Physics

Kinematics

$\overline{v} = \frac{\Delta x}{\Delta t}$ (SI: $\frac{\mathrm{m}}{\mathrm{s}}$)

$a = \frac{\Delta v}{\Delta t}$ (SI: $\frac{\mathrm{m}}{\mathrm{s}^2}$)

Linear Motion

$v = v_0 + at$

$x = v_0 t + \frac{1}{2}at^2$

$v^2 = v_0^2 + 2ax$

$\overline{v} = \frac{(v_0+v)}{2}$

$x = \overline{v}t$

Newton's Laws

$F = ma$ (SI: N)

Gravity

$F = \frac{Gm_1m_2}{r^2}$

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

Circular Motion

$a_c = \frac{v^2}{r}$ (SI: $\frac{\mathrm{m}}{\mathrm{s}^2}$)

$F_c = \frac{mv^2}{r}$ (SI: N)

Torque

Center of Mass: $x_{\mathrm{cm}} = \frac{\sum m_i x_i}{M}$

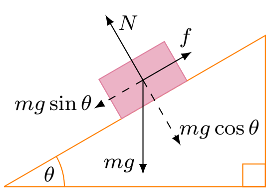
Torque: $\tau = rF\sin\theta$ (SI: N·m)

Mechanical Advantage

$F_1 \cdot d_1 = F_2 \cdot d_2$

Mechanical Advantage: $\mathrm{MA} = \frac{F_{\mathrm{in}}}{F_{\mathrm{out}}}$

Slopes



Work Energy Power

Work: $W = Fd$ (SI: J)

P: $P = \frac{W}{\Delta t}$ (SI: W)

KE: $K = \frac{1}{2}mv^2$

PE: $U = mgh$

$W = \Delta K = -\Delta U$

$E = K + U$

Springs

Hooke's Law: $F = -kx$

Potential Energy: $U = \frac{1}{2}kx^2$

Frequency of Oscillation: $f = \frac{1}{2\pi}\sqrt{\frac{k}{m}}$

Pendulums

Force: $F = mg\sin\theta$

Potential Energy: $U = mgL(1 - \cos theta)$

Frequency of Oscillation: $\frac{1}{2\pi}\sqrt{\frac{g}{L}}$

Thermodynamics

Thermal Expansion

Linear: $\Delta L = \alpha L \Delta T$

Volume: $\Delta V = \beta V \Delta T$

Specific Heat

$Q = mc\Delta T$

$U = Q - W$

Water s.h.c. : 1 cal g^{-1} K^{-1} = 4.2 J g^{-1} K^{-1}

Fluid Dynamics

$\rho = \frac{m}{V}$ (SI: $\frac{\mathrm{kg}}{\mathrm{m}^3}$)

Weight $= \rho g V$ (SI: N)

Specific Gravity $= \frac{\rho_{\mathrm{substance}}}{\rho_{\mathrm{water}}}$; $\rho_{\mathrm{water}} = 1000$ kg m^{-3}

Pressure

$P = \frac{F}{A}$ (SI: Pa)

Hydrostatic: $P_h = \rho g h$

Gauge: $P_g = P - P_{atm}$

Absolute: $\sum P$

1 atm = 760 torr = 760 mmHg = 10^5 Pa

Flow

Continuity Equation: $A_1 v_1 = A_2 v_2$

Bernoulli's Equation: $P + \frac{1}{2}\rho v^2 + \rho g h = \mathrm{constant}$

Poiseuille: $Q = \frac{\pi P r^4}{8\eta l}$; $\eta \rightarrow$viscosity

Reynold's Numnber: $v_{\mathrm{critical}} = \frac{R\eta}{2\rho r}$

Principles

Archimedes: $F_{\mathrm{buoy}} = g \cdot \rho_{\mathrm{fluid}} \cdot V_{\mathrm{submerged}}$

Pascal:

$P = \frac{F_1}{A_1} = \frac{F_2}{A_2}$

$A_1 d1 = A_2 d_2$

$W = F_1 d_1 = F_2 d_2$

Electrostatics

Coulomb's Law: $F = \frac{kq_1q_2}{r^2}; k = 9 \cdot 10^9\ \mathrm{N} \cdot \mathrm{m}^2 \cdot \mathrm{C}^{-2}$ (SI:N)

Electric Fields

Electric Field Equation: $E = \frac{F_e}{q} = \frac{kQ}{r^2}$ (SI: $\frac{\mathrm{N}}{\mathrm{C}}$ or $\frac{\mathrm{V}}{\mathrm{M}}$)

> Electric field lines go from + to −
> + charge moves in the same direction of the electric field
> − charge moves in the opposite direction

Electric Dipoles

Dipole Moment: $p = q \cdot d$ (SI: C·m)

$F_e = qE$

$\sum F_e = 0$

> Dipole will realign to be parallel with an electric field

Electrical Potential

Voltage: $V = \frac{U}{q}$ (SI: V or $\frac{\mathrm{J}}{\mathrm{C}}$)

Voltage Difference: $\Delta V = \frac{W}{q} = \frac{kQ}{r} = Ed$ (SI: V or $\frac{\mathrm{J}}{\mathrm{C}}$)

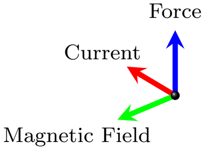
> Voltage is the amount of work to move a postitive test charge from infinity to some location

Magnetism

$F_m = Q \cdot v \cdot \beta \cdot \sin\theta$; (SI: $\beta \rightarrow$T)

Lorentz Force: $F = F_m + F_e$

Right Hand Rule



Electromagnetism

$F_{\mathrm{m}} = I \cdot L \cdot \beta \cdot sin\theta$

Biot-Savart Law: $\beta = \frac{\mu_0 I}{2\pi R}$

Circuits

Current: $I = \frac{Q}{\Delta t}$ (SI: A)

Resistance: $R = \frac{\rho L}{A}$; $\rho \rightarrow$ resistivity, A $\rightarrow$ area (SI: Ω)

Voltage: $V = IR$ (SI: V)

Power: $P = IV$ (SI: W)

Capacitance: $C = \frac{Q}{V}$ (SI: F)

Resistors

Series: $R_{eq} = R_1 + R_2 + R_3 + ...$

Parallel: $\frac{1}{R_{\mathrm{eq}}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + ...$

Capacitors

Series: $\frac{1}{C_{\mathrm{eq}}} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3} + ...$

Parallel: $C_{eq} = C_1 + C_2 + C_3 + ...$

Energy Stored: $U = \frac{1}{2}QV = \frac{1}{2}CV^2 = \frac{1}{2}\frac{Q^2}{C}$

Dielectric: $C_{\mathrm{dielectric}} = kC; k \rightarrow$ dielectric constant

Waves

$f = \frac{1}{T}$ (SI: Hz)

$v = f \cdot \lambda$ (SI: $\frac{\mathrm{m}}{\mathrm{s}}$)

Standing Waves

Open Pipe & Fixed String: $\lambda = \frac{2L}{n}$; $n \rightarrow 1, 2, 3 \ldots$

Closed Pipe: $\lambda = \frac{4L}{n}$; $n \rightarrow 1, 3, 5 \ldots$

Sound

Intensity: $I = \frac{P}{A}$

Sound Level: $\beta = 10\log(\frac{I}{I_0})$; $I_0 = 10^{-12}$ (SI: dB)

Doppler Effect: $f' = f\frac{v \pm v_{\mathrm{d}}}{v \mp v_{\mathrm{s}}}$; $v = 343\,\frac{\mathrm{m}}{\mathrm{s}}$

Optics

Reflection and Refraction

$\theta_{\mathrm{incidence}} = \theta_{\mathrm{reflection}}$

Snell's Law: $n_{\mathrm{i}} \sin\theta_{\mathrm{i}} = n_r \sin\theta_{\mathrm{r}}$

Index of Refraction: $n = \frac{c}{v}$; $c = 3 \cdot 10^8\,\frac{\mathrm{m}}{\mathrm{s}}$

Mirrors and Lenses

Focal Point: $f = \frac{1}{2}$ radius of curvature

Thin Lens Equation: $\frac{1}{f} = \frac{1}{d_{\mathrm{o}}} + \frac{1}{d_{\mathrm{i}}}$

Magnification Equation: $M = -\frac{d_{\mathrm{i}}}{d_{\mathrm{o}}} = \frac{h_{\mathrm{i}}}{h_{\mathrm{o}}}$