$$\sqrt[n]{r}\left[\cos\left(\frac{\theta}{n}+\frac{\overset{2\pi}{360k}}{n}\right)+i\sin\left(\frac{\theta}{n}+\frac{\overset{2\pi}{360k}}{n}\right)\right]$$

$$r=\frac{6}{1-\cos\theta}$$
$$r=6+\overset{x}{\cancel{r\cos\theta}}$$
$$r^2=x^2+12x+36$$
$$\cancel{x^2}+y^2=\cancel{x^2}+12x+36$$
$$y^2=12(x+3)$$

Graphing (r, θ) → graph θ first, then r

- If $r > 0$, $2\pi <= \theta < 4\pi$, do $(r, \theta + 2\pi)$
- If $r > 0$, $-2\pi <= \theta < 0$, do $(r, \theta - 2\pi)$
- If $r < 0$, $0<= \theta < 2\pi$, do $(-r, \theta + \pi)$
- $X = r \cos \theta$, $Y = r \sin \theta$
- Pol to Rec → remember $X = r \cos \theta$, $Y = r \sin \theta$
- Rec to Pol → find $r = \sqrt{x^2 + y^2}$ AND $\theta = \tan^{-1}(x/y)$
- Equ to Pol to Rec → make one side into $r\cos\theta$ or $r\sin\theta$ (multiplying by r), and then complete the square
- Equ to Rec to Pol → just plugin $X = r \cos \theta$, $Y = r \sin \theta$ and solve (you'll get trig values = #)
- R = # MEANS its a circle. Θ = angle MEANS line through (0,0). $Y= r\sin\theta$ MEANS hor line. $X =r\cos\theta$ MEANS vert line.

MAKE TABLE FOR ALL, PLUG IN VALUES
IF sin AND + +,- + graph on pos y-axis   IF sin AND + -, - - graph on neg y-axis
IF cos AND + +, - + graph on pos x-axis   IF cos AND - -, + - graph on neg x-axis
Cardioid: $a(1\pm\cos\theta)$ and $a(1\pm\sin\theta)$
Limacon without loop: $a\pm b\cos\Theta$ and $a\pm b\sin\Theta$ AND $a>b$
Limacon with loop: $a\pm b\cos\Theta$ and $a\pm b\sin\Theta$ AND $b>a$
Rose: $r=a\cos(b\Theta)$and $r=a\sin(b\Theta)$. IF b=even number, petals = 2b. IF b=odd number, petals = b
Lemniscates: $r^2 = a^2 \sin(2\Theta)$ and $r^2 = a^2 \cos(2\Theta)$. PROPELLER type

Complex {a(cosxi + sinxi)} to rectangular{a+bi} → multiply it out
Polar{a+bi} to complex → find r, find theta

Multiplying complex numbers: multiply outside numbers, and add the angles together
Dividing complex numbers: divide outside numbers, and subtract the angles

$[r (\cos\theta+i\sin\theta)]^n$ → $r^n[\cos(n\theta)+i\sin(n\theta)]$
$(a+bi)^n$ → convert to complex, do step directly above
Complex roots (look at image given)

Unit vector/ "same-direction" vector: $a/ \sqrt{a^2+b^2}\, i + b/ \sqrt{a^2+b^2}\, j$ and $\Theta = \tan^{-1}(y/x)$

(Plane problem with Plane velocity, plane direction, wind velocity, wind direction AKA GROUNDSPEED):
ALWAYS write I before J

1. Find Va = Velocity of plane (#j if going straight)
2. Find Vw = Velocity of jet stream. Convert all to 0-180 range. Ex: N30W = 120 degrees. "Northeasternly" = 45 degrees.
3. Find Vg = Velocity relative to ground = Va + Vw
4. Find Actual speed = magnitude of Vg = Square root of Vg components squared
5. Find Angle of bearing = 90- inverse tangent (J / I) (use the j and i from Vg)

How much does it weigh problems:

1. Given: angle of incline of ramp, force to push object. Find: how much object weighs
2. Sin (angle) = force to push/ how much it weighs

Cable Tension Problems (ROUND TO FOUR DIGITS):

1. Left→ ||F1|| (DO NOT MAKE #) * [cos(180-left_angle)i + sin(180-left_angle)j]
2. Right→ ||F2|| (DO NOT MAKE #) * [cos(right_angle)i + sin(right_angle)j]
3. Down →- pounds*j
4. Left + Right + Down = 0
5. You'll get (A||F1||+B||F2||)i + (C||F1||+D||F2||-E) = 0. Use first equation (The one with A and B) to solve for ||F2|| = # ||F1||.
6. Substitute into second equation, solve to GET ||F1||, then solve to GET ||F2|| using ||F2|| = # ||F1||

One thing pulling two other things (truck pulling two other trucks):

1. Always draw angle on graph (rotate). You'll get bottom force(i) + ½ top force sqrt2 (i) + ½ top force sqrt2 (j) = F= ANS

Coefficient of friction = (object weight)sin(angle of incline)/(object weight)cos(angle of incline)

Dot product = multiply i parts, multiply j parts, multiply k parts, and ADD to get one number
Angle between vectors = cosθ = (dot product)/(magnitude of u)(magnitude of v)

Decomposing vectors into orthogonal vectors:

1. V1 = (v * w)/ ||w||^2 times w (as vector) REMEMBER: ||w|| = sqrt{A^2 + B^2}. V2 = V - V1

Parallel vectors → multiples of each other Orthogonal → dot product is 0
Given vectors, find y so that angle between vectors is θ:

1. Dot product is going to be a1a2+b1+b2 → #+#y
2. Find magnitudes. Ur going to get sqrt(#) and sqrt(#+y^2)
3. Substitute, cos of θ (num) = (dot product)/ (mag of u * mag of v). BUTTERFLY, SQUARING, CHECK BOTH ANSWERS

Find acute angle... unit vector...x-axis...[given distance], [given work]

1. Find PO = Position Vector. You'll get [given work] = #cosθ. SOLVE USING INVERSE COS

Finding force to keep an object still on a ramp:

1. Fg = -(weight)j w (the parallel force) = cos(angle)i + sin(angle)j
2. [-weight*sin(angle)] / [MAGNITUDE SQUARED] = magnitude of v = ANS

Work (2D and 3D):

1. force* (cos θi + sin θi) = #(#i + #j) → distance(i) * #(#i + #j) → (i) is ans. Since we don't have another j, no j component
2. F = Divide all of Ai + Bj + Ck with mag (sqrt[A^2+b^2+C^2]) to get new vector, attach newton in front of the new vector
3. PO = Position vector (use the coordinates given)
4. Multiply F and PO (multiply the i's together, multiply the j's and then the k's and then add)

Incline Problems:
Sin (the angle given) = ||F2|| / ||F1||
F2 = force required to hold object still on the ramp, the little vector of new triangle, given in POUNDS = pounds* sin(angle)
F1 = force of gravity, weight of object, the straight-down vector of new triangle = pounds*cos(angle)

River with width, river's speed, [_] mph boat Problems, HOW MUCH TIME TO CROSS?:

Vw = Velocity of boat relative to water = diagonal line
Vc = Velocity of water = laying on x-axis
Vd = Velocity of boat that's going to the opposite side= laying on y-axis

1. Find vector Vc = [river current]i + 0j
2. Solve for A: -[river current] = [given velocity of boat]cosA. Subtract 90 to get direction angle (ANS)
3. To find out how long it takes: (river width) / [given velocity of boat] = sqrt [(-[river current])^2 + B^2]

Calculate direction angles of a 3D vector: cos^-1 [A(or B or C)/ sqrt (A^2 + B^2 + C^2)] (DO FOR A B AND C)
Calculate direction ANGLE or a 3D vector...
Ex: vector v makes angle of a= pi/3 with pos x-axis and b = pi/3 with positive y-axis and ACUTE angle e with the z-axis. Find e.
Use the formula cos^2 a + cos^2 b + cos^2 e = 1
You'll get (½)^2 + (½)^2 + cos^2 e = 1
Then you'll get cos^2 e = ½ == e can equal pi/4 OR 3pi/4. BUT we know it has to be ACUTE, so it's going to be pi/4