

TANZANIA HEAD OF ISLAMIC SCHOOLS COUNCIL
FORM SIX INTER ISLAMIC MOCK EXAMINATIONS

131/2 PHYSICS 2.

DF

PROPOSED MARKING GUIDE

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1. (a) (i) P → Gauge pressure of liquid $\frac{0}{2}$ mark
 ρ → Density of the fluid (liquid) $\frac{0}{2}$ mark
 V → flow velocity of fluid (liquid) $\frac{0}{2}$ mark

(ii) Conditions.

- Fluid must be incompressible
 - Fluid must be non-viscous
 - The flow must be irrotational
 - The flow must be steady
- $\left. \begin{matrix} \\ \\ \end{matrix} \right\}$ any two. $0\frac{1}{2}$ marks

(iii) When speed of fluid increases the internal pressure of fluid DECREASES so that; $0\frac{1}{2}$ marks

$$P + \frac{1}{2} \rho V^2 = \text{constant.} \quad 0\frac{1}{2} \text{ marks}$$

(b) Given; Height of Mercury $h_m = 0.5 \text{ m}$

Required; Velocity head of water.

1st find height of water (h_w).

From

$$P_{Hg} = P_{H2O} \quad - - - - - \quad 0\frac{1}{2}$$

$$\rho_m g h_m = \rho_w g h_w \quad - - - - - \quad 0\frac{1}{2}$$

$$h_w = \frac{\rho_m h_m}{\rho_w} = \frac{13600 \times 0.5}{1000} = 6.8 \text{ m.} \quad 0\frac{1}{2}$$

Then from

$$V_w^2 = 2g h_w = 2 \times 9.8 \times 6.8 \quad 0\frac{1}{2}$$

$$V_w = \sqrt{2 \times 9.8 \times 6.8} = 11.5 \text{ m/s.}$$

\therefore The velocity head of water is 11.5 m/s. $0\frac{1}{2}$

(P) Due to accumulation of snow on the wing of aeroplane, the structure of the wings no longer remains as of that of aerofoil. As a result the net upward force (lift) is decreased

03 marks

(P) From the continuity equation.

$$-A \frac{dh}{dt} = \alpha v \quad \text{but } v = \sqrt{2gh} \quad \text{---}$$

01 1/2 marks

$$-A \frac{dh}{dt} = \alpha \sqrt{2gh} \quad \text{---}$$

$$-\frac{dh}{h^{1/2}} = \frac{\alpha \sqrt{2g}}{A} dt \quad \text{---}$$

00 1/2 marks

Integrate both sides.

$$-\int_{H_1}^{H_2} h^{-1/2} dh = \frac{\alpha \sqrt{2g}}{A} \int_0^t dt \quad \text{---}$$

00 1/2 marks

$$-2[h^{1/2}]_{H_1}^{H_2} = \frac{\alpha \sqrt{2g}}{A} t \quad \text{---}$$

00 1/2 marks

$$2[\sqrt{H_1} - \sqrt{H_2}] = \frac{\alpha \sqrt{2g}}{A} t +$$

$$t = \frac{A}{\alpha} \sqrt{\frac{2}{g}} (\sqrt{H_1} - \sqrt{H_2}) \quad \text{---}$$

01 marks

(d)(i) According to Bernoulli's principle this energy is acquired from the expense of a lowered pressure at the constriction. - 0.2 marks.

(ii) According to Poiseuille's formula

$$Q = \frac{\pi P R^4}{8\eta L}$$

The rate through individual capillaries are

$$Q_1 = \frac{\pi P (2R)^4}{8\eta L}, Q_2 = \frac{\pi P (4R)^4}{8\eta L} \text{ and } - - - 0.7 \text{ mark!}$$

$$Q_3 = \frac{\pi P (5R)^4}{8\eta L}$$

Since the capillaries are in series.

$$\frac{\pi P_1 (3R)^4}{8\eta L} = \frac{\pi P_2 (4R)^4}{8\eta L} = \frac{\pi P_3 (5R)^4}{8\eta L} - - - 0.7 \text{ mark!}$$

$$81P_1 = 256P_2 = 625P_3$$

meaning

$$P_1 = \frac{625}{81} P_3 - - - 0.5 \text{ mark!}$$

It is given that $P_3 = 8.1 \text{ mm of liquid}$

$$P_1 = \frac{625}{81} \times 8.1 \text{ mm of liquid} - - - 0.5 \text{ mark!}$$

$$P_1 = 62.5 \text{ mm of liquid} - - - 0.5 \text{ mark!}$$

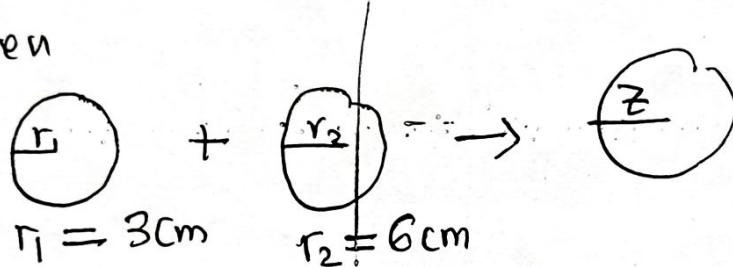
\therefore The pressure across the first pipe

$$P_1 = \underline{\underline{62.5 \text{ mm. of liquid}}} - - - 0.5 \text{ mark!}$$

Q(A) (i) This is because the surface tension of hot soup is less than cold one, consequently hot soup spread more than cold soup, for this reason hot soup is tastier than cold soup. —— 02 marks.

(ii) It is because hot needle lower surface tension of water between the matchsticks and the pull of the water molecules on the outside matchsticks becomes greater than the pull on the inside. As a result the matchsticks fly apart. —— (02 marks)

(b) Given



$$r_1 = 3\text{ cm} \quad r_2 = 6\text{ cm}$$

Since these bubbles coalesce in vacuum the total energy is conserved

$$8\pi\gamma r_1^2 + 8\pi r_2^2 \gamma = 8\pi z^2 \gamma$$

~~$$8\pi\gamma(r_1^2 + r_2^2) = 8\pi\gamma(z^2)$$~~

$$z^2 = r_1^2 + r_2^2 \quad \text{---} \quad \text{01 mark}$$

$$z^2 = 3\text{ cm}^2 + 6\text{ cm}^2$$

$$z^2 = 9 + 36 = 45$$

$$z = \sqrt{45} \text{ cm} = 6.7\text{ cm}$$

∴ The radius of common interface.

$$z = 6.7\text{ cm.}$$

— 01 mark

(c) (i) The ductility of a material is the extent of plastic deformation, clearly it is greater for a material "A".

Q marks

(ii) The maximum height of a mountain on earth can be estimated from elastic behaviour of earth. If "h" is the maximum height of a mountain then

Q marks

Pressure exerted by mountain on earth =
elastic limit of earth material.

BD/2 m/s

$$\rho gh = 3 \times 10^8$$

$$h = \frac{3 \times 10^8}{3 \times 10^3 \times 9.8} = 10^4 \text{ m.}$$

\therefore The maximum height (h) = 10^4 m

Q marks

(d) (i) Average speed

$$V_{av} = \frac{5 + 12 + 12 + 12 + 8 + 14 + 14 + 17 + 20}{9} = 12.7 \text{ m/s}$$

Q marks

(ii) Root mean square speed

$$V_{rms}^2 = \frac{v_1^2 + v_2^2 + \dots + v_9^2}{9}$$

$$V_{rms}^2 = \frac{5^2 + 12^2 + 12^2 + 12^2 + 8^2 + 14^2 + 14^2 + 17^2 + 20^2}{9}$$

Q marks

$$V_{rms}^2 = 178$$

$$V_{rms} = \sqrt{178} = 13.3 \text{ m/s}$$

Q marks

(iii) Most probable speed is,

$$12 \text{ m/s}$$

Q marks

3(q)(i) At a given temperature, the velocity of sound in air (gas) is independent on pressure.

Therefore the velocity of sound in a tube is 330 m/s even if pressure is increased to 100 mm Hg.

- 02 marks

(i) The water surface reflects sound back into air and only a little fraction of sound ($\approx 0.1\%$) is refracted through water, that is why a diver cannot hear the sound. - - -

| 02 marks

(b) The frequency of fundamental vibration is given as;

$$f = \frac{1}{2L} \sqrt{\frac{I}{m}}$$

OB | music

When temperature of the wire is changed by ($\Delta\theta = 20^\circ\text{C}$) Tension is developed in the wire

$$T = \gamma A \alpha \Delta \theta_1 - \dots - \text{osimatic}$$

$$f = \frac{1}{2L} \sqrt{\frac{YA\Delta\theta}{m}} - \dots$$

001/mole

$$\text{As } y = 2 \times 10^{11} N/m^2, A = 10^{-6} m^2, d = 1.21 \times 10^{-5}/i, \Delta \theta = 20$$

$$f = \frac{1}{2 \times 1} \sqrt{\frac{2 \times 10^{11} \times 10^{-6} \times 1.2 \times 10^{-5} \times 20}{0.1}} = 11 \text{ V/spc} \quad -0.1 \text{ mark}$$

∴ The frequency = 11 vibrations/seconds. i.e. of mawle

(C) (i) The relationship between transmitted intensity and angle is given by Malus law i.e

$$I = I_0 \cos^2 \theta$$

where

$I \rightarrow$ Transmitted Intensity.

$\theta \rightarrow$ Angle between transmission axis of polaroid and analyser. — 02 marks

(ii) From Malus law;

$$I = I_0 \cos^2 \theta \quad \text{— — —} \quad 01 \text{ mark}$$

$$\text{But } I = I_0 - \frac{50}{100} I_0 = \left(\frac{50}{100} I_0 \right)$$

Then

$$\frac{50 I_0}{100} = I_0 \cos^2 \theta$$

$$\cos^2 \theta = \frac{1}{2}$$

$$\cos \theta = \sqrt{0.5} = 0.707 \quad \text{— — —} \quad 01 \text{ mark}$$

$$\cos \theta = 0.707$$

$$\theta = \cos^{-1}(0.707) = 45^\circ.$$

$\therefore \text{The angle } (\theta) = 45^\circ. \quad \text{— — —}$

01 mark

(iii) Plane of vibration is the plane that contain vibrations of the waves while

Plane of polarization is the plane that

contain the direction of propagation

of the waves. These two are perpendicular to each other.

02 marks

(i) When a vehicle is in motion, its tyre rubs against the ground (road) and get charged due to friction. Further due to friction of air, the body of the vehicle also get charged. If the accumulation of charges become excessive, sparking may occur and the inflammable material may catch fire. Since the chain ropes are touching the ground, the charge leak to the earth hence the danger of fire is avoided.

02

02 marks.

(ii) Force between charge is given as;

$$F = \frac{K q_1 q_2}{r^2}$$

01 mark

$$F = K' q_1 q_2 \text{ Hence}$$

$$\frac{F'}{F} = \frac{q'_1 q'_2}{q_1 q_2}$$

01 mark

$$\frac{F'}{F} = \frac{(2+4)(+6+4)}{(2) \times (6)}$$

04

$$F' = \frac{(-2)(+12)}{12} F = -\frac{4}{12} F$$

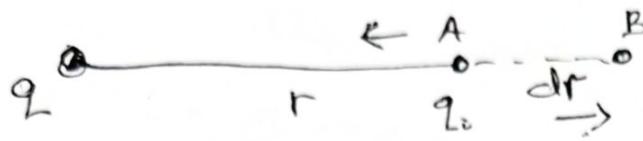
01 mark

$$F' = -\frac{4}{12} \times 12 = -4N$$

\therefore New force will be $F = -4N$ (attraction)

01 mark

(b) (P) Consider the charge q_0 is to be moved against electrostatic force from B to A i.e



Work done against electric field of 'q' is

$$dW = -Fdr \quad \text{--- --- ---} \quad 0.5 \text{ mark}$$

But as

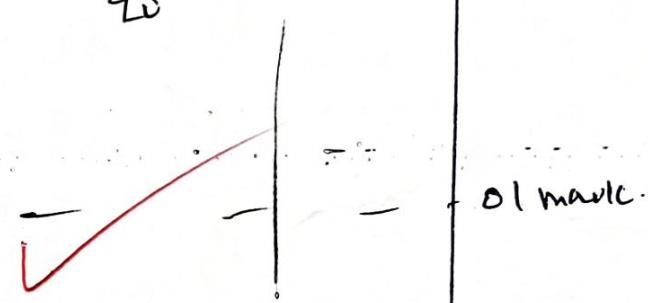
$$E = F/q_0 \Rightarrow F = Eq_0.$$

$$dW = -Eq_0 dr$$

$$\frac{dW}{q_0} = -Edr \quad \text{From } \frac{dW}{q_0} = dV \quad \text{--- --- ---} \quad 0.5 \text{ mark}$$

$$dV = -Edr$$

$$E = -\frac{dV}{dr}$$



(PP) Given $r_{AB} = 0.2 \text{ m}$, $r_{BC} = 0.15 \text{ m}$ and $r_{CA} = 0.1 \text{ m}$

$$q_A = 10 \times 10^{-6} \text{ C}, q_B = -75 \times 10^{-6} \text{ C} \text{ and}$$

$$q_C = 25 \times 10^{-6} \text{ C}$$

Total energy of the system is given as.

$$W = W_{AB} + W_{BC} + W_{CA} \quad \text{--- --- ---} \quad 0.5 \text{ marks}$$

$$W = \frac{kq_Aq_B}{r_{AB}} + \frac{kq_Bq_C}{r_{BC}} + \frac{kq_Cq_A}{r_{CA}} \quad \text{--- --- ---} \quad 0.5 \text{ mark}$$

$$W = 9 \times 10^9 \left[\frac{10 \times 10^{-6} \times -75 \times 10^{-6}}{0.1} + \frac{-75 \times 10^{-6} \times 25 \times 10^{-6}}{0.2} + \frac{25 \times 10^{-6} \times 10 \times 10^{-6}}{0.1} \right] \quad 0.5 \text{ mark}$$

$$W = 9 \times 10^9 (-1.6875 \times 10^{-8} + 2.5 \times 10^{-9}) = -129.375 \text{ J}$$

Work done of the system -129.375 J 0.5 mark

(C) Total emf (E_0) = 12V

Capacitance (C_0) = 5μF

Resistance (R) = $2 \times 10^6 \Omega$

Time for discharge = 5 sec.

Required: Charge (Q) after 5 sec

From

$$Q = Q_0 e^{-t/RC} \quad \text{--- } 0.5 \text{ mark}$$

where

$$Q_0 = E_0 C = 12 \times 5 \times 10^{-6} \quad \text{--- } 0.5 \text{ mark}$$

$$Q_0 = 60 \times 10^{-6} C$$

$$RC = 2 \times 10^6 \times 5 \times 10^{-6}$$

$$RC = 10 \text{ sec} \quad \text{--- } 0.5 \text{ mark}$$

Then

$$Q = 60 \times 10^{-6} e^{-5/10} \quad \text{--- } 0.5 \text{ mark}$$

$$Q = 60 \times 10^{-6} \times 0.606530659$$

$$Q = 36 \times 10^{-6} C$$

$$Q = 36 \mu C$$

∴ The charge $\underline{Q = 36 \mu C}$ --- 01 mark

03

5 (a) (i) Because they are scalar quantities and the magnitude of the velocity does not change when the particle enter magnetic field perpendicular. - - - - - 02 marks.

(ii) The induced emf in the coil is given as

$$\epsilon = IR \text{ and } R = \frac{\rho L}{A} = \frac{\rho \pi D}{\pi r^2} \text{ where } D \text{ - } 01 \text{ mark}$$

and r are diameter and radius of the coil and radius of the copper wire respectively.

Hence;

$$\epsilon = \frac{I \rho D}{r^2} = \frac{7.3 \times 1.68 \times 10^{-8} \times 15 \times 10^{-2}}{(0.18 \times 10^{-2})^2}$$

$$\underline{\epsilon = 5.7 \times 10^{-3} \text{ Volts}}$$

But it is clear that;

$$\epsilon = - A_{\text{loop}} \cdot \frac{dB}{dt} \quad - \quad 01 \frac{1}{2} \text{ mark}$$

$$\frac{dB}{dt} = - \frac{\epsilon}{A_{\text{loop}}} = \frac{(-5.7 \times 10^{-3})}{\pi \left(\frac{0.15}{2}\right)^2} = 0.32 \text{ T s}^{-1} \quad - \quad 00 \frac{1}{2} \text{ mark}$$

\therefore The rate of change of magnetic field intensity;

$$\underline{\frac{dB}{dt} = 0.32 \text{ T s}^{-1}} \quad - \quad 01 \text{ mark}$$

(b) (i) From the formula

$$S_v = \frac{B A N}{K R}$$

0.5 mark

Voltage sensitivity (S_v) increases with increase in

→ Magnetic flux density (B)

→ Area of the conductor (A)

→ Number of turns (N)

And decreases with increase in;

→ Torsional constant (K)

→ Resistance of the coil (R)

0.5 mark

0.5 mark

(ii) The Magnetic field Intensity, H is given by

$$B = \mu_0 (H + M)$$

0.5 mark

Meaning.

$$H = \frac{B}{\mu_0} - M$$

0.5 mark

Given $B = 5.3 T$, $\mu_0 = 4\pi \times 10^{-7} \text{ mA}^{-1}$ and

$$M = 9 \times 10^5 \text{ Am}^{-1}$$

Then;

$$H = \frac{5.3}{4\pi \times 10^{-7}} - 9 \times 10^5 = 3.32 \times 10^6 \text{ Am}^{-1}$$

0.5 mark

∴ The magnetic field (intensity)

$$\underline{\underline{H = 3.32 \times 10^6 \text{ Am}^{-1}}}$$

0.5 mark

(C)(i) For Material Q, slope is positive and has small magnetic susceptibility (χ_H) hence its a paramagnetic material, "P" has large

P - pure
 Q - Para positive slope (χ_H) hence its a FERROMAGNETIC material.

02 marks

(PP) From $M = \frac{c B_0}{T}$ but $I = \frac{M}{\text{Volume}} \Rightarrow M = IV_0$

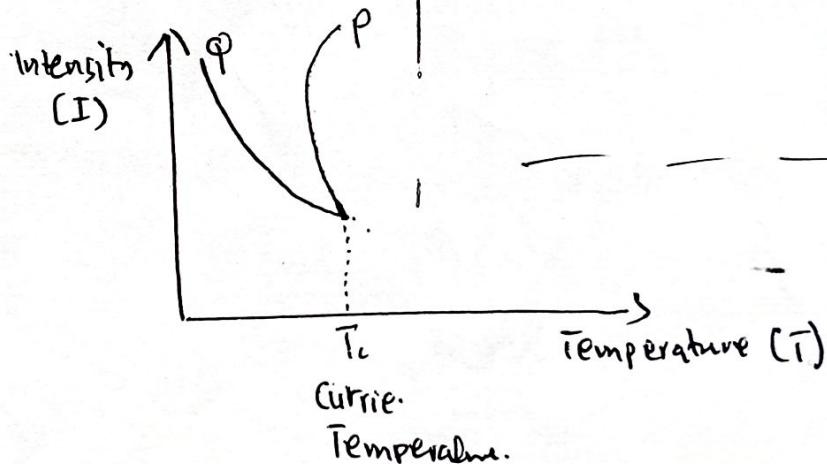
01 mark

$$IV_0 = \frac{c B_0}{T}$$

$$I = \left(\frac{c B_0}{V_0}\right) \cdot \frac{1}{T} \Rightarrow I \propto \frac{1}{T} \quad \text{--- 01 mark}$$

As Intensity (I) is inverse proportional to temperature

For material "P" and "Q"



02 marks

(d) Given: $I = 6t^2 + 22t + 47$ for induced emf

$$\epsilon = L \frac{dI}{dt} = \left[\frac{d}{dt} [6t^2 + 22t + 47] \right] \times L \quad \text{--- 01 mark}$$

$$\epsilon = [12t + 22] \times L$$

$$\epsilon = 3.4(12t + 22) = 40.8t + 74.8 \quad \text{--- 01 mark}$$

∴ The expression

$$\epsilon = 40.8t + 74.8$$

01 mark

b(q)(i) The energy of electron in n th orbit of hydrogen atom is given as;

$$E_n = -\frac{13.6 \text{ eV}}{n^2}$$

01 mark

The Integer "n" can assume any positive number from (1) to infinity (∞) and hence infinity number of lines can be drawn to form hydrogen spectrum.

01 mark

(ii) Random means difficult to predict which atom will decay first in a given sample and

01 mark

Spontaneous means radioactive process is

independent on ~~natural &~~ physical factors

as temperature and pressure it occurs naturally.

01 mark

(b) (a) Given; $V = 60 \text{ kV} = 60 \times 10^3 \text{ V}$

$$I = 30 \text{ mA} = 30 \times 10^{-3} \text{ A}$$

$$\frac{dm}{dt} = 0.06 \text{ kg s}^{-1} \text{ and } P_H = \frac{99}{100} P. \text{ Then;}$$

(i) Rate of supply of electrical energy.

$$P = IV = 30 \times 10^{-3} \times 60 \times 10^3 = 1.8 \times 10^3 \text{ J/s.}$$

01 mark

$$\therefore \text{The power (P)} = 1.8 \times 10^3 \text{ J/s.}$$

01 mark

(ii) The increase in temperature ($\Delta \theta$) from

$$P_H = \frac{99}{100} \times 1800 = 1782 \text{ J/s.}$$

01 mark

$$\text{But } P_H = (m/t) \cdot C \Delta \theta$$

01 mark

$$\Delta \theta = \frac{1782}{0.06 \times 4.2 \times 10^3} = 7.1^\circ \text{C.}$$

01 mark

\therefore The increase in temperature ($\Delta \theta$) = 7.1°C.

01 mark

(c) (i) Ionization energy (E_i) energy required to remove electron completely from its gaseous atom to infinity. i.e

$$E_i = E_\infty - E_g$$

$$E_i = O^- - \frac{2.16 \times 10^{-18}}{1^2}$$

$$\underline{E_i = 2.16 \times 10^{-18} \text{ Joules.}}$$

— — — — — 01 mark

— — — — — 01 mark.

(ii) From $n=2$ to $n=3$.

$$\Delta E = \left(\frac{2.16 \times 10^{-18}}{3^2} - \frac{2.16 \times 10^{-18}}{2^2} \right)$$

$$\Delta E = 2.16 \times 10^{-18} \times 0.138888 = 3 \times 10^{-19} \text{ J.}$$

— — — — — 01 mark

But since

$$\Delta E = \frac{hc}{\lambda}$$

$$\lambda = \left(\frac{\Delta E}{hc} \right)^{-1} = \frac{hc}{\Delta E} = \frac{6.6 \times 10^{-34} \times 3 \times 10^8}{3 \times 10^{-19}}$$

— — — — — 01 mark

$$\lambda = 6.6 \times 10^{-7} \text{ mls.}$$

∴ The wavelength of the line emitted

$$\underline{\lambda = 6.6 \times 10^{-7} \text{ m.}}$$

— — — — — 01 mark

6(d) Original activity $A_0 = 12000 \text{ d/m}$

Activity of $1\text{cm}^3 = 0.5 \text{ d/m}$

time (t) = 30 hrs

half life time ($t_{1/2}$) = 15 hrs.

1st find activity after 30 hours from:

$$\frac{dA}{dt} = -N\gamma \quad \text{But } N = N_0 e^{-\gamma t} \quad \text{01 mark}$$

$$\left(\frac{dN}{dt}\right)_{30} = -N_0 \gamma e^{-\gamma t} \quad \text{01 mark}$$

$$A = A_0 e^{-\gamma t}$$

$$A = \left[12000 e^{-\frac{\ln 2}{15} \cdot 30} \right] \quad \text{as } \gamma = \frac{\ln 2}{t_{1/2}}$$

$$A = 12000 e^{-2 \ln 2} \quad \text{01 mark}$$

$$A = 12000 e^{\ln(8^{-1})} \quad \text{01 mark}$$

$$A = 12000 \times \frac{1}{4} = 3000 \text{ d/m} \quad \text{01 mark}$$

Since

1cm^3 of blood has $A = 0.5 \text{ d/m}$

then

$V?$ will be in 3000 d/m

$$V = \frac{3000 \text{ d}}{0.5 \text{ d/m}} \quad \text{01 mark}$$

$$V = 6000 \text{ cm}^3$$

$$\underline{\text{Total Volume of blood}(V) = 6000 \text{ cm}^3} \quad \text{01 mark}$$