Chapters 1-9 (Linear Motion)

v̅ = Δd/Δt

a̅ = Δv/Δt

Kinematics (Constant acceleration in the x-y plane):

 Contains:

 x vx ax t

vx = vx0 + axt n y y y

x = x0 + ½(vx0 + vx)t y y n y

x = x0 + vx0t + ½axt2 y n y y

vx2 = vx02 + 2ax(x-x0) y y y n

 y vy ay t

vy = vy0 + ayt n y y y

y = y0 + ½(vy0 + vy)t y y n y

y = y0 + vy0t + ½ayt2 y n y y

vy2 = vy02 + 2ay(y-y0) y y y n

Dynamics:

$$F=ma$$

W = mg

f = µFN

Fspring = kΔx

Energy/Momentum:

Work: W = **F**∙**d** = Fdcosθ

KE = ½ Iω2

Ug = mgh

Uspring = ½ kx2

Power: P = W/t

Mechanical Advantage = di/do = Fo/Fi

Momentum: p = mv

Impulse = Ft

Impulse = Δp

Conservation of p: Σpi = Σpf

Elastic: m1v10 + m2v20 = m1v1f + m2v2f

Inelastic: m1v10 + m2v20 = (m1 + m2)vf

Elastic collision between moving mass m1 and stationary mass m2:

$$v\_{1f}=\left(\frac{m\_{1}-m\_{2}}{m\_{1}+m\_{2}}\right)v\_{0}$$

$$v\_{2f}=\left(\frac{2m\_{1}}{m\_{1}+m\_{2}}\right)v\_{0}$$

Chapters 10 – 11 (Rotational Motion)

s(arc length) = θr

vt = ωr

at = αr

ac = rω2 = v2/r

T (period) = 2π/ω

Kinematics (Constant angular acceleration):

 Contains:

 θ ω α t

ω = ω0 + αt n y y y

θ = θ0 + ½(ω0 + ω)t y y n y

θ = θ0 + ω0t + ½αt2 y n y y

ω2 = ω02 + 2α(θ-θ0) y y y n

Rotational Dynamics:

Fc = mv2/r

τ = rFsinθ

τ = Iα

I = mr2 (for a point mass)

Rotational Energy/Momentum:

Angular Momentum: L = Iω

L = mvr (for a point mass)

KE = ½ Iω2

KETotal = ½ Iω2 + ½ Iω2

Chapters 12 – 14 (Gravity, Waves, SHM, Sound)

Universal Law of Gravitation:

$$F=G\frac{m\_{1}m\_{2}}{r^{2}} $$

$$g\_{Body}=G\frac{m\_{Body}}{r^{2}} $$

$G$ = 6.67 x 10-11 Nm2/kg2

Periodic Motion & Waves:

$$f=1/T$$

Spring: $T=2π\sqrt{^{m}/\_{k}}$

Pendulum: $T=2π\sqrt{^{L}/\_{g}}$

Wave Equation: $v= λf$

Intensity: $I=P/4πr^{2}$

Intensity Level: $β=10∙log⁡\left(^{I}/\_{I\_{0}}\right)$, where I0=10-12 W/m2

Doppler Effect -

Moving Observer: $f^{'}= \left(1\pm ^{u}/\_{v}\right)f$

Moving Source: $f^{'}= \left(\frac{1}{1\pm ^{u}/\_{v}}\right)f$

where u = speed of source/observer and v = speed of waves

General Doppler: $f^{'}= \left(\frac{1\pm ^{u\_{0}}/\_{v}}{1\pm ^{u\_{s}}/\_{v}}\right)f$

Waves on a String: $f\_{1}=^{v}/\_{2L}$ or $λ\_{1}=2L$

Higher Harmonics (n): $f\_{n}=nf\_{1}$ or $λ\_{n}=^{λ\_{1}}/\_{n}$

Vibrating Columns of Air -

1 Open End: λ = 4(l + 0.4\*d) (Experimental)

2 Open Ends: λ = 2(l + 0.8\*d), (Experimental)
 where d is the diameter of the tube

1 Open End: λ = 4l (Theoretical)

2 Open Ends: λ = 2l (Theoretical)

Beats: $f\_{beat}=\left|f\_{1-}f\_{2}\right|$

Chapters 15 – 18 (Fluid, Heat, Thermodynamics)

Fluids

Density: ρ = m/V

Pressure: P = F/A

Pressure w/ Depth: P = F/A + ρgh

Flotation: Vsub = Vsolid(ρsolid/ρfluid)

Continuity, Compressible Flow: ρ1A1v1 = ρ2A2v2

Continuity, Incompressible Flow: A1v1 = A2v2

Bernoulli’s – Change in Speed: P1 + ½ρv12 = P2 + ½ρv22

Bernoulli’s – Change in Height: P1 + ρgh1 = P2 + ρgh2

Bernoulli’s – General: P1 + ½ρv12 + ρgh1 = P2 + ½ρv22 + ρgh2

Temperature & Heat

Linear Expansion: ΔL = αL0ΔT,
 where α = the coefficient of linear expansion

Heat Capacity: C = Q/ΔT

Specific Heat: c = Q/m ΔT

Radiation: Power α T4

Thermodynamics

0th Law: When 2 objects have the same T, they are in thermal equilibrium

1st Law: ΔU = Q – W, where U = internal energy

2nd Law: Heat flows from high T to low T

3rd Law: It is impossible to reach 0K

Heat Engine Efficiency: e = W/Qh = (Qh – Qc)/Qh = 1 – Qh/Qc

emax = 1 – Tc/Th

Wmax = emaxQh = (1 – Tc/Th)Qh

Coefficient of Performance (Refrigerator): COP = Qc/W

Coefficient of Performance (Heat Pump): COP = Qh/W

Entropy: ΔS = Q/T