TANZANIA HEADS OF ISLAMIC SCHOOL COUNCIL (TAHISCO)

INTER ISLAMIC MOCK EXAMIMNATION

PHYSICS

131/1

(For both school Private candidates)

MARKING SCHEME

2026

1. (a) (i) Because for a given equation or physical relation the same dimensions of each term can be added or subtracted, as the same which can be done for algebraic quantities. **(02 marks)**

(ii) The frequency depends on γ, ρ and r

$f \alpha \gamma^a \rho^b r^c$

$f = k\gamma^a \rho^b r^c$

but ; $[f] = T^{-1}$, $[\gamma] = Mt^{-2}$

$[\rho] = mL^{-3}$ and $[r] = L$ **(01mark)**

Dimensional equation

$L^o m^o T^{-1} = (Mt^{-2})^9 (mL^{-3})L^2$

$L^o m^o T^{-1} = m^a{+}b\ L^{c-3b} T^{-2a}$ **(01mark)**

Equating exponents of which the base are same for

L : c -3b = 0 _____ (i)

M : a + b = 0 _____ (ii)

T : -2a = -1

$a = \frac{1}{2},\ b = -\frac{1}{2}$ and $c = \frac{-3}{2}$ **(0 ½)**

$f = k\gamma^{\frac{1}{2}} \rho \frac{-1}{2} r^{\frac{-3}{2}}$

hence

$f = \sqrt[k]{\frac{\gamma}{\rho r^3}}$ **(0 ½)**

(b) (i) This statement means that the actual mass of nearly born baby lies between (4+0.25)kg and 4-0.25)kg or actual mass lies between 4.25kg and 3.75kg. **(02 marks)**

(ii) The accuracy of the instrument depends open its least count (L.C). The smaller the L.C the more accurate is the measurement, theoretically we

can decrease L.C and hence increase on the circular scale but there is a limit to it. Therefore, the accuracy cannot be increased infinitely because there is a limit of resolution of human eye. **(02 marks)**

2. (a) (i) Force = $\frac{Impulse}{Time}$, when the man falls on the net it is depressed where man falls on it and thus the contact time is increased. As a result, the force of reaction on the man is decreased to a great extent and the man is not injured. **(02 marks)**

(ii) By conserving momentum

mbUb = (mb+mc)V

V = $\frac{mbUb}{mb+mc} = \frac{20\times200}{20+380} = 10m/s$

The conserving energy **01 ½ marks**

K.E. at lowest position = P.E at highest position

$\frac{1}{2}(mb+mc)V^2 = (mb+mc)gh$

Giving $\frac{1}{2}V^2 = gh$

$\frac{\frac{1}{2}V^2}{g} = h \rightarrow h = \frac{\frac{1}{2}\times10^2}{9.8} = 5.1m$ **(01 ½ marks)**

(b) (i) No it does not, because rocket keep producing thrust while their engines are firing, the mass of the rocket changes as fuel burns while in projectile motion an object is thrown or launched and the only force acting is gravity (air resistance usually ignored) **(02 marks)**

(ii) From R = $\frac{u^2sin2\theta}{g} = \frac{2u^2Sin\theta Cos\theta}{g^2}$

T = $\frac{2usin\theta}{g} \rightarrow T^2 = \frac{2u^2Sin^2\theta}{g^2} \rightarrow$

$\frac{T^2}{R} = \frac{4u^2Sin^2\theta}{g^2} \times \frac{g}{2u^2Sin\theta Cos\theta} = \frac{2sin\theta}{gCos\theta}$

$\frac{T^2}{R} = \frac{2}{5}tan\theta \rightarrow tan\theta = \frac{T^2g}{2R} = \frac{4^2\times9-8}{2x120}$

tanθ = 0.6533

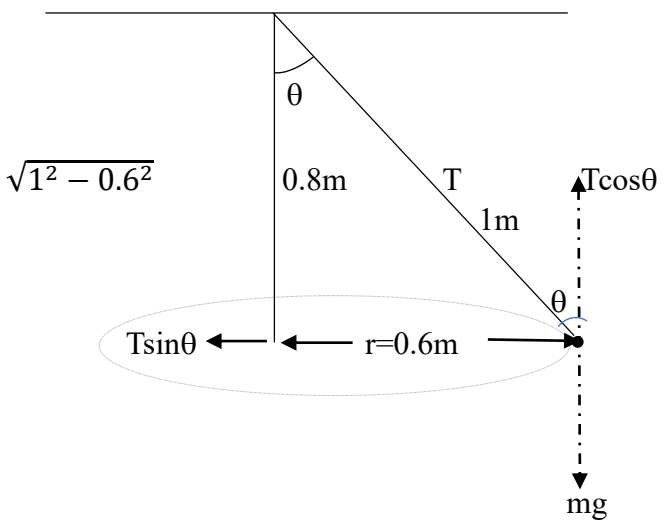
θ = 33.7° **02marks**

and 4 = $\frac{2usin33.7^o}{9-8}$

u = $\frac{4x9-8}{2\ Sin\ 33.7} = 35.32m$ **(01mark)**

3. (a) (i) While going around a corner a cyclist bends to keep balance and avoid toppling over, by bending the component of weight in horizontal direction acts inward towards the centre of the curve and provides necessary centripetal force $\left(\frac{mv^2}{r}\right)$ to keep the bicycle in the circular track. **(02 marks)**

(ii)



$\tan\theta=\frac{0.6}{0.8}=\frac{3}{4}$

At equilibrium $T\cos\theta = mg$ and $T\sin\theta = \frac{mV^2}{r}$

$\frac{Tsin\theta}{Tcos\theta} = \frac{mv^2}{r} \times \frac{1}{mg} \rightarrow \tan\theta = \frac{v^2}{rg}$

$V = \sqrt{rgtan\theta} = \left(0.6 \times 9.8 \times \frac{3}{4}\right)^{\frac{1}{2}}$ **(01mark)**

V = 2.1m/s

But $V = wr \rightarrow w = \frac{2\pi}{T}$

$V = \frac{2\pi r}{T} \rightarrow = \frac{2\pi r}{V} = \frac{2\pi \times 0.6}{2.1}$

T = 1.795 sec **(01mark)**

(b) (i) When the restoring force is stronger for a given displacement resulting to higher frequency and shorter period. **(01mark)**

(ii) Energy interchange enables conservation of total energy which in turn keeps a body in oscillatory motion between two extremes through an equilibrium position. Hence a body can execute SHM due to this energy interchange. **02marks**

(iii) K.E = $\frac{1}{2}$ k (A^2-y^2) and P.E = $\frac{1}{2}$ ky^2

When K.E. = P.E

Means $\frac{1}{2}k(A^2 - y^2) = \frac{1}{2}ky^2$ **(01mark)**

$A^2 - y^2 = y^2$

$A^2 = 2y^2$

$\frac{A^2}{2} = y^2 \rightarrow y = \sqrt{\frac{A^2}{2}} = \frac{A}{\sqrt{2}}$ **(01mark)**

$\therefore y = 0.707\ A$

4. (a) (i) Torque (τ) is a turning effect mathematically given by τ Fr where F is force r is the perpendicular distance from the axis of rotation.

- The door has a large lever arm (Distance from the hinges to the door knob) which produces large turning effect even when the force is small. **(01mark)**
- On the other hand a cork has small lever arm and high resistance, so lasrge turning effect is needed since r is very small force (F) must be very large to produce the required turning effect, so a thumb and finger works together to produce the required turning effect. **(01mark)**

(ii) At the top of the plane the sphere has P.E. = mgh At the bottom of the plane the sphere has K.E (both rotational and translation) = $\frac{1}{2}Iw^2$. **(00 ½ mark)**

Since energy is conserved mgh = $\frac{1}{2}mv^2 + \frac{1}{2}Iw^2$ **(00 ½ mark)**

I = $\frac{2}{5}mr^2 \rightarrow mgh = \frac{1}{2}mv^2 + \frac{1}{2}\left(\frac{2}{5}mv^2\right)w^2$

On solving $V = \sqrt{\frac{10}{7}gh}$ **(01mark)**

Which concludes, velocity is independent of angle of inclination. **(01mark)**

(b) (i) Gravitation force is experienced to a great extent in massive objects especially heavenly objects (planets and stars) both the earth and an object in its vicinity move towards each other as a result of attractive force existing between them (gravitational force) but the earth gets an extremely small acceleration since a = $\frac{F}{m}$ when m is very large a becomes too small to be noticed. **(02marks)**

(ii) Conservating energy

At the surface of the earth Total energy of the satellite

= K.E + P.E = $\frac{1}{2}mv^2 + \frac{-GMm}{R}$ **(00 ½ mark)**

At a heigh h the total energy of the satellite

= K.E + P.E = $\frac{1}{2}mv^2 + \frac{(-GMm)}{R+h}$ **(00 ½ mark)**

$\therefore \frac{1}{2}mv_0^2 - \frac{GMm}{R} = \frac{1}{2}mv^2 - \frac{GMm}{R+h}$ **(00 ½ mark)**

$V_0^2 - V^2 = \frac{2GM}{R} - \frac{2GM}{R+h}$

$V_0^2 - v^2 = 2GM\left(\frac{1}{R} - \frac{1}{R+h}\right)$

GM = Gr^2

$v_0^2 - v^2 = 2gR^2\left(\frac{1}{R} - \frac{1}{R+h}\right)$ **(00 ½ mark)**

$\boldsymbol{v_0^2 - v^2 = 2gR^2\left(\frac{R+h-R}{(R+h)R}\right) = \frac{gR^2h}{(R+h)R}}$ **(00 ½ mark)**

$$v_0^2 - v^2 = \frac{2gRh}{R+h}$$

$$v_0^2 - v^2 = \frac{2gh}{\frac{R}{R}+\frac{h}{R}} = \frac{2gh}{1+\frac{h}{R}}$$

$\therefore v^2 - v_0^2 - \frac{2gh}{1+\frac{h}{R}}$ **(00 ½ mark)**

5. (a) (i) Double glazing prevents heat loss by conduction since the process traps air between the two window panes, since air is a bad conductor of heat the conduction of heat is minimized. **(02marks)**

(ii) From

$\theta = \left[\frac{x_\theta - x_0}{x_{100} - x_0}\right] \times 100^oC$ **(00 ½ mark)**

$X_{50}^0 = X_0 - (0.5 \times 50) + 2 \times 10^{-4} \times 50^2 = x = X_0 - 24.5$ **(00 ½)**

$X_0 = X_0$ **(00 ½)**

$X_{100} = X_0 - (0.5 \times 50) + 2 \times 10^{-4} \times 100^2 = X_0 - 48$ **(00 ½)**

$$\theta = \frac{X_0 - 24.5 - X_0}{X_0 - 48 - X_0}$$

$\theta = 51.04^0C$ **(00 ½)**

(b) (i) As the air gets warm it expands and its volume increases and its density falls $\left(since\ \gamma = \frac{m}{v}\right)$ so it rises due to the fact that its density decease and become less then that of cold air which falls to composite for the vised warm air. (**02)**

(ii) p = $\delta AT^4, A = 4\pi r^2$ **(00½ mark)**

P_1 = $4\delta\pi r^2T^4$, if $r_1 = r$, $r^2 = \frac{r}{2}$

P_2 = $4\delta\pi\left(\frac{r}{2}\right)^2 T_2^4, if\ T_1 = T, T_2 = 2T$ **(00½ mark)**

P_2 = $4\ \delta\pi\left(\frac{r}{2}\right)^2 (2T)^4$ **(00½ mark)**

P_2 = $\frac{4\delta\pi r^2}{4} \times 16T^4 = 4(4\pi r^2T^4)$

But $4\pi r^2T^4 = P_1$ **(00½ mark)**

P_2 = 4x450 = 1800W **(00½ mark)**

6. (a) (i) When the piston is moved with high speed the process is adiabatic because adiabatic process happens quickly so that no heat enters or leaves the system. **(01)**

- When the piston is moved with low speed the process is isothermal, low speed means the temperature of the system will always remain constant. **(01)**

(ii) The process happens at a constant pressure (isobaric) from

Q = u + w **(00 ½)**

Q = ncpΔT → cp = $\frac{Q}{n\Delta T} = \frac{4.99\times10^3}{3\times50}$ **(01)**

Cp = 33.27J/mol

Cp – Cv = R **(00 ½)**

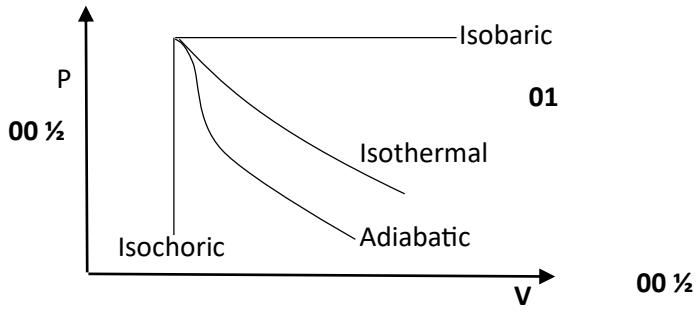
Cv = Cp – R = 33.27 – 8.3 = 25J/mol **(00 ½)**

ρ = $\frac{cp}{cv} = \frac{33.27}{25} = 1.33$ **(00 ½)**

(b) (i)
- The first low does not indicate the direction of transfer of heat.
- The first law does not tell anything about the conditions under which heat can be converted into work.
- The does not tell why the whole heat energy cannot be converted ` mechanical work continuously

Any 02 @ 01

(ii)



7. (a) (i)
- Positive influence of O_2 to plant
- Oxygen is used for respiration which enables plants to obtain energy for growth and metabolic activities negative influence of O_2 to plant. **(01)**
- Oxygen causes decline in the process of photosynthesis by inhibiting enzymes

  Positive influence of CO_2 to plant
- Is a raw material for photosynthesis hence it increase crop yield and growth. **(01)**

(ii) Total heat transfer = $\frac{k\Delta T}{z} \times t$ **(01)**

$= \frac{0.27\times23\times3\times3600}{0.43}$ **(01)**

$= 1.6 \times 10^5 J/m^2$ **(01)**

(b) (i)
- They do not pollute the environment or do not bring negative effect to the environment **(01)**
- They can be infinity as long as they are not over exploited. **(01)**

(ii) The epicenter of the earth quake is determined by calculating the time difference between the arrival of p-waves and s-waves the time difference is proportional to the epicentral distance if d is the distance from epicenter to the station t_1 and t_2 and to time spent by p and s waves to reach the station with velocity v_1 and v_2 respectively $t_1 = \frac{d}{v_1}$.

Since s wave reaches late $t_2 > t_1$ $\Delta t = \frac{d}{v_2} - \frac{d}{v_1} = d\left(\frac{1}{v_2} - \frac{1}{v_1}\right)$ **(03)**

SECTION B (30 Marks)

8. (a) (i) Because are bound to the atom by strong force from the nucleaus. The free electrons are free only to some extent that they may transfer from one atom to another within the conductor because the positive ions are pulling them back. **(02)**

(ii) Because electric field propagates at a speed almost equal to speed of light, as the switch is closed, the electric field is at once established in the whole circuit. As a results free electrons are everywhere in the wire. **(02)**

(iii) $A = 4mm2 = 4x10^{-6}m^2$
$L = 4m$
$I = 10A1.6$
time $= \frac{L}{Vd}$
$n = 8 \times 10^{28}$
$I = neVdA \rightarrow Vd = \frac{I}{neA} = \frac{10}{8\times10^{28}\times1.6\times10^{-19}\times4\times10^{-6}}$ **(01 ½)**
$Vd = 1.953 \times 10^{-4} m/s$
$t = \frac{4}{1.953\times10^{-4}} = 20480\ sec = 5.7\ hours.$ **(01)**

(b) (i) The law of conservation of energy

(ii) **(00 ½)**

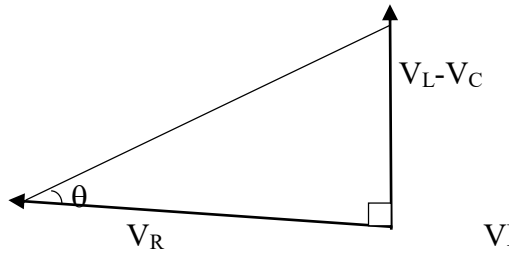
Let I_1, I_2 and I_3 be the current through the cells E, E_2 and E_3 respectively.
Apply Kirchoff's current law to the junction A
$I_1+I_2+I_3 = 0$
$I_3 = -(I_1 + I_2)$ **(00 ½)**

Loop BE, AE_2B
Apply Kirchoff's voltage law
$-4I_1 + 2 + 3I_2 + I = 0$
$-4I_1 + 3I_2 = {}^{-}I$
$4I_1 - 3I_2 = 1$
Apply Kirchoff's voltage law (loop BE_1AE_3B)
$-4I_2 + 2 + 2I_3 - 4 = 0$
$3I_1 + I_2 = {}^{-}1$

Solving $I_1 = \frac{-2}{13}A, I_2, \frac{-7}{13}A, I_3 = \frac{9}{13}A.$

(c) (i) Capacitive reactance $Xc = \frac{1}{2\pi fc}$ as frequency f is increased, Xc will be nearly zero and the capacitor behaves as a pure conductor. **(02)**

(ii) By drawing phasor diagram



$V = \sqrt{V_R^2 + (V_L - V_C)^2} \rightarrow V = IZ, V_L = I \times L, V_C = TX_C$

$(Tz)^2 = I^2R^2 + I^2(X_L\text{-}X_C)^2$

$Z = \sqrt{R^2 + (X_L - X_C)^2}$

$X_L = 2\pi F_l = 2\pi x60x0.45 = 169.65\Omega$

$X_C = \frac{1}{2\pi fc} = \frac{1}{2\pi \times 60 \times 10 \times 10^{-6}} = 265.25\Omega$

Z = (502 + (169.65 – 265.25)2) ½

Z = 108Ω

Phase angle $\rightarrow \tan\theta = \frac{VL-VC}{VR} = \frac{IXL-IXC}{IR}$ **(01)**

$\tan\theta = \frac{XL-XC}{R} = \frac{169.65-265.25}{50}$

$\tan\theta = 1.912$ **(01)**

$\theta = -62.4^o$

Power factor = cos θ = cos – 62.4° = 0.463. **(01)**

9. (i) The conductivity increases with the increase in temperature since electrons acquires enough kinetic energy to be able to cross the forbidden energy gap to conduction band. **(02)**

(ii) $I = \frac{1}{R}$ **(00 ½)**

R = 150Ω + 100Ω + 50Ω = 300Ω **(00 ½)**

$I = \frac{6}{300} = 0.02A$ **(01)**

(iii) Donor atoms provides extra electron to an intrinsic semiconductor after covalent bond, the free electron in every atom bond contribute to the conduction of electric current e.g. phosphorus. **(02)**

Acceptor atoms acquires an electron from an intrinsic semiconductor leaving a hole after/covalent bond the hole is responsible for conduction of electric current e.g. Arsenic. **(02)**

(b) (i) Because NPN transistor have electrons as majority charge carriers, and electrons are faster than holes making the response to signal and operation of a transistor in general to be fast and efficient. **(02)**

(ii) Increasing temperature generally decreases (degrades) transistor performance by decreasing charge mobility increasing leakage current and increasing the risk of thermal run away. **(02)**

(iii) $V_i = I_B R_B$ since $V_{BE} = 0$.

$I_B = \frac{V_i}{R_B} = \frac{1.5}{6\times10^3} = 2.5 \times 10^{-4} A = 0.25mA$ **(01)**

$I_c = BI_B = 50 \times 2.5 \times 10^{-4} = 0.0125A = 12.5\ mA$ **(01)**

From $V_{cc} = I_c R_L + V_{CE}$

$V_{CE} = V_{cc} - I_c R_L$

$= 6 - (0.0125 \times 200)$

$= 3.5V$

$V_{CE} = V_0$

$\therefore V_o = 3.5V$

10. (a) (i) NOR gates are intergrated to burglar alarm circuits because they produce a high output only when all inputs are low, allowing for efficient triggering of the alarm system when specific security conditions are met. **(02)**

(ii) $\bar{A}B + A\bar{B} = Q$

$\therefore Q = A\bar{B} + \bar{A}B = A \oplus B$ **(01)**

$\therefore$ The Boolean expression is $A \oplus B$ **(01)**

Simplest logic gate circuit

(02)

(b) (i) Is the voltage gain when the opamp is connected to a feedback resistance (Rf)

And for non-inventing opamp = $\frac{1+Rf}{Ri}$ **(01)**

Advantages

- It only depends on feedback and input resistances
- It is stale and constant over orange of input voltage (inverting gain)
- It is independent of the characteristics of an amplifier (inverting gain)
- It is employed in relaxation oscillation (non-inverting gain)

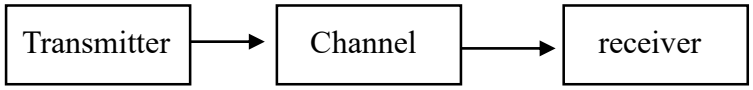
Any two @ 01 = (02)

(ii) From $V_o = -Rf\left(\frac{v_1}{R_2} + \frac{V_2}{R_3}\right) = -(4V_1 + 0.jv_2)$ **(01)**

- $10 \times 10^3\left(\frac{V_1}{R_2} + \frac{V_2}{R_3}\right) = -(4V_1 + 0.5V_2)$ **(00 ½)**
- $\left(\frac{10\times10^3 V_1}{R_2} + \frac{10\times10^3 V_2}{R_3}\right) = -(4V_1 + 0.5V_2)$ **(00 ½)**
- $R_2 = \frac{10\times10^3}{4} = 2500\Omega\ and\ R_3 = \frac{10\times10^3}{0.5} = 20000$ **(01)**

$\therefore R_2 = 2.5\Omega$ and $R_3 = 20k\Omega$

(c)



Transmitter	-	Transforms message signal to suitable form that can be transmitted over channel. **(01)**
Channel	-	A medium through which modulated signal is transmitted from transmitter to receiver. **(01)**
Receiver	-	A device which receives the modulated signals from communication channel. **(01)**