ionised*

1

(dilute because) small amount of acid per unit volume

ignore low concentration

1

(b) 5.0

allow 5 **1**

(c) (titre): chooses titrations 3, 4, 5 **1**

average titre = 22.13 (cm^3)

allow average titre = 22.13(3…) (cm^3)

allow a correctly calculated average from an incorrect choice of titrations

1

(calculation):

(moles NaOH = $\frac{22.13}{1000} \times 0.105 = 0.002324$)

allow use of incorrect average titre from step 2 **1**

(moles H_2SO_4 =

½ × 0.002324 =) 0.001162

allow use of incorrect number of moles from step 3 **1**

(concentration = $\frac{0.001162}{25} \times 1000$)

= 0.0465 (mol/dm^3)

allow use of incorrect number of moles from step 4 **1**

alternative approach for step 3, step 4 and step 5

$\frac{2}{1} = \frac{22.13 \times 0.105}{25.0 \times conc.\ H_2SO_4}$ *(1)*

(concentration H_2SO_4 =) $\frac{22.13 \times 0.105}{25.0 \times 2}$

= 0.0465 (mol/dm^3) (1)

*an answer of 0.046473 **or** 0.04648 correctly rounded to at least 2 sig figs scores marking points 3, 4 and 5*

*an answer of 0.092946 **or** 0.09296 **or** 0.185892 **or** 0.18592 correctly rounded to at least 2 sig figs scores marking points 3 and 5*

*an incorrect answer for one step does **not** prevent allocation of marks for subsequent steps*

(d) pipette measures a fixed volume (accurately) **1**
(but) burette measures variable volume
allow can measure drop by drop **1**

(e) $(\text{moles} =) \frac{30}{1000} \times 0.105$
or 0.00315 (mol)
or (mass per dm^3 =) 0.105 × 40
or 4.2 (g) **1**
$(\text{mass} = \frac{30}{1000} \times 0.105 \times 40)$
= 0.126 (g) **1** *an answer of 0.126 (g) scores **2** marks an answer of 126(g) scores **1** mark*

Topic 3 - Electrolysis mark scheme

M1.(a) electricity
allow an electric current
1

(b) (i) chlorine/Cl_2
*do **not** accept chloride*
1

(ii) (zinc ions are) positive
ignore to gain electrons
1

and (opposite charges) attract
1

(iii) reduction
1

(c) (i) in alloy:
accept converse
different sized atoms/particles
or
no layers/rows
accept layers distorted
1

so cannot slide
1

(ii) shape memory (alloys)
accept smart
1

***M2.**(a) magnesium loses two electrons **and** chlorine gains one electron*
*accept magnesium loses electrons **and** chlorine gains electrons for 1 mark*
ignore oxidation and reduction
2

one magnesium and two chlorines
accept $MgCl_2$
1

noble gas structure
or
eight electrons in the outer shell
accept full outer shell (of electrons)
or
(electrostatic) attraction between ions
or
forms ionic bonds

*do **not** accept covalent bonds*

1

*reference to incorrect particles **or** incorrect bonding **or** incorrect structure = **max 3***

(b) (i) because ions can move

ignore ions attracted
*do **not** accept molecules / atoms moving*
*do **not** accept incorrect reference to electrons moving*

1

(and ions move) to the electrodes
or
(and ions) carry charge

1

accept converse for solid

(ii) magnesium (ions) attracted (to the electrode)

1

so magnesium ions gain electrons

accept magnesium ions are reduced
ignore oxidised

1

2 electrons

*accept a correct half equation for 2nd **and** 3rd marking points*

1

(iii) hydrogen

allow H_2

1

(iv) magnesium is more reactive than hydrogen

accept converse
*allow magnesium is high in the reactivity series **or** magnesium is very/too reactive.*
*do **not** accept magnesium ions are more reactive than hydrogen ions*

1

*(v) **2** $Cl^- \rightarrow Cl_2 + \mathbf{2}e^-$*

must be completely correct

Topic 4-5 Mark scheme

Q1

Answer	Acceptable answers	Mark
natural gas		**(1)**

Answer	Acceptable answers	Mark
An explanation linking forward and back reactions take place / reversible / dynamic (1) at the same rate / equilibrium (1)	dynamic equilibrium = 2 marks	 **(2)**

Question Number	Answer	Acceptable answers	Mark
(a)	An explanation linking Marking point 1 – one from • forward and back reactions take place (at the same time) (1) • rate of the forward and back reactions is the same (1) Marking point 2 – one from • no (overall) change in the {amount/concentration/mass/ volume} of each {substance / reactant / product} (1) • no observable change (1)	assume 'both reactions' implies the forward and back reaction allow reversible reaction with the same rate (1) allow reversible reaction in a closed system (1) do not allow the forward reaction equals the reverse reaction allow overall effect is nil (1) allow reactants and products reach a balance (1) ignore forward reaction cancels out back reaction do not allow {amount / concentration /mass/volume} of reactants and products are equal	**(2)**

Question Number	Answer	Acceptable answers	Mark
(b)(i)	An explanation linking two of • higher pressure favours forward reaction/equilibrium shifts to the right (1) • because decrease in {volume / number of molecules}/side with lower volume (1) • yield increases (1)	ignore answers related to rate/collisions maximum (1) if 3 statements given, but 1 is incorrect	**(2)**

Q2

Question Number	Answer	Acceptable answers	Mark
(b)(ii)	An explanation linking any two of • lower temperature favours forward reaction/equilibrium shifts to the right (1) • because (forward) reaction is exothermic (1) • yield increases (1)	ignore answers related to rate/collisions if answer refers to increasing temperature, maximum (1) for (forward) reaction is exothermic / reverse reaction is endothermic maximum (1) if 3 statements given, but 1 is incorrect	**(2)**

uestion umber	Answer	Acceptable answers	Mark
(b)(iii)	catalyst	iron	**(1)**

Topic 5 Mark schemes

Q1.

(a) colour

1

(b) Fe_2O_3 or $(Fe^{3+})_2\ (O^{2-})_3$

2 and 3 should be below halfway on Fe and O

1

(c) (i) 4 4

or correct multiples

1

(ii) any **two** from:

ignore references to malleable / ductile / conductivity / stiff / boiling point / density

- high melting point
  accept can withstand high temperatures
- strong / tough
  accept <u>not</u> brittle
- hard
  *do **not** accept flexible*
- not (very) reactive

2

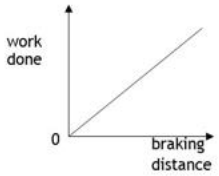
[5]

Physics Questions Paper 1 (Separate) - ANSWERS

Q1.

Question number	Answer	Additional guidance	Mark
	(original) GPE – KE (at bottom) (1)	allow (idea of) input – output allow wrong way round (eg output-input)	**(1)**

Q2.

Question Number	Answer	Mark
	 ☒ A **The only correct answer is A (showing direct proportionality)** **B** is not correct – curve (not showing direct proportionality) **C** is not correct – constant value shown (not showing direct proportionality) **D** is not correct – curve (not showing direct proportionality)	**(1)**

Q3.

Question number	Answer	Mark
	☒ C beta plus Options A, B and D are not represented by Figure 9.	**(1)**

Q4.

Question number	Answer	Mark
(i)	B	**(1)**

Question number	Answer	Mark
(ii)	B	**(1)**

Q5.

Question Number	Answer	Acceptable answers	Mark
(i)	**D** ..is expanding ... did not have a beginning		**(1)**

Question Number	Answer	Acceptable answers	Mark
(ii)	Cosmic Microwave Background (Radiation)	[order of words unimportant] CMB(R) reject 'CMB and red shift'	**(1)**

Q6.

Question number	Answer	Additional guidance	Mark
(i)	Any two valid differences e.g. mice are (more) sensitive to higher frequencies (than humans) (1) humans are (more) sensitive to lower frequencies (than mice) humans have a lower intensity of sound (threshold) to just hear (1) mice have two minima on the graph, humans one (1)	 humans more sensitive (overall / for lower frequencies) two particularly sensitive frequencies	**(2) grad**

Question number	Answer	Additional guidance	Mark
(ii)	number **and unit** must both be correct to get the mark 2.5 kHz **OR** 2.5 kilohertz	 acceptable range 2.0 to 3.0 kHz 2.0 to 3.0 kilohertz	**(1) cler**

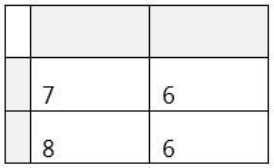
Question number	Answer	Additional guidance	Mark
(iii)	(this frequency corresponds with) most sensitive / the minimum (frequency) (1)		**(1) grad**

Q7.

Question number	Answer	Additional guidance	Mark
(i)	use of gradient on graph (1) = $\frac{1480}{97}$ evaluation (1) 15.3 (counts /s)	look for a triangle / line going up allow $\frac{1480}{100}$ accept other data from the graph allow numbers between 12.0 and 16.0 award full marks for answers in the correct range without working	**(2)**

Question number	Answer	Additional guidance	Mark
(ii)	explanation the process (of radioactive decay) is unpredictable / (occurs) random(ly) (1) so the count rate would not be constant / there will be variations with each reading (1)	 do not allow 'difficult to predict' ignore background results (expected to) scatter	(2)

Q8.

Question Number	Answer	Additional guidance	Mark
	 (1) (1)	one mark for each column must have both numbers in a column correct to get the mark	(2)

Q9.

Question number	Answer	Additional guidance	Mark
	A description including two from: trace / mark where the ray went into and out of(through) the glass block / line on either side of glass block(1) (remove block) join entry and exit points (of ray of light) (1) use the protractor to measure the angle between the refracted/drawn ray and the normal (1)	 accept 90° line etc.	(2)

Q10.

Question number	Answer	Additional guidance	Mark
	A description to include any three of the following (smaller) nuclei / atoms / particles (1) come together / join (1) to produce a larger nucleus / atom / particle (1) needing high temperature / pressure (1) overcoming repulsion (between nuclei) (1) energy released (1)	 two named eg hydrogen (nuclei) allow fuse not 'bond' helium for nucleus accept fast (moving) nuclei ignore energy created	(3)

Q11.

Question number	Answer	Additional guidance	Mark
	An answer that combines the following points of understanding to provide a logical description: • radio waves will not reach the satellites (from Earth) / be received (on Earth) from the satellites (1) • because they are reflected by the atmosphere (1)	ORA for microwaves reflected by ionosphere / before reaching satellite	**(2)**

Q12.

Question Number	Answer	Additional guidance	Mark
	An explanation linking: neutron (decays) to proton (1) beta emitted (1)	mass number stays the same but atomic number increases by 1 accept answers in terms of quarks (dud becomes uud) beta decay / β seen NOT β^+/beta plus allow (fast) electron emitted allow for 2 marks: n □ p + e OR $^{14}_{6}C \rightarrow {}^{14}_{7}N + {}^{0}_{-1}\beta^{(-)}$	**(2)**

Q13.

Question Number	Answer	Additional guidance	Mark
(i)	single arrow towards centre of the circle applied to the object (1)	judge by eye	**(1)**

Question Number	Answer	Additional Guidance	Mark
(ii)	an explanation including velocity is a vector (1) (because) direction changes (1)	velocity has (magnitude and) direction / velocity is speed in a (certain) direction	(2)

Q14.

Question number	Answer	Additional guidance	Mark
	P - control rods (1) Q - graphite/moderator (1)	boron steel rods heavy water	(2)

Q15.

Question Number	Answer	Additional guidance	Mark
(i)	an explanation including: (fluorine-18 has) a short half-life (1) (so) it must be **used** as soon as possible after making (1)	decays too quickly related to transport / proximity ignore arguments about harm to person / the environment	(2)

Question Number	Answer	Additional guidance	Mark
(ii)	an explanation including: **alpha** short range/low penetration (1) (so) needs to be close to the tumour (1) **gamma** long range/high penetration (1) (so) can get into the body from outside (1)	 accept highly ionising accept weakly ionising pass through the skin 'alpha more ionising than gamma' 1 mark by itself	**(4)**

Q16.

Question number	Answer	Additional guidance	Mark
	recall and substitution (1) D = ½ v x t = ½1500 x 0.048 evaluation (1) 36 (m)	 award full marks for the correct answer without working award 1 mark only for 72 m (i.e. ½ ignored)	**(2) grad**

Q17.

Question number	Answer	Additional guidance	Mark
	recall **and** rearrangement (1) $\lambda = \frac{v}{f}$ evaluation (1) 3.08 (m) (so) length of aerial = 1.54 m (1) check working $\frac{3\times10^8}{2} = 1.5 \times 10^8$ gets only 1 mark for ecf	 $\frac{3.0\ (\times 10^8)}{97.4\ (\times 10^6)}$ accept 3.1 (m) award 1 mark for wavelength that rounds to 3.1 to any other power of 10 independent mark. allow ECF from candidate's wavelength accept 1.5 (m) award 2 marks for 1.5 to any other power of 10 award full marks for the correct answer without working Allow 1.46 rounded to 1.5 for 1 mark only if it is ecf from mp2	**(3)**

Q18.

Question number	Answer	Additional guidance	Mark
	recognition of there being **4 half lives** involved (1) so fraction of **1/16** involved (1) evaluation (1) 2.4 (kBq)	 allow 2 marks for 4.8 (kBq) (used three instead of 4 half lives) allow 1 mark for any other $(1/2)^n$ being involved i.e. for answers that round to 19.3 (kBq), 9.63 (kBq), 1.2(kBq) award full marks for the correct answer without working	**(3)**

Q19.

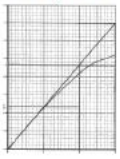
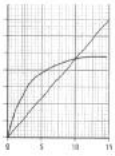
Question number	Answer	Additional guidance	Mark
(i)	accept any temperature between 5500 and 7500 (K) (1)		**(1)**

Question number	Answer	Additional guidance	Mark
(ii)	the greater the temperature the higher the brightness	or reverse argument allow luminosity for brightness allow heat for temperature	**(1)**

Question number	Answer	Additional guidance	Mark
(iii)	the greater the mass the higher the brightness	or reverse argument allow luminosity for brightness allow bigger/ heavier for greater mass in this context	(1)

Q20.

Question number	Answer	Additional guidance	Mark
(i) CLIP WITH GRAPH	distance = area under graph (1) ½ × 7 × 15 (1) 52(.5) (m) (1)	attempt to find area seen on graph correct area(s) identified including calculation 53 (m) allow 7 × 15 or 105 for 1 mark only award full marks for the correct answer with no working	(3)

Question number	Answer	Additional guidance	Mark
(ii) CLIP WITH GRAPH H paper	(curve) <u>starting</u> from 0,0 (1) of decreasing gradient (1)	curve can be above or below the line both of these are acceptable  	(2)

Q21.

Question number	Answer	Additional guidance	Mark
	A description to include: measurement of (relevant) distance (1) measurement of (relevant) time (1) use of speed = $\frac{\text{distance}}{\text{time}}$ (1) detail (1)	 one of distance down slope or distance along bench or length of toy car/card 'record the distance the car travels and time it' scores 2 marks for example: speed down slope × 2 mark distance along bench use a light gate speed gun at the bottom of the slope repeating AND averaging	**(4)**

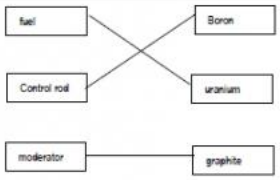
Q22.

Question number	Answer	Additional guidance	Mark
	explanation linking: wave P refracts (towards the normal) (1) because P slows down (1) AND wave Q is reflected (at an equal angle from the boundary) (1) without change of speed of Q (1)	 accept 'upper layer' for 'P' accept 'wavelength decreases' accept 'bends' for 'refracts' in this instance accept 'lower layer' for 'Q' accept 'wavelength unchanged' accept 'wave Q bounces off' (at an equal angle) allow one mark for refraction and reflection if no other mark awarded	**(4)**

Q23.

Question number	Indicative content	Mark
	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant. **AO2 (strand 2) (6 marks)** <u>Determining force</u> • Use of F = (mv - mu)/t or F =ma • mass (of trolley(s)) needed • and times during impact (t) <u>Showing effect of crumple zone</u> • experiment repeated with and without the spring • (note) difference in contact times • use of spring as crumple zone • with spring, time for contact greater, less impact force <u>Precautions or controls</u> • times repeated and average taken • careful controls – same starting position / same angle of slope / release without pushing etc.	**(6)Exp**

Q24.

Question Number	Answer	Acceptable answers	Mark
(a) (i)		All three correct for 2 marks One or two only correct for 1 mark Reject any box with more than one line	**(2)**

Question Number	Answer	Acceptable answers	Mark
(a) (ii)	A suggestion to include Neutrons do not need to be captured (by another nucleus) / do not play a part in the fusion process	Fusion does not use neutrons No chain reaction	**(1)**

Question Number	Answer	Acceptable answers	Mark
(b)	A description to include Thermal energy used to create steam / boil water(1) (Steam used to drive) turbine (1) (Turbine used to turn) generator (1)	Ignore detail of fission process.	**(3)**

Question Number		Indicative Content	Mark
QWC	*** (c)**	An explanation including some of the following points • Description of the problem - Nuclei have positive charge - Repel each other - Reduces possibility of suitable collisions - Rate of fusion too small to be useful • Description of how this can be overcome o Very high temperature (of fuel) o Very high KE / speed of nuclei o High KE can overcome repulsion o Very high density / pressure o Increases possibility of suitable collisions	**(6)**

Q25.

Question Number	Answer	Mark
	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant. **AO1 (6 marks)** **Stage 1** • (At the beginning) maximum force is applied • With zero resistive force(s) • And maximum acceleration **Stage 2** • As the speed increases the increasing resistive force results in a decreasing resultant forward force • And a decreasing acceleration • So velocity increases at a decreasing rate **Stage 3** • Eventually thrust = resistive force(s) • Then no resultant force forward and no acceleration • Submarine continues forward at a constant speed	**(6)**

Q26.

Question Number	Answer	Mark
	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant.	**(6)**

	AO1 strand 1 (6 marks) **evidence for expansion** • red shift • light from distant galaxies/stars • shifted to red side of em spectrum • (observed) wavelength of light is longer • showing source moving away • (nearly) all galaxies show this • Doppler effect • (expanding at an increasing rate / dark energy) **evidence for beginning at a point** • CMBR • microwave radiation left over from beginning • the increase of recessional velocities with distance - (extrapolating) • microwaves because of cooling • detected from all over the sky	