

Chapter 1 Unit(s) / Mechanics / Sig-Figs / Vectors	Chapter 1 Unit(s) / Mechanics / Sig-Figs / Vectors (cont)	Chapter 2: Motion along A Straight Line (cont)	Chapter 3: 2D or 3D Motion (cont)
Speed = (d/t) (m/s) d = distance : m = meters t = time : s = seconds	$\tan(\Theta) = (y / x)$ or (A_y / A_x) or (B_y / B_x) $x = \hat{i}$ Vector A = $A_x\hat{i} + A_y\hat{j}$ $y = \hat{j}$ Vector B = $B_x\hat{i} + B_y\hat{j}$ $z = \hat{k}$	Acceleration (a) = if $a > 0$ (positive) if $a < 0$ (negative) [a is constant]	Projectile Motion two assumptions: 1. The freefall acceleration (g) is constant 2. Air resistance is negligible
1 km = 1000 m	Vector R = Vector A + Vector B Vector R = $(A_x + B_x)\hat{i} + (A_y + B_y)\hat{j}$ Vector R (direction) = $(x)\hat{i} + (y)\hat{j}$ Vector R (magnitude) = $\sqrt{(x)^2 + (y)^2}$	Instantaneous Acceleration = derivative of the given equation	y-direction = constant acceleration motion x-direction = constant velocity motion
1 kg = 1000 g mass = (kg)	Quadratic Formula $x = (-b \pm \sqrt{b^2 - 4 \cdot a \cdot c}) / (2 \cdot a)$	Constant Acceleration = constant acceleration motion in 1D	Acceleration is only negative (y-direction) $g = -9.8 \text{ m/s}^2$
1 hour = 3600 seconds time = (seconds)	Chapter 2: Motion along A Straight Line	$V_{\text{final}} = (a \cdot t) + V_{\text{initial}}$ $V_{\text{final}}^2 = (v_{\text{initial}})^2 + 2 \cdot a \cdot (t_{\text{final}} - t_{\text{initial}})$	Constant Velocity Motion $x = (x_{\text{initial}}) + (v [x\text{-direction}]) \cdot t$ $V (y\text{-direction}) = (v_{\text{initial}} [y\text{-direction}] + g \cdot t$
1 mile = 1.609 km length = (meter)	One Dimensional Motion Average Speed = (total distance) / (time) Displacement = Final Point - Initial Point	$\Delta x = (x_{\text{final}}) - (x_{\text{initial}})$ $\Delta x = (v_{\text{average}}) \cdot (\text{seconds})$ $\Delta x = (1/2 \cdot (V_{\text{final}}) + (V_{\text{initial}})) \cdot t (\text{seconds})$	$V (y\text{-direction})^2 = (v_{\text{initial}} [y\text{-direction}]^2 + 2 \cdot g \cdot ((y_{\text{final}}) - (y_{\text{initial}})))$
Volume = 1 cm^3	Chapter 2: Motion along A Straight Line	$x_{\text{final}} = 1/2 ((V_{\text{initial}}) + (V_{\text{final}})) \cdot t + (x_{\text{initial}})$ $x_{\text{final}} = x_{\text{initial}} + (V_{\text{initial}}) \cdot t (\text{seconds}) + 1/2 \cdot a \cdot t^2$	$V (y\text{-direction}) = (v_{\text{initial}} [y\text{-direction}] + g \cdot t$
Sig Figs	Not Constant Velocity Average Velocity (V) = (displacement / time)	Gravity (g) = -9.8 m/s² $V_{\text{final}} = (V_{\text{initial}}) + g \cdot t (\text{seconds})$	Trig Identity $\sin(\Theta\Theta) = \sin\Theta\cos\Theta + \cos\Theta\sin\Theta$
$\pi = 3.14$ (3 sigfig)	Chapter 2: Motion along A Straight Line	The Acceleration Vector $a = \Delta V / \Delta t$ (v-final) = (v-initial) + ΔV	Constant Speed Motion <i>velocity is always changing</i> $r = \text{radius}$ $V = (2\pi r)^2 : 4\pi^2 r$
$\pi = 3.14159$ (6 sigfig)	One Dimensional Motion Average Velocity (V) = $(\Delta x / \Delta t)$	$\Delta V = (v_{\text{final}}) - (v_{\text{initial}})$ $\Delta V = (v_{\text{final}}) + (-v_{\text{initial}})$	$T = \text{time-period}$ $a = \Delta V / \Delta t$: never zero $\Delta V = (V / r) \cdot \Delta r$
Density = (mass / volume) (kg / m ³) (g / cm ³) $\sqrt{\quad}$ = square root	Instantaneous Velocity = derivative of the given equation Instantaneous Velocity = $((a_{\text{final}}) - (a_{\text{initial}})) / ((t_{\text{final}}) - (t_{\text{initial}}))$ $\Delta t = (t_{\text{final}}) - (t_{\text{initial}})$ $\Delta x = (x_{\text{final}}) - (x_{\text{initial}})$	Constant Speed Changing Direction $a = \Delta V / \Delta t$ (v-final) = (v-initial) + ΔV $\Delta V = (v_{\text{final}}) - (v_{\text{initial}})$ $\Delta V = (v_{\text{final}}) + (-v_{\text{initial}})$	Centripetal Acceleration $A_c = (V^2) / r$ $A_c = (2\pi r)^2 / r$ $A_c = 4\pi^2 r / T^2$
Vector (Displacement) = $\sqrt{(x)^2 + (y)^2}$	Acceleration $\Delta V = (V_{\text{final}}) - (V_{\text{initial}})$ $\Delta t = (t_{\text{final}}) - (t_{\text{initial}})$		Tangential and Radial Acceleration $A_c = a\text{-rad}$
Total distance = x + y			
Vector A = Vector B if Vector A = Vector B			
Magnitude: $\sqrt{(x)^2 + (y)^2}$ = (Answer in Units) : 1 Direction			
Components of Vector Vector A = A_x $A_x = A \cdot \cos(\Theta)$ + A_y $A_y = A \cdot \sin(\Theta)$			
$A = \sqrt{(A \cdot \cos(\Theta))^2 + (A \cdot \sin(\Theta))^2}$			
Θ = Angle			
$x = \cos(\Theta)$ $\cos(\Theta) = A_x / A$ $y = \sin(\Theta)$ $\sin(\Theta) = A_y / A$			



Chapter 3: 2D or 3D Motion (cont)

Vector A-total = Vector A-tangential + Vector A-radical
 $A_{total} = \sqrt{(A_{tan})^2 + (A_{rad})^2}$

Relative Motion

$$r' = (v_{initial} \cdot t) - (vector-r)$$

$$Vector-r = \sqrt{(v_{initial} \cdot t)^2 + (r')^2}$$

$$Vector-V' = (v_{final}) - (v_{initial})$$

Chapter 4: Newtons Laws

Superposition of Forces

Vector-R = Vector-F1 + Vector-F2

N = Net Force

$$F_x = N \cdot \cos(\theta) \quad R_x = \sum F_x$$

$$F_y = N \cdot \sin(\theta) \quad R_y = \sum F_y$$

$$R = \sqrt{(R_x)^2 + (R_y)^2}$$

Newton's 1st Law

No Force; No Acceleration; No Motion

Inertia:

the tendency of an object to resist any attempt to change its velocity

Newton's 2nd Law

Net Force = $m \cdot a$
 a (x-direction) = $(F_x \text{ total}) / \text{mass}$
 a (y-direction) = $(F_y \text{ total}) / \text{mass}$

$$\tan(\theta) = y / x$$

Newton's 3rd Law

F_n = Normal Force

$$F_y = F_n - m \cdot g \quad F_x = m \cdot g \cdot \sin(\theta) \cdot \cos(\theta)$$

Chapter 5: Applying Newton's Laws

$$vector-F = m \cdot a \quad F_x = m \cdot a_x$$

T = tension
 : friction
 $F_y = m \cdot a_y$

$$y = T - m \cdot g \quad F_r = F_n : \text{Normal Force } (F_n)$$

No Friction α = Coefficient

$$F_n = m \cdot g \quad F_x = T_1 \cdot \cos(\theta) + T_2 \cdot \cos(\theta)$$

$$F_y = T_1 \cdot \sin(\theta) + T_2 \cdot \sin(\theta)$$

Friction

Static Friction (f_s): Object not in motion

Kinetic Friction (f_k): Object is in motion

Empirical Formula
 μ_k : Coefficient of Kinetic Friction
 μ_s : Coefficient of Static Friction
 Static: $f_s \leq \mu_s \cdot F_n$
 F_n
 Static: $f_k = \mu_k \cdot F_n$
 F_n

Terminal Speed $F_r \propto v$

$$F_r \propto v^2$$

Uniform Circular Motion $F_c = m \cdot a_c : m \cdot v^2 / r$

Chapter 5: Applying Newton's Laws (cont)

Vertical Circle
 Top: $F_y = -m \cdot (v^2 / r)$
 Bottom: $F_y = \mu_s \cdot m \cdot (g + v^2 / r)$

$$\max V = \sqrt{(f_s \cdot r) / m}$$

$$\max V = \sqrt{\mu_s \cdot g \cdot r}$$

Top View
 $T \cdot \sin(\theta) = m \cdot a_c$
 $a_c = \tan(\theta) \cdot g$



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Published 29th September, 2021.

Last updated 29th September, 2021.

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