Physics CT Notes Y4

Chapter 1 - Physical Quantities, Units and Measurements

Base Quantity	SI Unit	Symbol for SI Unit
length	meter	m
mass	kilogram	kg
time	second	s
electric current	ampere	A
thermodynamic temperature	kelvin	K
amount of substance	mole	mol
luminous intensity	candela	cd

Common prefixes	Factor	Prefix	Symbol
	10^{12}	tera	T
	10^{9}	giga	G
	10^{6}	mega	M
	10^{3}	kilo	k
	10^{-1}	deci	d
	10^{-2}	centi	c
	10^{-3}	milli	m
	10^{-6}	micro	μ
	10^{-9}	nano	n

Scalar Quantities only have magnitude
- distance
- speed
- mass
- energy

Vector Quantities have both magnitude and direction
- displacement
- velocity
- force
- weight

Chapter 2 - Kinematics

suvat equations

$v = u + at$

$v^2 = u^2 + 2as$

$s = ut + \frac{1}{2}at^2$

$s = \frac{1}{2}(u+v)t$

$s = vt - \frac{1}{2}at^2$

s - displacement
u - initial velocity
v - final velocity
a - acceleration
t - time

Chapter 3 - Dynamics I: Mass and Weight

Mass

- SI Unit: kg
- Scalar quantity
- Measured with electronic balance or beam balance

Weight

- SI Unit: N
- Vector quantity
- Measured with spring balance

Weight = Mass × Gravitational Field Strength ($10\ N\ kg^{-1}$ on Earth)

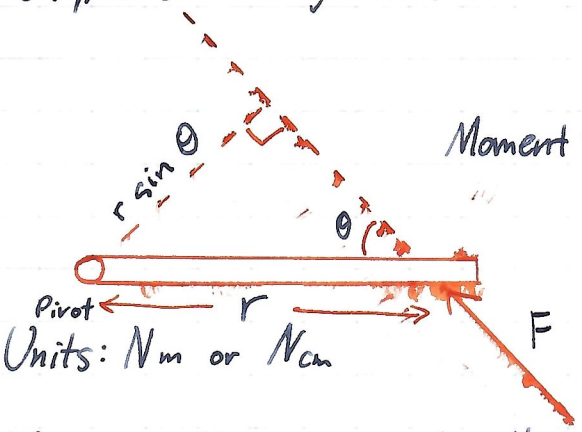
Chapter 4 - Dynamics II: Forces

N1L: Every object will continue in its state of rest or uniform motion in a straight line unless a resultant force acts on it.

N2L: When a resultant force acts on an object of a constant mass, the object will accelerate in the direction of the resultant force.

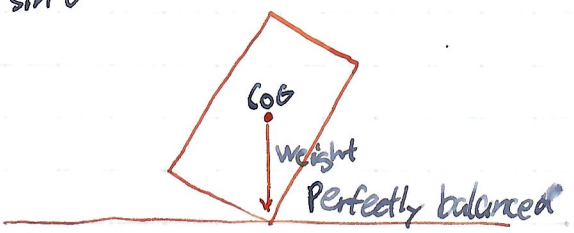
N3L: If body A exerts a force F_{AB} on body B, then body B will exert an equal and opposite force F_{BA} on body A.

Chapter 5 - Turning Effects of Forces



Moment = $Fr \sin\theta$

Units: Nm or Ncm



If the vertical line through an object's CoG falls within its base, it can return to its original position

Chapter 6 - Pressure

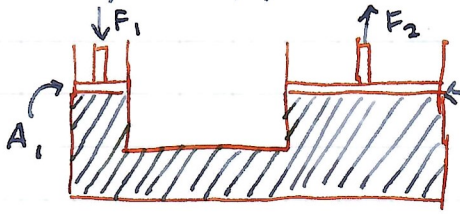
$$\text{Pressure} = \frac{\text{Force}}{\text{Contact Area}} \qquad 1\ Pa = 1\ N/m^2$$

Liquid pressure

As a liquid is incompressible, pressure is transmitted throughout the liquid and hence,

$P_1 = P_2$

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



A hydraulic press

Pressure = $h\rho g$ where h = height or depth (m), ρ = density (kg/m^3), g = gravitational field strength (N/kg)

Chapter 7 - Energy

$E_k = \frac{1}{2}mv^2$ where E_k = energy in the kinetic store (J), m = mass (kg), v = speed (m/s)

$E_p = mgh$ where E_p = GPE (J), m = mass (kg), g = GFS (N/kg), h = height (m)

☆ Work is done only when an object moves under the influence of a force.

$W = Fs$ where W = Work done (J), F = Constant force (N), s = distance moved in the direction of the force (m)

$$\text{Power (W)} = \frac{\text{Work done (J)}}{\text{time (s)}}$$

Chapter 8 - Kinetic Particle Model of Matter

Nothing important / difficult

Chapter 9 - Thermal Processes

Conduction is a process of energy transfer where energy is transferred through the passing on of vibrational motion from one particle to another.

Convection is a process of energy transfer by means of convection currents of a fluid due to a difference in density.

Radiation is the process of energy transfer by electromagnetic waves. It does not require a medium.

Rate of radiation emission / absorbance increases when,

- Surface area increases
- Surface is rough
- Surface is dark-coloured

Chapter 10 - Thermal Properties of Matter

$Q = mc\Delta\theta$ where Q = Change in internal energy (J),
m = mass of substance (kg),
c = specific heat capacity (J/kg K or J/kg °C),
$\Delta\theta$ = change in temperature (K or °C)

Latent heat of fusion L_f: the amount of energy transferred to change a substance between the solid and liquid states, at constant temperature.
Latent heat of vaporisation L_v: the amount of energy transferred to change a substance between the liquid and gaseous states, at constant temperature.

Chapter 11 - General Wave Properties I: Introduction

$\lambda = vT$ where λ is the wavelength in m, v is the wave speed in ms^{-1}, and T is the period in s

$f = \frac{1}{T}$ where f is the frequency in Hz, and T is the period in s

Chapter 12 - General Wave Properties II: Sound

Sound

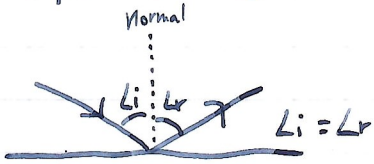
- Longitudinal wave
- Compressed regions are compressed and extended regions are rarefactions
- Human hearing range is 20Hz - 20kHz
- Needs a medium to propagate

Chapter 13 - Electromagnetic Waves

EM Waves

- Transverse waves
- Doesn't require a medium to propagate
- [redacted] speed of $3 \times 10^8 ms^{-1}$ in a [redacted] vacuum
- Mnemonic: Raging Martians Invaded Venus Using X-ray Guns
  - Radio, microwave, infrared, visible, ultraviolet, x-ray, gamma

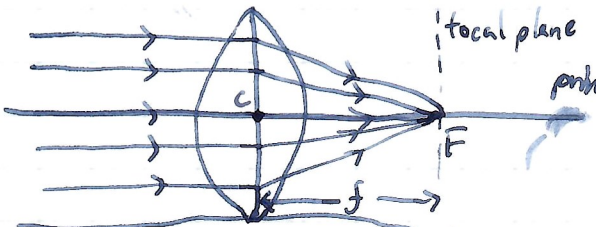
Chapter 14 - Light



$n = \frac{c}{v} = \frac{\sin i}{\sin r} = \frac{1}{\sin C}$

where c is $3 \times 10^8 ms^{-1}$, v is the speed of light in the medium, i is the angle of incidence, r is the angle of refraction, and C is the critical angle

Only converging lenses are tested.



C - optical centre
F - principal focal point
f - focal length

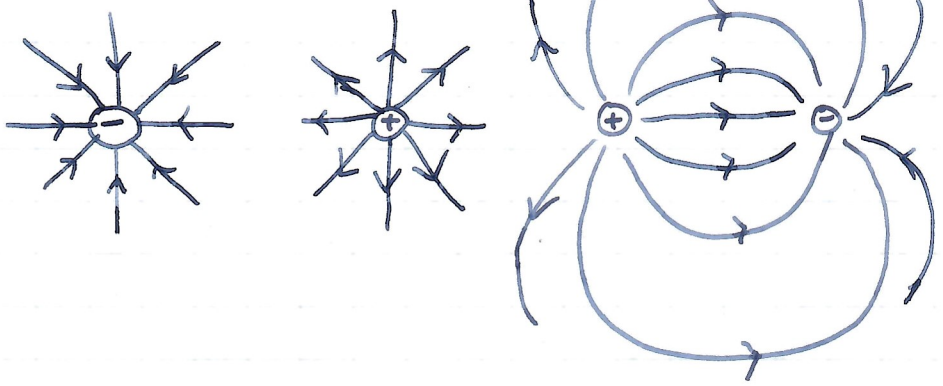
$\frac{1}{f} = \frac{1}{u} + \frac{1}{v}$ ☆

where u is the object distance and v is the image distance

Chapter 15 - Static Electricity

Like charges repel, unlike charges attract

An electric field is a region where an electric charge experiences an electric force



Chapter 16 - Current of Electricity

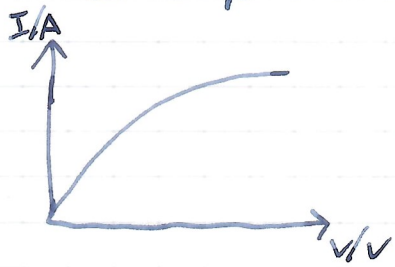
$I = \frac{Q}{t}$ where I = current (A), Q = charge (C), t = time taken (s)

$E = \frac{W}{Q}$ where E = emf of electrical source (V), W = Work done (J), and Q = charge (C)

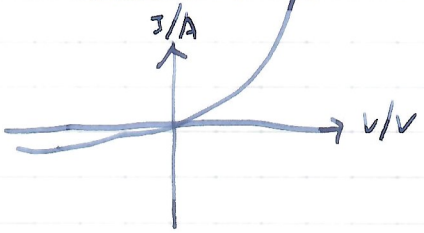
$V = IR$ where V = p.d. across component (V), I = current (A), R = resistance (Ω)

I-V Graphs

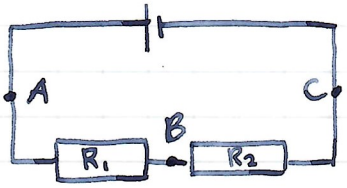
filament lamp



semiconductor diode



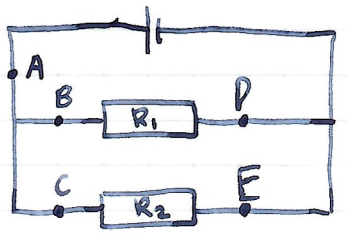
Chapter 17 - D.C. Circuits



$I_A = I_B = I_C$

$R_e = R_1 + R_2$

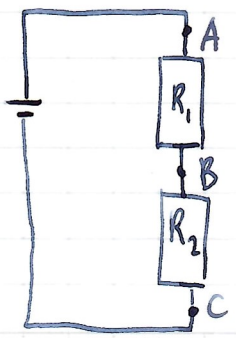
$emf = V_{AB} + V_{BC}$



$I_A = I_B + I_C$

$emf = V_{BD} = V_{CE}$

$\frac{1}{R_e} = \frac{1}{R_1} + \frac{1}{R_2}$



$V_{AB} = \frac{R_1}{R_1 + R_2} V_{AC}$ $V_1 = \frac{R_1}{R_1 + R_2} V_s$

NTC Thermistor
- Temperature ↑
- Resistance ↓

LDR
- Light ↑
- Resistance ↓