Chapter 1 Unit(s) / Mechanics / Sig-Figs / Vectors

Speed = (d/t) || (m/s)	d = distance : m = meters
	t = time : s = seconds
1 km = 1000 m	
1 kg = 1000 g	mass = (kg)
1 hour = 3600 seconds	time = (seconds)
1 mile = 1.609 km	length = (meter)
Volume = 1 cm^3	

Sig Figs

π = 3.14 (3 sigfig)

π = 3.14159 (6 sigfig)

Density = (mass / volume) || (kg / m^3) || (g / cm^3)

√ = square root

Vector (Displacement) = $\sqrt{(x)^2 + (y)^2}$

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 = Ax + Ay	Ax = A · cos(Θ) Ay = A · sin(Θ)

A = $\sqrt{(A \cdot \cos(\Theta))^2 + (A \cdot \sin(\Theta))^2}$

Θ = Angle

x = cos(Θ) y = sin(Θ)	cos(Θ) = Ax / A sin(Θ) = Ay / A

Chapter 1 Unit(s) / Mechanics / Sig-Figs / Vectors (cont)

tan(Θ) = (y / x) or (Ay / Ax) or (By / Bx)

x = î y = ĵ z = k̂	Vector A = Axî + Ayĵ Vector B = Bxî + Byĵ

Vector R = Vector A + Vector B

Vector R = (Ax + Bx)î + (Ay + By)ĵ

Vector R (direction) = (x)î + (y)ĵ

Vector R (magnitude) = $\sqrt{(x)\hat{i}^2 + (y)\hat{j}^2}$

Quadratic Formula

x = (-b +/- $\sqrt{b^2 - 4 \cdot a \cdot c}$) / (2 · a)

Chapter 2: Motion along A Straight Line

One Dimensional Motion

`Average Speed` = (total distance) / (time)

`Displa cement` = Final Point - Initial Point

Not Constant Velocity

`Average Velocity (V)` = (displacement / time)

`Average Velocity (V)` = (Δx / Δt)

Instantaneous Velocity = derivative of the given equation

Instantaneous Velocity = ((a-final) - (a-initial)) / ((t-final)-(t-initial))

Δt = (t-final) - (t-initial)

Δx = (x-final) - (x-initial)

Acceleration

ΔV = (V-final) - (V-initial)

Δt = (t-final) - (t-initial)

Chapter 2: Motion along A Straight Line (cont)

Acceleration (a) = (ΔV) / (Δt) [a is constant]	if a > 0 (positive) if a < 0 (negative)

Instantaneous Acceleration = derivative of the given equation

Constant Acceleration

= constant acceleration motion in 1D

`V-final` = (a · t) + V-initial

`V-final`^{2} = (v-initial)^2 + 2 · a ((t-final) - (t-initial))

Δx = (x-final) - (x-initial)

Δx = (v-average) · (seconds)

Δx = (1/2 · (V-final) + (V-initial)) · t (seconds)

`x-final` = 1/2 ((V-initial) + (V-final)) · t + (x-initial)

`x-final` = x-initial + (V-initial) · t(seconds) + 1/2 · a · t^2

Gravity (g) = -9.8 m/s^2

V-final = (V-initial) + g * t (seconds)

Chapter 3: 2D or 3D Motion

The Acceleration Vector

a = ΔV / Δt	(v-final) = (v-initial) + ΔV ΔV = (v-final) - (v-initial) ΔV = (v-final) + (-(v-initial))

Constant Speed Changing Direction

a = ΔV / Δt	(v-final) = (v-initial) + ΔV ΔV = (v-final) - (v-initial)

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

Projectile Motion

two assumptions:

1. The freefall acceleration (g) is constant

2. Air resistance is negligible

y-direction = constant acceleration motion

x-direction = constant velocity motion

Acceleration is only negative (y-direction)

g = -9.8 m/s^2

Constant Velocity Motion

x = (x-initial) + (v [x-direction]) · t

V (y-direction) = (v-initial) [y-direction] + g · t

(y-final) = (y-initial + (v-initial) [y-direction] · t + 1/2 · g · t^2

V (y-direction)^2 = (v-initial) [y-direction]^2 + 2 · g ((y-final) - (y-initial))

V (y-direction) = (v-initial) [y-direction] + g · t

Trig Identity

sin(ΘΘ) = sinΘcosΘ + cosΘsinΘ

Constant Speed Motion

velocity is always changing

r = radius	V = $(2\pi r)^2$: $4\pi^2 r$

T = time-period

a = ΔV / Δt : never zero

ΔV = (V / r) · Δr

Centripetal Acceleration

Ac = (V^2) / r

Ac = $(2\pi r)^2$ / r

Ac = $4\pi^2 r$ / T^2

Tangential and Radial Acceleration

Ac = a-rad

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

Vector A-total = Vector A-tangential + Vector A-radical
A-total = √(A-tan)^2 + (A-rad)^2

Relative Motion

r ' = ((v-initial) · t) - (vector-r)

Vector-r = √((v-initial) · 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

Fx = N · cos(Θ) Fy = N · sin(Θ)	Rx = ∑Fx Ry = ∑Fy

R = √(Rx)^2 + Ry^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 · g	a (x-direction) = (Fx total) / mass a (y-direction) = (Fy total) / mass

tan(Θ) = y / x

Newton's 3rd Law

Fn = Normal Force

Fy = Fn - m · g · cos(Θ)	Fx = m · g · sin(Θ)

Chapter 5: Applying Newton's Laws

vector-F = m · a	Fx = m · ax
T = tension : friction	Fy= m · ay
y = T - m · g	Fr = Fn : Normal Force (Fn)
No Friction	α = Coefficient
Fn = m · g	Fx = T1· cos(Θ) + T2· cos(Θ)
	Fy = T1· sin(Θ) + T2· sin(Θ)

Friction

Static Friction (fs): Object not in motion
Kinetic Friction (fK): Object is in motion

Empirical Formula	μk: Coefficient of Kinetic Friction μs: Coefficient of Static Friction Static: fs ≤ μs · Fn Static: fk = μk · Fn
Terminal Speed	Fr α v
	Fr α v^2
Uniform Circular Motion	Fc = m · ac : m · V^2 / r

Chapter 5: Applying Newton's Laws (cont)

Vertical Circle	Top: Fy = -m · (V^2 / r) Bottom: Fy = μs * m · (g + V^2 / r) maxV = √(fs · r) / m maxV = √ μs · g · r
Top View	T · sin(Θ) = m · ac ac = tan(Θ) · g