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Equation Sheet

Metric Unit Conversions (Chapter 1)

Power	Prefix	Abbreviation	Power	Prefix	Abbreviation
10^{-18}	atto-	a	10^{-1}	deci-	d
10^{-15}	femto-	f	10^{1}	deka-	da
10^{-12}	pico-	p	10^{3}	kilo-	k
10^{-9}	nano-	n	10^{6}	mega-	M
10^{-6}	micro-	μ (Greek letter *mu*)	10^{9}	giga-	G
			10^{12}	tera-	T
10^{-3}	milli-	m	10^{15}	peta-	P
10^{-2}	centi-	c	10^{18}	exa-	E

Equations of Motion (Chapters 1 & 2)

Equation (x)	Units	Description	Equation (y)
$\Delta x = x_f - x_i$	m	Displacement	$\Delta y = y_f - y_i$
$\Delta t = t_f - t_i$	s	Change is time	$\Delta t = t_f - t_i$
$\Delta v = v_f - v_i$	$\frac{m}{s}$	Change in Velocity	$\Delta v = v_f - v_i$
$v_{ave} = \frac{\Delta x}{\Delta t}$	$\frac{m}{s}$	Average Velocity	$v_{ave} = \frac{\Delta y}{\Delta t}$
$v_{ave} = \frac{v_i + v_f}{2}$	$\frac{m}{s}$	Average Velocity	$v_{ave} = \frac{v_i + v_f}{2}$
$a_{ave} = \frac{\Delta v}{\Delta t}$	$\frac{m}{s^2}$	Average Acceleration	$a_{ave} = \frac{\Delta v}{\Delta t}$
$\Delta x = \frac{1}{2}\left(v_i + v_f\right)\Delta t$	m	Displacement	$\Delta y = \frac{1}{2}\left(v_i + v_f\right)\Delta t$
$v_f^2 = v_i^2 + 2a\Delta x$	$\frac{m}{s}$	Velocity	$v_f^2 = v_i^2 + 2a\Delta y$
$v_f = v_i + a\Delta t$	$\frac{m}{s}$	Velocity	$v_f = v_i + a\Delta t$
$\Delta x = v_i t + \frac{1}{2} a t^2$	m	Displacement	$\Delta y = v_i t + \frac{1}{2} a t^2$

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<u>VECTOR OPERATIONS (CHAPTER 3)</u>

$$\sin\theta = \frac{Opposite}{Hypotenuse}$$

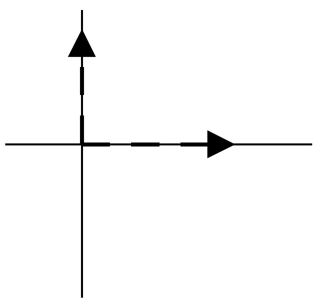
$$\cos\theta = \frac{Adjacent}{Hypotenuse}$$

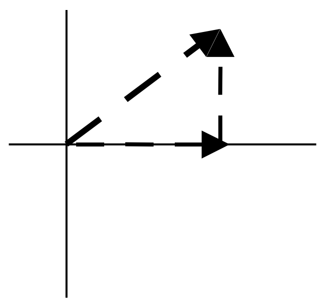
$$\tan\theta = \frac{Opposite}{Adjacent}$$

SohCahToa

<u>Finding Resultant and Resolving Components – Section 2</u>

If you have the perpendicular components of a Vector, you find the resultant using the Pythagorean Theorem and the tan function:



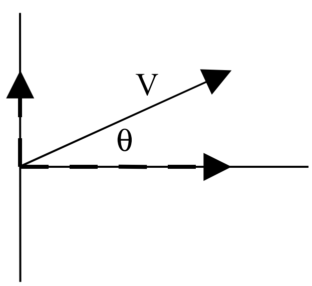


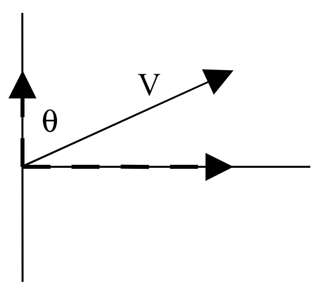
The resultant Vector $V_r = \sqrt{V_x^2 + V_y^2}$

The angle $\theta_1 = \tan^{-1}\frac{V_y}{V_x}$

The angle $\theta_2 = \tan^{-1}\frac{V_x}{V_y}$

IF you have a Vector (V) with an angle (θ) - Use sin and cos to break it into components





Use this area for your own notes that will help you perform these functions:

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Projectile Motion – Section 3 (Projectile Launched Horizontally)

The following are given:

$a_x = 0$

$a_y = a_g = g = -9.81\,\frac{m}{s^2}$ *(Free Fall)*

v_{xi} *is constant for duration of flight*

$v_{yi} = 0$

$\Delta x = v_{xi}\,t$

$\Delta y = \frac{1}{2} a_y t^2$

$t = \frac{\Delta x}{v_{xi}}$

$t = \sqrt{\frac{2\Delta y}{a}}$

Projectile Motion (Projectile Launched at an Angle)

The following are given:

$a_x = 0$

$a_y = a_g = g = -9.81\,\frac{m}{s^2}$

$v_{xi} =$ *the x component of the velocity*

$v_{yi} =$ *the y component of the velocity vector*

$v_y = 0$ *at the top of the flight* (Δy_{max})

$\Delta x = v_{xi}\,t$

$\Delta y = v_{yi}\,t + \frac{1}{2} a_y t^2$

$t = \frac{\Delta x}{v_{xi}}$

$\Delta y = 0$ *when* $y_f = y_i$ *, so when* $\Delta y = 0$;

one $t = 0$ *and the other* $t = \frac{-2v_i}{a}$

Force Chapter 4

The Unit of Force is the **Newton (N)**

Weight is the force of GRAVITY acting on an object

$\Sigma F = F_{net} =$ *Net Force*

When $\Sigma F = 0 \Rightarrow$ *Syetem is in equalibrium*

ΣF *is the vector sum of* $\Sigma F_x + \Sigma F_y$

$F = ma$ *Newton's Second Law of Motion*

Frictional Forces

Normal Force (F_n) - acts on a surface in the direction perpendicular to the surface

$\mu_s = \frac{F_{s,max}}{F_n}$ $\quad F_{s,max} = \mu_s F_n$ $\quad$ Static Friction – At rest

$\mu_k = \frac{F_k}{F_n}$ $\quad F_k = \mu_k F_n$ $\quad$ Kinetic Friction – In Motion

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Work and Energy Chapter 5

Work (W)

The unit of Work in the **Joule (J)**

$W = Fd\cos\theta$

$W_{net} = F_{net}\, d\cos\theta$

Energy (KE, PE)

The unit of Energy in the **Joule (J)**

$KE = \frac{1}{2}mv^2$	Kinetic Energy – Energy of Motion
$W_{net} = \Delta KE$	The Work - Kinetic Energy Theorem
$PE_g = mgh$	Gravitational Potential Energy
$PE_{elastic} = \frac{1}{2}kx^2$	Elastic Potential Energy (k - spring constant $(\frac{N}{m})$)
$ME = KE + \Sigma PE$	Mechanical Energy

POWER (P)

The unit of Power is the Watt (W)

$P = \frac{W}{\Delta t}$ Power – Rate at which work is done

Since $W = Fd$ Then $P = \frac{Fd}{\Delta t}$ *or* $F\left(\frac{d}{\Delta t}\right)$ and since $\frac{d}{\Delta t} = v$

Then

$P = Fv$ Another Equation for Power

Momentum and Collisions Chapter 6

Momentum	Units $Kg \bullet \frac{m}{s}$	$P = mv$
Impulse	Units $Kg \bullet \frac{m}{s}$	$F\Delta t = \Delta mv = mv_f - mv_i$

Collisions – Conservation of Momentum

$m_1 v_{1_i} + m_2 v_{2_i} = m_1 v_{1_f} + m_2 v_{2_f}$	Total Initial Momentum = Total Final Momentum
$m_1 v_{1_i} + m_2 v_{2_i} = (m_1 + m_2) v_f$	Perfectly Inelastic Collision

Circular Motion and Gravitation Chapter 7

$a_c = \frac{v_t^2}{r}$	Centripetal Acceleration
$F_c = m\, a_c = \frac{mv_t^2}{r}$	Centripetal Force

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$F_g = G\frac{m_1 m_2}{r^2}$ Newton's Law of Universal Gravitation

$g = G\frac{m_E}{r^2}$

$G = 6.673 X 10^{-11}\frac{N \bullet m^2}{kg^2}$ Gravitational Constant

Electrical Energy and Current Chapter 17

V	V Volts	Voltage – Electromotive Force
I	A Amp(ere)	Current - Amount of charge flowing
R	Ω Ohm	Resistance – Load

$V = IR$ Ohm's Law

$R = \frac{V}{I}$ $I = \frac{V}{R}$

P W Watts Power – Rate at which work is done

$P = VI$ $P = I^2 R$ $P = \frac{V^2}{R}$

Electrical Energy (KWH – KiloWatt Hours)

$KWH = P t$ Energy – Power times time

$Total\ Cost\ of\ Energy = P t \frac{cost}{KWH}$ Energy Cost

Circuits and Circuit Elements Chapter 18

$R_{eq} = R_1 + R_2 + R_3 + \ldots \ldots + R_n$ Resistors in Series

$\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \ldots \ldots + \frac{1}{R_n}$ Resistors in Parallel