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Mathematics 0580 Formula Sheet Pg 1/9

① Standard Form

$A \times 10^n$
 $1.69 \leq 10$ & n can be +ve or -ve.

Example
 Express in standard form:

- a) 321490 = 3.21×10^5
 b) 0.000678 = 6.78×10^{-6}

② Prime Number

Memorise all prime numbers from 2 to 71.

2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, 37, 41, 43, 47, 53, 59, 61, 67, 71

③ Upper & Lower Bound

Example
 Each of the length is measured
 correct to the nearest centimetre.

Find:

- (a) the upper bound for the perimeter &
 (b) the lower bound for the perimeter

Answer

- a) Upper bound \rightarrow round all reading up by
 0.5 cm.

$$10\text{cm} \rightarrow 10.5\text{cm}$$

$$5\text{cm} \rightarrow 5.5\text{cm}$$

$$\text{Perimeter} = 10.5 + 10.5 + 5.5 + 5.5$$

$$= 32\text{cm}$$

- b) Lower bound \rightarrow round all reading down
 by 0.5 cm.

$$10\text{cm} \rightarrow 9.5\text{cm}$$

$$5\text{cm} \rightarrow 4.5\text{cm}$$

$$\text{Perimeter} = 9.5 + 9.5 + 4.5 + 4.5$$

$$= 28\text{cm}$$

④ Direct & Inverse Proportion

Example 1

x is directly proportional to y .

When $y = 10$, $x = 5$

Find x when $y = 20$.

Answer

$$x = ky$$

$$5 = k(10)$$

$$k = \frac{5}{10} = \frac{1}{2}$$

$$x = \frac{1}{2}y$$

When $y = 20$,

$$x = \frac{1}{2}(20)$$

$$= 10$$

Example 2

x is inversely proportional to y

When $y = 10$, $x = 2$

Find x when $y = 30$

Answer

$$x = \frac{k}{y}$$

$$2 = \frac{k}{10}$$

$$k = 2 \times 10$$

$$= 20$$

$$x = \frac{20}{y}$$

When $y = 30$

$$x = \frac{20}{30}$$

$$= \frac{2}{3}$$

⑤ Percentage

Example

Express 64 as a percentage of 80.

Answer

$$\frac{64}{80} \times 100\% = 80\%$$

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Algebra and Trigonometry based Physics Formula sheet

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The presence of a formula does not guarantee its use! Students are always welcome to suggest changes additions deletions corrections etc.

I. UNIT PREFIXES

Giga (G)- 1 billion or 10^9
 Mega (M)- 1 million or 10^6
 kilo (k)- 1 thousand or 10^3
 centi (c) - 1 hundredth or 10^{-2}
 milli (m) - 1 thousandth or 10^{-3}
 micro (μ) - 1 millionth or 10^{-6}
 nano (n) - 1 billionth or 10^{-9}

II. EQUATIONS FOR PHYSICS EXAM

Always

$$x - x_0 = v_{avg}t \quad (1)$$

For constant acceleration

$$v = v_0 + at \quad (2)$$

$$(x - x_0) = v_0t + \frac{1}{2}at^2 \quad (3)$$

$$v^2 = v_0^2 + 2a(x - x_0) \quad (4)$$

$$v_{avg} = \frac{v + v_0}{2} \quad (5)$$

Acceleration from free fall

$$a = -g = -9.8 \frac{\text{m}}{\text{s}^2} \quad (6)$$

III. DYNAMICS

Newton's Second Law

$$\vec{F}_{net} = m\vec{a} \quad (7)$$

Force of kinetic friction

$$F_{fr} = \mu_k N \quad (8)$$

where N is the normal force.

Force of static friction

$$F_{fr} \leq \mu_s N \quad (9)$$

where N is the normal force.

Centripetal acceleration, points inward (along radius of circle)

$$a_R = \frac{v^2}{r} \quad (10)$$

where v is speed of particle and r is radius of the circular arc traveled by the particle. Centripetal Force = mass \times centripetal acceleration.

Newton's Law of Gravitation

$$F = G \frac{M_1 M_2}{R^2} \quad (11)$$

where $G = 6.67 \times 10^{-11} \text{ N m}^2 / \text{kg}^2$, the M 's are the masses of the two bodies and R is the distance between their centers.

For a constant force, work is given by

$$W = Fd \cos \theta \quad (12)$$

where F is the constant force, d is the displacement and θ is the angle between the F and d vectors.

Work Energy Principle

$$W_{net} = \Delta KE \quad (13)$$

where KE = Kinetic Energy = $\frac{1}{2}mv^2$

Force from spring

$$F = -kx \quad (14)$$

where x is the displacement from equilibrium and k is the spring constant.

Potential energies for conservative forces

$$PE_{grav} = mgy \quad (15)$$

$$PE_{spring} = \frac{1}{2}kx^2 \quad (16)$$

Work by a conservative force

$$W_{cons} = -\Delta PE \quad (17)$$

If only conservative forces,

$$\Delta KE + \Delta PE = 0 \quad (18)$$

Momentum

$$\vec{p} = m\vec{v} \quad (19)$$

Newton's second Law in terms of momentum

$$\vec{F} = \frac{\Delta \vec{p}}{\Delta t} \quad (20)$$

For elastic head on collisions

$$v_1 - v_2 = -(v_{1f} - v_{2f}) \quad (21)$$

TRIGONOMETRY LAWS AND IDENTITIES

TANGENT IDENTITIES

$$\tan \theta = \frac{\sin \theta}{\cos \theta}$$
$$\cot \theta = \frac{\cos \theta}{\sin \theta}$$

RECIPROCAL IDENTITIES

$$\csc \theta = \frac{1}{\sin \theta}$$
$$\sec \theta = \frac{1}{\cos \theta}$$
$$\cot \theta = \frac{1}{\tan \theta}$$
$$\sin \theta = \frac{1}{\csc \theta}$$
$$\cos \theta = \frac{1}{\sec \theta}$$
$$\tan \theta = \frac{1}{\cot \theta}$$

PYTHAGOREAN IDENTITIES

$$\sin^2 \theta + \cos^2 \theta = 1$$
$$\tan^2 \theta + 1 = \sec^2 \theta$$
$$\cot^2 \theta + 1 = \csc^2 \theta$$

PERIODIC IDENTITIES

$$\sin(\theta + 2\pi n) = \sin \theta$$
$$\cos(\theta + 2\pi n) = \cos \theta$$
$$\tan(\theta + \pi n) = \tan \theta$$
$$\csc(\theta + 2\pi n) = \csc \theta$$
$$\sec(\theta + 2\pi n) = \sec \theta$$
$$\cot(\theta + \pi n) = \cot \theta$$

EVEN/ODD IDENTITIES

$$\sin(-\theta) = -\sin \theta$$
$$\cos(-\theta) = \cos \theta$$
$$\tan(-\theta) = -\tan \theta$$
$$\csc(-\theta) = -\csc \theta$$
$$\sec(-\theta) = \sec \theta$$
$$\cot(-\theta) = -\cot \theta$$

DOUBLE ANGLE IDENTITIES

$$\sin(2\theta) = 2 \sin \theta \cos \theta$$
$$\cos(2\theta) = \cos^2 \theta - \sin^2 \theta$$
$$= 2 \cos^2 \theta - 1$$
$$= 1 - 2 \sin^2 \theta$$
$$\tan(2\theta) = \frac{2 \tan \theta}{1 - \tan^2 \theta}$$

HALF ANGLE IDENTITIES

$$\sin\left(\frac{\theta}{2}\right) = \pm \sqrt{\frac{1 - \cos \theta}{2}}$$
$$\cos\left(\frac{\theta}{2}\right) = \pm \sqrt{\frac{1 + \cos \theta}{2}}$$
$$\tan\left(\frac{\theta}{2}\right) = \pm \sqrt{\frac{1 - \cos \theta}{1 + \cos \theta}}$$

LAW OF COSINES

$$a^2 = b^2 + c^2 - 2bc \cos \alpha$$
$$b^2 = a^2 + c^2 - 2ac \cos \beta$$
$$c^2 = a^2 + b^2 - 2ab \cos \gamma$$

LAW OF SINES

$$\frac{\sin \alpha}{a} = \frac{\sin \beta}{b} = \frac{\sin \gamma}{c}$$

LAW OF TANGENTS

$$\frac{a-b}{a+b} = \frac{\tan\left[\frac{1}{2}(\alpha-\beta)\right]}{\tan\left[\frac{1}{2}(\alpha+\beta)\right]}$$
$$\frac{b-c}{b+c} = \frac{\tan\left[\frac{1}{2}(\beta-\gamma)\right]}{\tan\left[\frac{1}{2}(\beta+\gamma)\right]}$$
$$\frac{a-c}{a+c} = \frac{\tan\left[\frac{1}{2}(\alpha-\gamma)\right]}{\tan\left[\frac{1}{2}(\alpha+\gamma)\right]}$$

COFUNCTION IDENTITIES

$$\sin\left(\frac{\pi}{2} - \theta\right) = \cos \theta$$
$$\csc\left(\frac{\pi}{2} - \theta\right) = \sec \theta$$
$$\tan\left(\frac{\pi}{2} - \theta\right) = \cot \theta$$
$$\cos\left(\frac{\pi}{2} - \theta\right) = \sin \theta$$
$$\sec\left(\frac{\pi}{2} - \theta\right) = \csc \theta$$
$$\cot\left(\frac{\pi}{2} - \theta\right) = \tan \theta$$

PRODUCT TO SUM IDENTITIES

$$\sin \alpha \sin \beta = \frac{1}{2} [\cos(\alpha - \beta) - \cos(\alpha + \beta)]$$
$$\cos \alpha \cos \beta = \frac{1}{2} [\cos(\alpha - \beta) + \cos(\alpha + \beta)]$$
$$\sin \alpha \cos \beta = \frac{1}{2} [\sin(\alpha + \beta) + \sin(\alpha - \beta)]$$
$$\cos \alpha \sin \beta = \frac{1}{2} [\sin(\alpha + \beta) - \sin(\alpha - \beta)]$$

SUM TO PRODUCT IDENTITIES

$$\sin \alpha + \sin \beta = 2 \sin\left(\frac{\alpha + \beta}{2}\right) \cos\left(\frac{\alpha - \beta}{2}\right)$$
$$\sin \alpha - \sin \beta = 2 \cos\left(\frac{\alpha + \beta}{2}\right) \sin\left(\frac{\alpha - \beta}{2}\right)$$
$$\cos \alpha + \cos \beta = 2 \cos\left(\frac{\alpha + \beta}{2}\right) \cos\left(\frac{\alpha - \beta}{2}\right)$$
$$\cos \alpha - \cos \beta = -2 \sin\left(\frac{\alpha + \beta}{2}\right) \sin\left(\frac{\alpha - \beta}{2}\right)$$

SUM/DIFFERENCES IDENTITIES

$$\sin(\alpha \pm \beta) = \sin \alpha \cos \beta \pm \cos \alpha \sin \beta$$
$$\cos(\alpha \pm \beta) = \cos \alpha \cos \beta \mp \sin \alpha \sin \beta$$
$$\tan(\alpha \pm \beta) = \frac{\tan \alpha \pm \tan \beta}{1 \mp \tan \alpha \tan \beta}$$

MOLLWEIDE'S FORMULA

$$\frac{a+b}{c} = \frac{\cos\left[\frac{1}{2}(\alpha-\beta)\right]}{\sin\left(\frac{1}{2}\gamma\right)}$$

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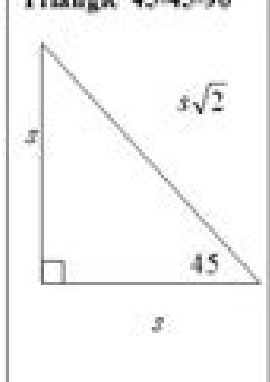
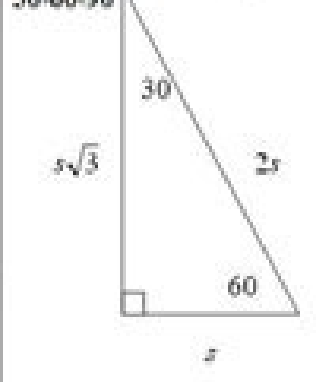
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Formulas

Right Prism LA = ph SA = LA + $2B$ V = Bh	Right Cylinder LA = πdh or LA = $2\pi rh$ SA = LA + $2B$ SA = $\pi dh + 2\pi r^2$ V = Bh or V = πr^2h	Rectangle <i>Perimeter</i> $P = 2b + 2h$ or $2l + 2w$ <i>Area</i> $A = bh$	Square <i>Perimeter</i> $P = 4s$ <i>Area</i> $A = s^2$
Regular Pyramid LA = $\frac{1}{2}pl$ SA = LA + B V = $\frac{1}{3}Bh$	Right Cone LA = πrl SA = LA + B SA = $\pi rl + \pi r^2$ V = $\frac{1}{3}Bh$ or V = $\frac{1}{3}\pi r^2h$	Area of a Parallelogram $A = bh$ Area of a Triangle $A = \frac{1}{2}bh$ Area of a Regular Polygon $A = \frac{1}{2}ap$	Area of a Trapezoid $A = \frac{1}{2}h(b_1 + b_2)$ Midsegments of a Trapezoid <i>Midsegment</i> = $\frac{1}{2}(b_1 + b_2)$ Area of a Rhombus or Kite $\frac{1}{2}d_1d_2$
Sphere SA = $4\pi r^2$ V = $\frac{4}{3}\pi r^3$	Slope Intercept Form $y = mv + b$ Point Slope Form $(y_1 - y_2) = m(x_1 - x_2)$ Slope Formula $m = \frac{(y_2 - y_1)}{(x_2 - x_1)}$	Area of an Equilateral Triangle $A = \frac{1}{4}(s^2)(\sqrt{3})$	Area of an Annulus of a Circle $A = \pi R^2 - \pi r^2$
Circle Circumference $C = 2\pi r$ or πd Area $A = \pi r^2$	Circle ~ Length of Arc Length of $\widehat{AB} = \frac{m\widehat{AB}}{360} \cdot 2\pi r$ Equation of a Circle $(x-h)^2 + (y-k)^2 = r^2$	Area of a Sector of a Circle $A = \frac{arc}{360} \pi r^2$ Area of a Segment of a Circle $A = \frac{arc}{360} \pi r^2 - \frac{1}{2}bh$	
Special Right Triangle 45-45-90 	Special Right Triangle 30-60-90 	Pythagorean Theorem $a^2 + b^2 = c^2$ Distance Formula $d = \sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2}$ Midpoint Formula $M = \frac{x_2 + x_1}{2}, \frac{y_2 + y_1}{2}$	Interior Measure of a Polygon (sum of the angles) $(n - 2)180$ One angle $\frac{(n - 2)180}{n}$ Exterior Measure of a Polygon (Sum) 360 degrees One exterior Angle $\frac{360}{n}$



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