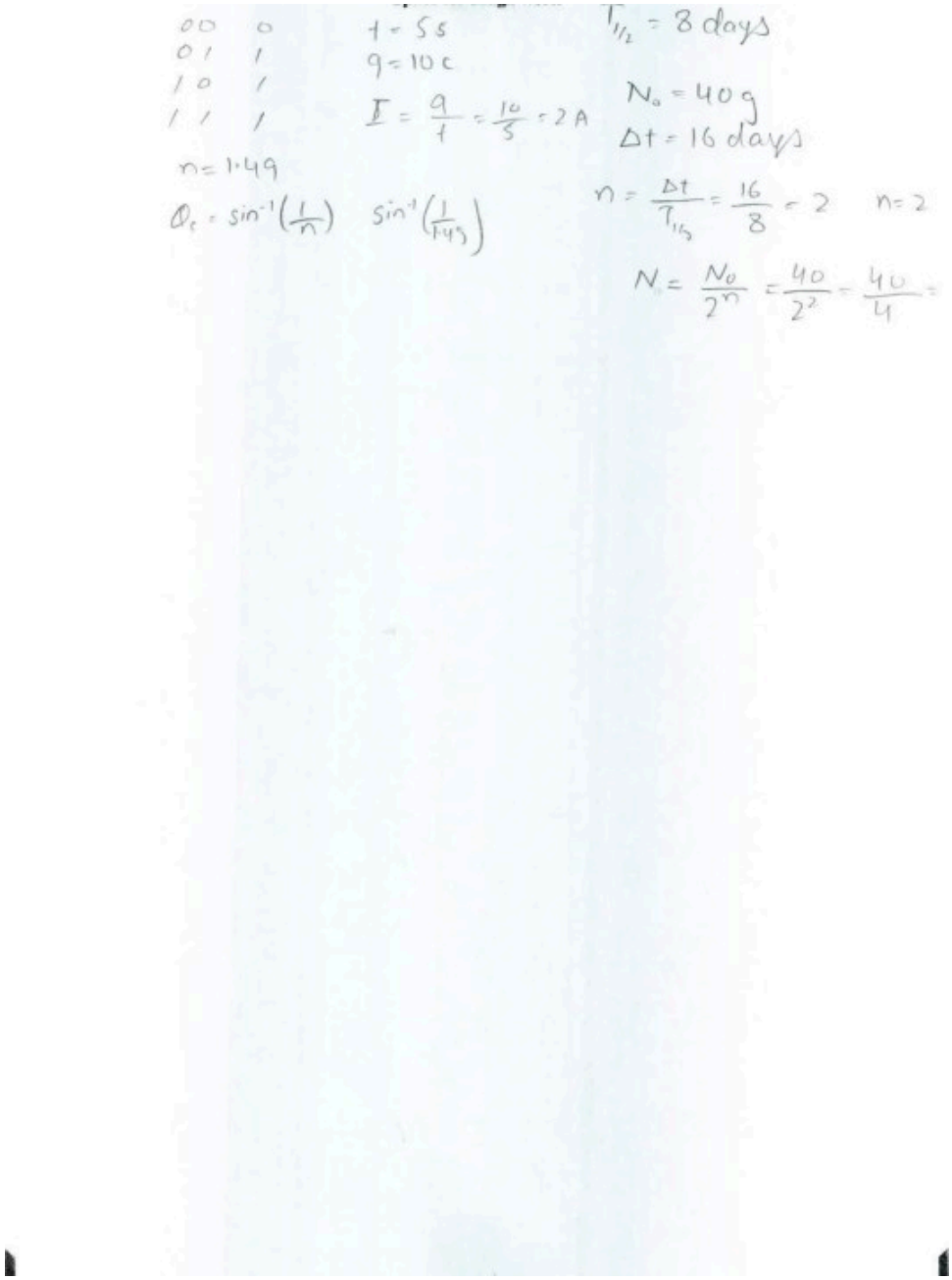



00 0
01 1
10 1
11 1
t = 5s
q = 10 c
I = q/t = 10/5 = 2 A
n = 1.49
θc = sin⁻¹(1/n) sin⁻¹(1/1.49)
T1/2 = 8 days
N0 = 40 g
Δt = 16 days
n = Δt/T1/2 = 16/8 = 2 n = 2
N = N0/2^n = 40/2² = 40/4 =

Use for rough work

Q. No. 2 Part (i)

Given data:- mass (m) = 2 kg

$T_i = 40°C$ $T_f = 45°C$ $\Delta T = T_f - T_i = 45 - 40°C$

$c = 420\ Jkg^{-1}K^{-1}$ $\Delta T = 5°C$ or $5K$

To find:- Q (heat) = ?

Solution:- using formula, $Q = cm\Delta T$

putting values. $Q = (420)(2)(5)$

$$\boxed{Q = 4200\ J}$$

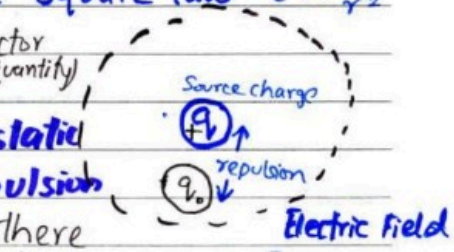
Result:- So, the heat required for substance of mass 2kg and temperature change of 5K is 4200 J.

Q. No. 2 Part (ii) **ELECTRIC FIELD:-** "Space or region around the charge within which it exerts its electrostatic force of attraction or repulsion on other (test) charge is known as electric field".

→ Electric Field obeys inverse square law $\vec{E} \propto \frac{1}{r^2}$

→ It is represented by $\vec{E}$ (vector quantity)

Electric Field affects test charge by showing electrostatic force of attraction or repulsion



• If source charge is positive, there will be repulsion. • If source charge is negative there will be attraction (As q_0 is always positive) • Formula for Electric field intensity is $\vec{E} = \frac{\vec{F}}{q_0}$

Q. No. 2 Part (iii) **Given data:-** $n = 3$ $\mathcal{E} = 1.5\ V$

To find:- a) $\mathcal{E}_{eq}$ in series b) $\mathcal{E}_{eq}$ in parallel

Solution:- a) for series emf will add up.

$\mathcal{E}_{eq} = \mathcal{E}_1 + \mathcal{E}_2 + \mathcal{E}_3 \Rightarrow \mathcal{E}_{eq} = 1.5 + 1.5 + 1.5$

$\boxed{\mathcal{E}_{eq} = 4.5\ V}$

b) for parallel emf will remain same

$\mathcal{E}_{eq} = \mathcal{E}_1 = \mathcal{E}_2 = \mathcal{E}_3 \Rightarrow \boxed{\mathcal{E}_{eq} = 1.5\ V}$

Result:-

a) 4.5 V (in series)

b) 1.5 V (in parallel)

Q. No. 2 Part (iv) **Given data:-** $P = 1000\ W$ $t = 5$ hours

1 unit cost is Rs. 30

To find:- Total Cost = ?

Solution:- using formula, (for energy)

$$E = \frac{\text{Power (W)} \times \text{time (hours)}}{1000} = \frac{1000 \times 5}{1000} = 5\ \text{kWh}$$

Energy is **5 kWh**

As, 1 unit = 1 kWh. also, 1 unit = Rs 30

So, 5 unit = Rs. 30 x 5

5 unit = Rs. 150

Result: Total cost is Rs. 150

Q. No. 2 Part (v) **Given data:-** $V = 220\ V$, $I = 2\ A$

To find:- Power (P) = ?

Solution:-

using formula,

$$P = VI$$

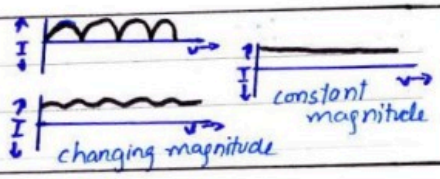
putting values,

$$P = (220)(2)$$

$$\boxed{P = 440\ W}$$

Result:- So, the power consumed by appliance is 440 W

Q. No. 2 Part (vi)

Alternating Current (A.C.)	(D.C.) Direct Current
Definition	
The current whose magnitude changes continuously, direction changes after equal interval of time.	The current whose magnitude either varies or remain steady, direction does not change.
Frequency	
• In Pakistan, 50 Hz • In Japan, 60 Hz	Frequency of D.C. is '0' Hz
Graph	
	

Q. No. 2 Part (vii) **ECHO**:- "Reflected sound heard after original sound is known as echo."

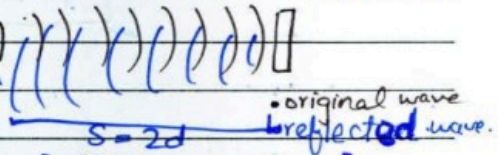
Requirements / Conditions for Echo:-

→ Our human ear can persists a sound upto 0.1 s

→ The speed of sound in air is 340 ms^{-1}.

→ for distance, $s = \frac{vt}{2} = \frac{(340)(0.1)}{2} = 17\,m$

So, the minimum distance to hear echo is 17 m.



Production of Echo:

Echo is produced when **sound waves strike a rigid barrier and reflects for the minimum distance of 17 m with speed of 340 ms^{-1}.**

.....

Q. No. 2 Part (viii) **OHM's LAW:-** The current applied to conductor varies directly with the potential difference at the end of conductor. Mathematically, ~~I∝V~~ $I = (\frac{1}{R})V$ **V=IR**
where '1/R' is the **constant of proportionality.**

Given data:- $R = 10\Omega$ $I = 2\ A$

To find:- $V = ?$

Solution:- using OHM's law, $V = IR$

$V = (2)(10)$

V= 20 V

Result:- So, the potential difference required for given resistor is 20 V.

Q. No. 2 Part (ix) **Given data:-** $d_o = 2cm$ $d_i = 6cm$

To find:- a) $M = ?$ b) $f = ?$

Solution:- a) for Magnification, $M = \frac{d_i}{d_o}$

$M = \frac{6}{2} \Rightarrow$ **M=3**

b) for focal length, $\frac{1}{f} = \frac{1}{d_i} + \frac{1}{d_o}$ $(\frac{1}{f} = \frac{1}{q} + \frac{1}{p})$

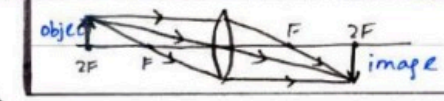
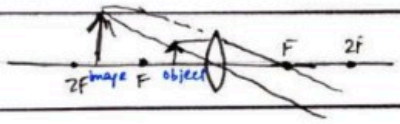
$\frac{1}{f} = \frac{1}{6} + \frac{1}{2}$ $\frac{1}{f} = \frac{2}{3}$

$f = \frac{3}{2}$ cm or 1.5 cm

Result:- a) So, the convex lens has magnification of 3.

b) Also, focal length of lens is 1.5 cm

Q. No. 2 Part (x)

Real Image	Virtual Image
Obtaining on screen	
Real Image is always obtained / caught on screen.	Virtual Image can never be obtained / caught on screen
Rays	
Light Rays actually meet at that point (image)	Light rays are imaginary / virtually meeting at that point (image)
Nature	
Real image is always inverted.	Virtual image is always erected.
Example	
	

Q. No. 2 Part (xi)

Boiling	Evaporation
Definition	
The process of phase change from liquid to gaseous state on providing external heat.	The process of phase change from liquid to gaseous state without providing external heat.
Temperature	
Boiling occurs at fixed boiling point.	Evaporation occurs at any temperature.
Molecule Participation	
Molecules from whole liquid can participate	Molecules from surface can participate.

Q. No. 3 (Page 1)

NUCLEAR FUSION REACTION:-

Definition:

"The process of combining of two smaller unstable nuclei to form a larger stable nucleus with release of energy and radiations is known as nuclear fusion reaction"

Example:

Nuclear Fusion Reactions at surface of Sun

Mass Defect:-

Sum of smaller nuclei masses is always greater than the larger stable nucleus, this is known as **mass defect**. This missing mass is converted into energy by Einstein's famous equation

$$E = mc^2$$

Energy:- The amount of energy produced in reaction is 26.3 MeV **(Proton-Proton cycle on Sun's Surface)**

This cycles occurs in three steps.

① $_{1}^{1}H + {}_{1}^{1}H \longrightarrow {}_{1}^{2}H + {}_{-1}^{0}\beta$

② $_{1}^{1}H + {}_{1}^{2}H \longrightarrow {}_{2}^{3}He + \gamma$

③ $_{2}^{3}He + {}_{2}^{3}He \longrightarrow {}_{2}^{4}He + {}_{1}^{1}H + {}_{1}^{1}H + \gamma$

High Temperature Requirement:-

Nuclear fusion reaction requires high temperature because smaller lighter molecules requires a large temperature for their combination

Q. No. 3 (Page 2)

→ lighter molecules need them to be in the high energy states (for fusion reaction to occur), thus requiring a very high temperature.

(b)

Given data:-

$m = 55.56$ kg

$c = 3.0 \times 10^8$ ms^{-1}.

To find:-

$E = ?$

Solution:-

using Einstein's equation,

$E = mc^2$

$E = (55.56)(3.0 \times 10^8)^2$

Energy $= (55.56)(9 \times 10^{16})$

Energy $= 5.0004 \times 10^{18}$ J

Result:- So, the amount of energy released is 5.0004×10^{18} J.

Q. No. 4 (Page 1)

TOTAL INTERNAL REFLECTION:-

"Bouncing back of entire light rays into the same medium is known as Total Internal Reflection"

CONDITIONS FOR TOTAL INTERNAL REFLECTION

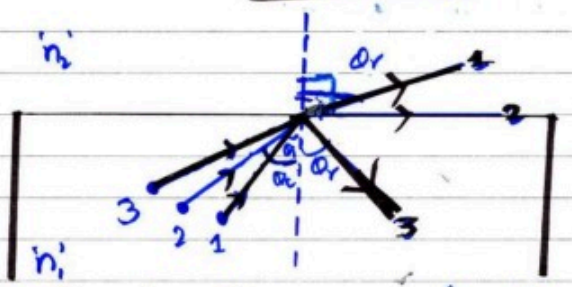
The following are the two main conditions for Total Internal Reflection:-

→ Light Ray must travel from denser medium to rarer medium.

→ Angle of incidence must be greater than critical angle. $\angle i > \angle C$

CRITICAL ANGLE:- Angle of Incidence is said to be critical angle when refracted ray becomes 90°

$\angle r = 90°$



Ray 1, shows normal refraction
Ray 2, shows critical angle.
Ray 3, shows Total Internal Reflection

Q. No. 4 (Page 2)

Relation between Critical Angle and Refractive Index

using SNELL'S law,

$$n_1 \sin\theta_i = n_2 \sin\theta_r$$

here $n_1 = n$ as light is entering from denser medium to rarer medium

so, $n_2 = 1$ (rarer is air)

$$n \sin\theta_i = (1)(\sin\theta_r)$$

for critical angle, $\theta_r = 90^\circ$ $\theta_i = \theta_c$

$$n \sin\theta_c = \sin(90) \quad (\because \sin(90) = 1)$$

$$n \sin\theta_c = 1$$

$$\boxed{n = \frac{1}{\sin\theta_c}}$$

This is the relation between critical angle and refractive index.

Q. No. 5 (Page 1)

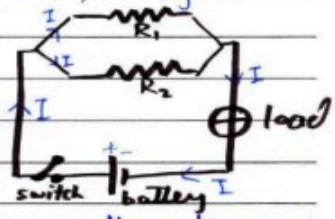
Resistors in Parallel:-

- In parallel combination, resistors are connected side-by-side.
- In parallel combination, current divides voltages remain same, resistance adds up (inverse)

$$V_{eq} = V_1 = V_2 = V_3$$

let two resistors are connected in parallel, As in parallel current divides, voltages remain same so,

$$I_{eq} = I_1 + I_2 \rightarrow (i)$$



This is the diagram for two resistors connected in parallel combination

using ohm's law, $V = IR$

$$I_1 = \frac{V}{R_1}, \quad I_2 = \frac{V}{R_2}$$

$$I_{eq} = \frac{V}{R_{eq}}$$

Putting values of I_1 and I_2 in eq (i)

$$I_{eq} = \frac{V}{R_1} + \frac{V}{R_2}$$

$$I_{eq} = V\left[\frac{1}{R_1} + \frac{1}{R_2}\right]$$

$$\frac{I_{eq}}{V} = \frac{1}{R_1} + \frac{1}{R_2}$$

As, $\frac{V}{R_{eq}} = I_{eq} \Rightarrow \frac{1}{I_{eq}} = \frac{R_{eq}}{V}$

$\frac{V}{I_{eq}} = R_{eq} \Rightarrow \frac{1}{R_{eq}} = \frac{I_{eq}}{V}$ putting in equation,

$$\boxed{\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2}}$$

This is derived formula for resistors in parallel

Q. No. 5 (Page 2) combination

Given data:-

$R_1 = 6\ \Omega$

$R_2 = 3\ \Omega$

connected in parallel combination

To find:-

$R_{eq} = ?$

Solution:-

$$\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2}$$

$$\frac{1}{R_{eq}} = \frac{1}{6} + \frac{1}{3}$$

$$\frac{1}{R_{eq}} = \frac{1}{2}$$

$$\boxed{R_{eq} = 2\ \Omega}$$

Result:- So, the combined resistance of two resistors in parallel is $2\ \Omega$

Q. No. 6 (Page 1)

TRANSFORMER:- "A device that increases or decreases given alternating voltage is known as transformer"

SYMBOL:-



WORKING PRINCIPLE:- The working principle of transformer is **mutual inductance** between two coils **(Faraday's law of Electromagnetic Induction)**

CONSTRUCTION:- Construction of transformer consists of three main parts i.e. primary coil, secondary coil and leminated iron-core (enamel coated)

WORKING:- As alternating current's magnitude is changing continuously, so **magnetic flux** is produced. These changing no. of field lines are also passing through **secondary coil** and due to changing no. of field lines (across secondary coil), current is produced according to Faraday's law of electromagnetic Induction.

TRANSFORMER'S EQUATION:- Ratio of voltage applied at primary to voltage gained at secondary is equal to no. of turns of primary to no. of turns at

Q. No. 6 (Page 2) secondary

$$\frac{V_p}{V_s} = \frac{N_p}{N_s}$$

This is the **transformer's equation**.

IDEAL TRANSFORMER:- The transformer in which there is no power loss to occur is known as ideal transformer.

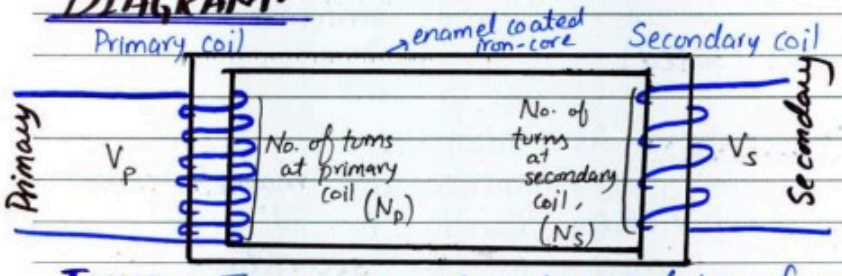
$$P_p = P_s \qquad (P = VI, \therefore)$$

$$V_p I_p = V_s I_s$$

$$\frac{V_p}{V_s} = \frac{I_s}{I_p}$$

This equation tells a relationship between voltage and current as both varies inverse to each other.

DIAGRAM:-



TYPES:- There are two types of transformer:

- **Step-up transformer:** That increases given alternating voltage As $N_s > N_p$ so, $V_s > V_p$
- **Step-down transformer:** That decreases given alternating voltage. As $N_p > N_s$ so, $V_p > V_s$