M. Yousaf Jamil — AS - Group D — AS - Physics - B4

Physics Formulas + Notes

Date: / /

Chap 1, 2, 3, 4, 5, 8, 9, 10

Ch1

$v = \frac{s}{t}$ unit ms^{-1}

$a = \frac{\Delta v}{t}$ unit ms^{-2}

or

$a = \frac{v-u}{t}$

gradient of s/t graph = v

gradient of v/t graph = a

Area below v/t graph = s

Ch2

$v = u + at$

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

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

$v^2 - u^2 = 2as$

4 eq. of motion for no/negligible friction or resistive forces

s, u, v, a, t — Any 3 must be given to find 4th

$g = 9.81\ ms^{-2}$

Projectiles: If initial velocity u against gravity, $g = -9.81\ ms^{-2}$

" " or " in direction of gravity, $g = 9.81\ ms^{-2}$

$h = \frac{u^2 \sin^2\theta}{2g}$, $t = \frac{u \sin\theta}{g}$, $T = \frac{2u\sin\theta}{g}$, $R = u\cos\theta \cdot t$, $R = \frac{u^2 \sin 2\theta}{g}$

Ch3

Base units: m, kg; kg, mass; s, time; A, current; K, temp.; mol, amount of substance; cd, luminous intensity

$F = ma$

$F = \frac{\Delta p}{t}$ ⇒ Newton's 2nd law of motion

$W = mg$

Object in motion remains in motion & object at rest remains at rest unless an external force acts upon it ⇒ Newton's first law of motion

Force on body 'A' on body 'B' is equal & opp. to force by body 'B' on body 'A'. Both forces are ~~opposite~~ of same type ⇒ Newton's 3rd law of motion

quick chng ... → elastic collision only: K.E & P remains conserved | Non elastic: P only conserved
remains conserved

[Closed triangle ⇒ equilibrium of forces

For relative speed: opp. directions: add ; same direction: subtract

horizontal ⇒ $F\cos\theta$] forces components
vertical ⇒ $F\sin\theta$]

$M = F \times d$ unit $kg\,ms^{-1}$ (Nm) ⇒ product of mass & velocity ⇒ vect.

Mass ⇒ Measure of body resistance, Measure of inertia ↳ to change velocity/motion

ch 4 Torque = $F \times d$ ↳ b/w 2 couple ↳ F of one of couple

Property of body to resist change in state of rest or motion

For couple of forces, both F must have:
- d b/w them
- same magnitude
- opp. direction but parallel

upthrust $F = \rho g V$ ↳ volume of object ↳ of liquid

$P = \frac{F}{A}$] ⇒ unit: Pa
$P = \rho g h$]
$\Delta P = \rho g \Delta h$

upthrust force = W of liq. displaced

equilibrium ⇒ ① No resultant M
② " F

e.g. $m_1 v_1 + m_2 v_2 = m_1 v_3 + m_2 v_4$ ↳ law of conservation of momentum

Isolated system → system with no external force

$W = F \times s$ unit: J
or $W = P\Delta V = PA\Delta h$ ⇒ gas

momentum in 2 dimension ⇒ components

$\Delta E_p = mg\Delta h$ unit: J ↳ always taken from object centre

forces on pivot ⇒ no turning effect

$E_k = \frac{1}{2}mv^2$ unit: J

Force equals rate of change of momentum ↳ Gen def. of force ↳ $F = \frac{\Delta p}{t}$

$\frac{1}{2}mv^2 = mgh$ ↳ no air resistance

ch 5 eff. = $\frac{useful}{total}$ Ek + $\frac{1}{2}mv^2 = mgh$ ↳ air resistance

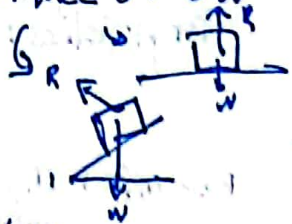
Normal reaction force ⇒ applied perpendicularly by surface on object

% eff. = $\frac{useful}{total} \times 100$

$P = \frac{W}{t}$ unit: W

Drag force of sphere ↳ $F_d = krv$ → speed, → radius ↳ constant

velocity is $0\,s^{-1}$ → Drag force depends on body.



or $P = F \times V$

$e = \frac{m}{v}$

Centre of gravity ⇒ where weight acts upon ⇒ seems to

Tension ⇒ greatest at max ... ↳ The force which acts on stretched object

+ → − ⇒ conventional current
− → + ⇒ electric "

static friction → friction on stopped object ↳ depends on nature of surface, mass of object

$I = \frac{Q}{t}$ or $Q = It$ ↳ second ↳ Ampere ↳ Coulomb

ch 8 work done by driving force − work done by friction = $\Delta GPE + \Delta K.E$

elementary charge: 1.6×10^{-19} C.

$I = nAvq$ ⇒ current = no. of free charge carriers × Area of wire × drift v × charge on electron

$n = \frac{N}{V}$ ⇒ no. density = $\frac{\text{no. of free charge carriers (electrons)}}{\text{volume}}$ ⇒ base of derivation of $I = nAvq$

Date : / /

$V = \frac{W}{Q}$ unit: V

or

$V = IR$ unit: V

Ch 8 removed

$P = IV$ unit: W → Main eq. asked in exam

or

$P = I^2R$

or

$P = \frac{V^2}{R}$ or $P = \frac{E}{t}$

$E = QV$. unit: J

or

$E = IVt$ $\therefore W = IV\Delta t$

or

$E = I^2Rt$

or

$E = \frac{V^2}{R} \times t$

$W = QV$

emf ⇒ non-electrical to electrical/across

V ⇒ electrical to non-electrical/across

1.6×10^{-19} J → eV

electron volt = coulomb × volt = CV

Mega electron volt = eV × 10^6 ⇒ MeV

↳ 1.6×10^{-13} J

kWh ⇒ power × t

At a joint, the sum of currents enter = sum of current leaving,

↳ Kirchoff's first law

Sum of emfs = sum of p.d] ⇒ in a loop of circuit

↳ Kirchoff's second law

e.g low to high pd ⇒ +ve ↳ in direction of conventional current ⇒ +ve else -ve

high to low pd ⇒ -ve

Ch 9

$R = R_1 + R_2 + \ldots + R_n$ ⇒ series

$\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \ldots + \frac{1}{R_n}$ ⇒ parallel

$I = \frac{Ne}{t}$

$Q = Ne$

$R_{eq} = \frac{R_1 \times R_2}{R_1 + R_2}$ ⇒ parallel 2 resistors

Internal resistance ⇒ of battery

↳ $E - I_r = IR$

$R_{eq} = \frac{R}{n}$ ⇒ parallel 'n' resistors (multiple) all with same resistance 'R'

where 'n' is no: of resistors

terminal p.d ⇒ p.d between terminals, ↳ electric current from battery delivered

Ohm's law: current flowing through conductor ∝ to p.d when no change in physical condition (temp.)

$R \propto T$

$R \propto L$

$R \propto \frac{1}{A}$

Potential divider ⇒ $V_{out} = \frac{R_{switched}}{total\ R} \times V_{in}$

Ch 10

$R = \frac{\rho L}{A}$ unit: Ω or $\rho = \frac{RA}{L}$ unit: Ωm

where ρ is resistance

thermistor ⇒ ↑θ ⇒ ↓R

LDR ⇒ ↑light ⇒ ↓R

0 - 0.2V ⇒ given threshold value ⇒ after this V it starts conducting

Estimations

(1) Speed of sound in air: 300-350 ms^{-1}

(2) ρ of air at rtp & pressure: 0.5-1.5 kg m^{-3}

(3) m of protractor: 5-30 g

(4) V of human head: $(2-7) \times 10^{-3}$ cm^3

(5) λ of UV light: 10-400 nm

(6) f of audible sound: 20 Hz - 20 kHz

(7) Mass of plastic ruler: 10-100 g

(8) λ of visible light: 400-700 nm

(9) f of visible light: $(43-75) \times 10^{14}$ Hz

(10) Thickness of paper sheet: 0.07-0.15 mm

(11) Time for sound to travel 100 m in air: 0.25-0.5 s

(12) W of 1000 cm^3 of H_2O: 8-12 N

(13) m of average person: 70 kg

(14) ρ of sand: 2×10^3 kg m^{-3}

(15) M of copper: 100-200 g

(16) m of metre rule: 80-100 g

(17) M of atom: 10^{-26} kg

(18) V of athelete: 8 ms^{-1}

(19) V of car on highway: 30 ms^{-1}

(20) ρ of H_2O: 1000 kg m^{-3}

(21) V of α particle in air: ~~1000 kg m^{-3}~~ 10^6 ms^{-1}

(22) V of β particle in air: 10^8 ms^{-1}

(23) V of jet: 220-250 ms^{-1}

(24) θ of Human body: 37-38 °C : or 310-311 K

(25) Young Modulus: 10^{11} Pa

(26) surface θ of sun: 5700 K

(27) diameter of an atom: 10^{-10} m to 10^{-12} m

(28) diameter of a nucleus: 10^{-14} m to 10^{-15} m

Homogenous eq.

Base units on both side of eq are same

Prefixs

10^{-15}	femto	f
10^{-12}	pico	p
10^{-9}	nano	n
10^{-6}	micro	μ
10^{-3}	milli	m
10^{-2}	centi	c
10^{-1}	deci	d
10^{1}	deca	da
10^{2}	hecto	h
10^{3}	kilo	k
10^{6}	~~giga~~ mega	M
10^{9}	giga	G
10^{12}	tera	T

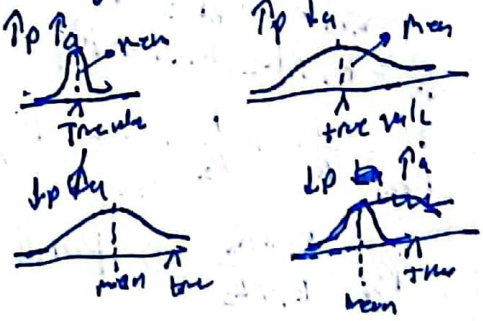
Errors

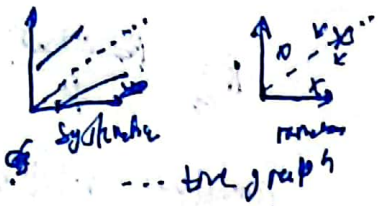
fixed by calibration

Systematic: Instrumental error is constant diff.

Random: due to physical factors

Gfix by arg. Gdiff. error rule





... true graph

ch10

Potentiometer → ratio of pd = ratio of resistance
↳ wire ÷ total ↳ wire ÷ total
↳ Determine emf of unknown battery
↳ adjust till $I = 0$ $E_x = \frac{\text{battery emf} \times \text{length of wire}}{\text{total wire length}} = \frac{EL}{L}$
eg. 2 cells → find balance mark ∴ ratio of emf = ratio of length

Uncertainty

rules: 1sf ~~uncertainty~~

Absolute: $d \pm \Delta d$ • same dp in value and uncertainty • same unit

Fractional/relative: $\frac{\Delta d}{d}$

Percentage: $\frac{\Delta d}{d} \times 100$

For add/subtract: Add/subtract d, but always add Δd

For multiply/divide, divide each uncertainty by measured value and add, multiply by value of one of which to find. Ignore constants. (usually g is constant unless uncertainty given).

eg. $P = \rho g h$
• to find Δp

$\frac{\Delta p}{p} = \frac{\Delta \rho}{\rho} + \frac{\Delta g}{g} + \frac{\Delta h}{h}$

$\Delta p = \left(\frac{\Delta \rho}{\rho} + \frac{\Delta g}{g} + \frac{\Delta h}{h}\right) p$

$\frac{\Delta g}{g}$ may be skipped depending on qs.

For powers always multiply

eg. $A = \pi r^2$

$\frac{\Delta A}{A} = 2 \times \frac{\Delta r}{r}$

$\Delta A = \frac{2\Delta r}{r} \times A$

Prefixes continued:

Short method: take value on scales, invert power of multiple

eg. convert 43 dJ to mJ

$43 \times 10^{-1} \times 10^{3}$ ↳ as milli is 10^{-3}, invert to 10^{3}

43×10^{2} mJ

... type shown ... 8 9 law of motion

Vectors

Add: Tip to tail rule of all vectors A, B A+B = R

Subtract: Tip to tail rule of all vectors with those subtracted in opp. direction: A, B A−B =

Multiply: tip to tail of modified lengths: A, B A+2B = R

Divide: Resolution: A ⇒

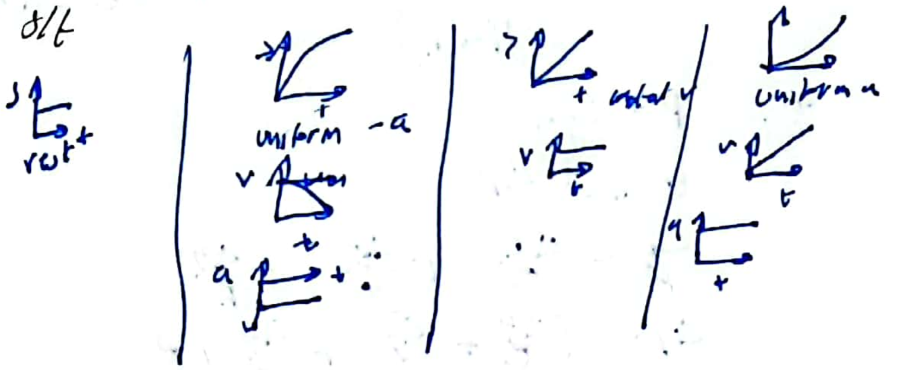
↳ Both component 90°; Pythagoras, sin, cos, tan to find value

Representing vector quantities

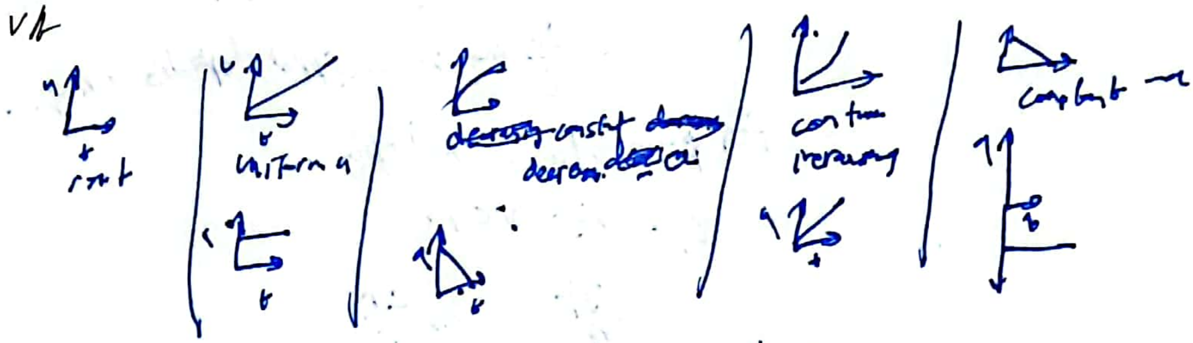
S bold $\vec{S}$ arrow

Graphs

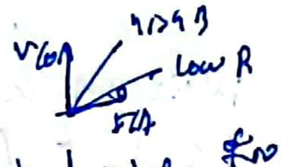
d/t

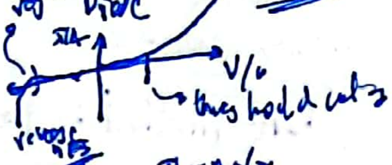


v/t



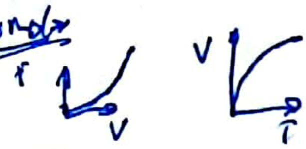
Ohmic conductor





V → intercept, instead value from graph

Thermistor



same graph for LDR

Terminal pd

y-intercept ⇒ emf
gradient ⇒ −r − internal resistance