UGANDA NATIONAL EXAMINATIONS BOARD
NOVEMBER - DECEMBER, 2018



UACE

Do not write in this margin

Candidate's Name ..........................................

Signature ..........................................

Subject .......................... Paper code ............/......

| Random No. | | | | | |
|---|---|---|---|---|---|
| Personal Number | | | | | |

1 a(i) A vector qtty has direction whereas a scalar qtty doesn't

(ii) scalars: mass, volume, distance
vectors: Force, acceleration, displacement (any two)

b(i) $F_x = 4.5 + 6.0\cos 70^\circ + 2.8\cos 30^\circ - 1.2\cos 30^\circ$
$= 7.94N$

$F_y = 0 - 6.0\sin 70^\circ + 2.8\sin 30^\circ + 1.2\sin 30$
$= -3.64N$

Resultant force, $F = \sqrt{7.94^2 + -3.64^2} = 8.73N$

Direction, $\tan\alpha = \frac{3.64}{7.94} \Rightarrow \alpha = 24.6^\circ$

(4)

(ii) $F = ma$
$8.73 = 0.2a \Rightarrow a = 43.65ms^{-2}$
$S = ut + \frac{1}{2}at^2$
$= 0\times4 + \frac{1}{2}\times43.65(4^2)$
$= 349.2m$

(2)

c) - A body continues in its state rest or uniform motion in a straight line unless acted upon by an external force.

The rate of change of momentum of a body is directly proportional to the applied force and takes place in the direction of the force

For every action, there is an equal and opposite reaction.

Force on body A, $F_A = m_1(v_1 - u_1)/t$

Force on body B, $F_B = m_2(v_2 - u_2)/t$.

By $3^{rd}$ law $F_A = -F_B$

$\Rightarrow \frac{m_1(v_1 - u_1)}{t} = -\frac{m_2(v_2 - u_2)}{t}$

$m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2$

(1)

Subject .................................. Paper code ............../...... Personal Number

d(i) $m_1u_1 + m_2u_2 = (m_1 + m_2)V$

$500 \times 30 + 1400 \times 25 = (500 + 1400)V$

$V = 26.82 ms^{-1}$ (2)

(ii) $K.e_B = \frac{1}{2} \times 500 \times 30^2 + \frac{1}{2} \times 1400 \times 25^2$

$= 797500J.$

$Ke_A = \frac{1}{2} \times 2200 \times 26.82^2 = 791,243.64J$

$Ke \text{ lost} = 797,500 - 791,243.64$

$= 6,256.36J$ (3)

(20)

2(a) Is the product of force and perpendicular distance from the line of action of the force. Units: Nm (2)

b) Drill three holes round the edge of the cardboard.
- Suspend the cardboard from a pin through one hole
When the cardboard is freely hanging, suspend a plumbline from the same pin.
- Mark a point below the pin where the plumbline passes
- Draw a line from the mark made to the first hole
- Repeat for the other two holes.
- Point of intersection of the three lines drawn is the centre of gravity. (4)

(c) Sum of clockwise moments about a point is equal to sum of anticlockwise moments about the same point.
- Algebraic sum of forces in one direction is zero (2)

Scanned by CamScanner

Candidate's Name ..........................................................

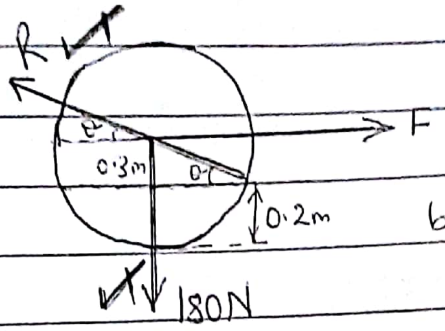
Signature ..........................................

Subject .................................. Paper code ............./......

| Random No. | | | | | |
|---|---|---|---|---|---|
| Personal Number | | | | | |

Do not write in this margin

d(i)




$R\sin\theta = 180$

$R = 180/\sin\theta$

but $\sin\theta = \frac{0.3}{0.5} = 3/5$

$\therefore R = 180 \times 5/3 = 300N$ (4)

(ii) $F = R\cos\theta$

$= 300\cos 36.9$

$= 239.9N$ (2)

(e) Frictional forces oppose relative motion btn surfaces in contact. When surfaces have projections with small area. When in contact, surfaces rest on each others projections, Because of actual area of contact being small, high pressure (either (A or p)) exists at the points of contact producing cold welds at the points, and a force which opposes motion is obtained.

- The frictional force is proportional to normal rxn. When the load increases, the pressure at points of contact increases the actual area of contact producing stronger bonds. A greater force is therefore required for motion to take place

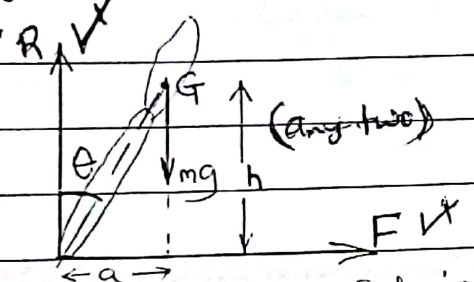
- Frictional force is independent of area of contact provided normal reaction is constant. When one object is turned over so that a different surface is presented, the actual area of contact remains constant (6

20

3 a (i) Centripetal acceleration is the rate of change of velocity of a body moving in a circular path ✓ (1)

(ii) Period is the time taken to move once round the circular path. ✓ (1)

b (i) The cyclist bends to enable normal reaction have an inward moment ✓ that ✓ counter balances ✓ the outward ~~moment~~ moment of friction to avoid overturning (3)

(ii) 


Taking moments about G

$Fh = Ra$ ✓

$\Rightarrow \frac{a}{h} = \frac{F}{R} = \tan\theta$ ✓ $\Rightarrow F = R\tan\theta$

For safe riding

$F \leq F_L$ ✓ (limiting friction)

but $F_L = \mu R$ ✓

$\therefore R\tan\theta \leq \mu R \Rightarrow \tan\theta \leq \mu$ ✓ (4)

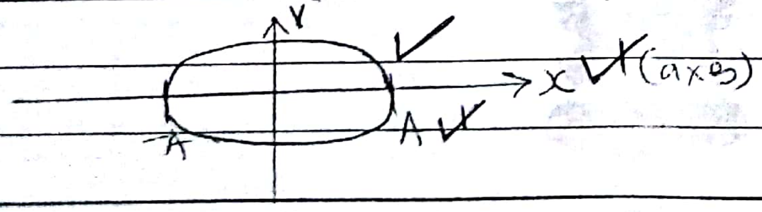
(iii) $2\pi r = 44 \Rightarrow r = 44/2\times3.14 = 7.006$ cm ✓

$V = \frac{0.44}{5} = 0.088\ ms^{-1}$ ✓

$F = \frac{mv^2}{r}$ ✓ $= \frac{1.5\times0.088^2}{7.006\times10^{-2}}$ ✓ $= 1.66\times10^{-1}N$ ✓ (4)

(c) Shm is the motion of a body whose acceleration is directed towards a fixed point and is proportional to the displacement of the body from the fixed point ✓ (1)

d (i) $V = \omega\sqrt{(A^2 - x^2)}$ ✓ (1)

(ii) 

(2)

Code ............/...... | Personal Number | margin

(iii) $Ke = \frac{1}{2}(\text{Total energy})$ ✓✓

$Ke = \frac{1}{2}m\omega^2(A^2 - x^2)$ ✓✓

Total energy $= \frac{1}{2}m\omega^2A^2$ ✓

$\therefore \frac{1}{2}m\omega^2(A^2 - x^2) = \frac{1}{2} \times \frac{1}{2} m\omega^2A^2$ ✓✓

$\therefore A^2 - x^2 = A^2/2$

$x^2 = A^2/2$ or $x = A/\sqrt{2}$

$\therefore x = \frac{14.142}{\sqrt{2}} = 10\text{ cm}$ ✓

ALTERNATIVE

$Ke = \frac{1}{2}mv^2 = \frac{1}{2}m\omega^2(A^2 - x^2)$ ✓

$pe = \frac{1}{2}kx^2 = \frac{1}{2}m\omega^2x^2$ ✓ ; $\omega^2 = \frac{k}{m}$

But $pe = ke$. ✓

$\Rightarrow \frac{1}{2}m\omega^2(A^2 - x^2) = \frac{1}{2}m\omega^2x^2$ ✓

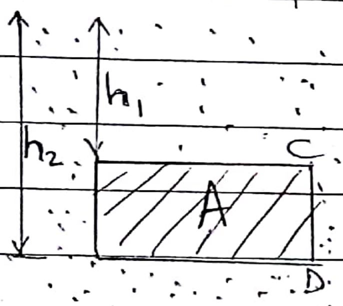
$x = \frac{A}{\sqrt{2}} = \frac{14.142 \times 10^{-2}}{1.4142}$

$= 10 \times 10^{-2}\text{ m}$

$= 10\text{cm}$ ✓

(20)

4(a) A body wholly or partially immersed experiences upthrust equal to that of fluid displaced ✓ (1)




$F_c = h_1\rho A$ ✓

$F_D = h_2\rho A$ ✓

Net upward force (upthrust) $= (h_2 - h_1)\rho g A$ ✓

Volume of liquid displaced $= (h_2 - h_1)A$ ✓

Weight of liquid displaced $= (h_2 - h_1)A\rho g$ ✓ (4)

b(i) A floating body displaces its own weight of fluid in which its floats ✓ (1)

(ii) - Overflow can filled with water to the spout ✓

- Object is lowered in the can until it floats ✓

- Displaced water collected in a beaker ✓

- Weight of floating body ✓ and weight displaced water determined ✓

- They are found to be the same ✓ (5)

c(i) $P + \frac{1}{2}\rho v^2 + h\rho g = \text{constant}$ ✓

$P$ = pressure, $\frac{1}{2}\rho v^2$ = ke per unit volume, $h\rho g$ = pe per volume ✓✓

(any two defined)

Subject ............................ Paper code ............/......

| Random No. | | | | | |
|---|---|---|---|---|---|
| Personal Number | | | | | |

(ii) Air flows above the wing of a plane at high velocity hence low pressure. Below the wings there is low velocity hence high pressure. The pressure difference causes a lift force therefore net upward force (3)

(iii) $P = \frac{1}{2}\rho(V_2^2 - V_1^2) = \frac{1}{2} \times 1.29 (120^2 - 110^2)$

$\cancel{F} = PA = \frac{1}{2} \times 1.29 (120^2 - 110^2) \times 20$

$= 2.97 \times 10^4 N$ (4)

(20)

5a(i) Properties of ultra violet: - Produces ionization
- Produces fluorescence
- promotes chemical rxns (any 3)
- Affects photographic film
- Produces photoelectric effect (3)
- Absorbed by glass
- ~~Can be polarised~~

(ii) A black body is one that absorbs all radiation incident on it without reflecting or transmitting any (1)

b) Power absorbed $= \sigma A (T_2^4 - T_1^4)$

$= 5.67 \times 10^{-8} A (500^4 - 400^4) = 2092.23 A$

Power conducted $= \frac{A(400 - T) \times 500}{10} = 50(400 - T) A$

$\frac{Q}{t} = KA\frac{\Delta\theta}{l} = \frac{A(400-T) 500}{10}$

Power absorbed = Power conducted

$\Rightarrow 50(400 - T) A = 2092.23 A$

$400 - T = 41.8446$

$T = 358.16 K$ (4

UACE

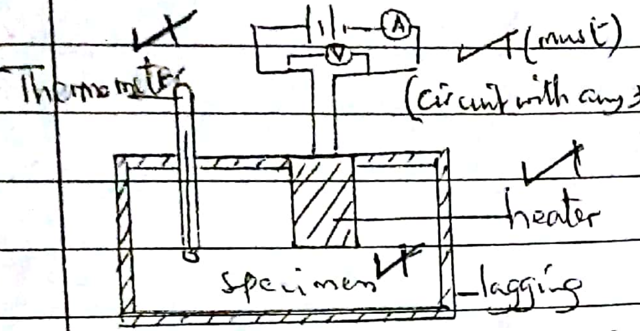
Do not write in this margin

Candidate's Name ..........................................................

Signature ..........................................................

| Random No. | | | | | |
|---|---|---|---|---|---|
| Personal Number | | | | | |

Subject ............................ Paper code ........../......




T(must) (circuit with any 3) — Two holes are drilled into the Solid.

— The mass, m of the solid is measured and recorded

A thermometer is inserted in one of the holes and an electric heater in another. Holes ~~then~~ filled with a good conducting fluid. The apparatus insulated and the initial temp, $\theta_0$ recorded.

The heater is switched on at the same time a stop clock is started. Steady Values of I and V are recorded. After a considerable rise in temp the heater is switched off and stop clock stopped. The highest temp observed $\theta_1$ is recorded and the time t noted.

$$\Rightarrow c = IVt / m(\theta_1 - \theta_0)$$

(ii) Some heat is lost to the surrounding through the insulator; Heat absorbed by thermometer and heater

— The solid expands during heating and so external work is done against atmospheric pressure

(d) During day radn is absorbed from the sun by earth
At night earth radiates heat into the atmosphere
On cloudless, the heat is lost
On cloudy the heat is reflected back to the earth and so feels warm.

Do not write in this margin

Candidate's Name ..............................................................

Signature .................................................. | Random No. | | | | | |

Subject ............................. Paper code ........../...... | Personal Number | | | |

Do not write in this margin

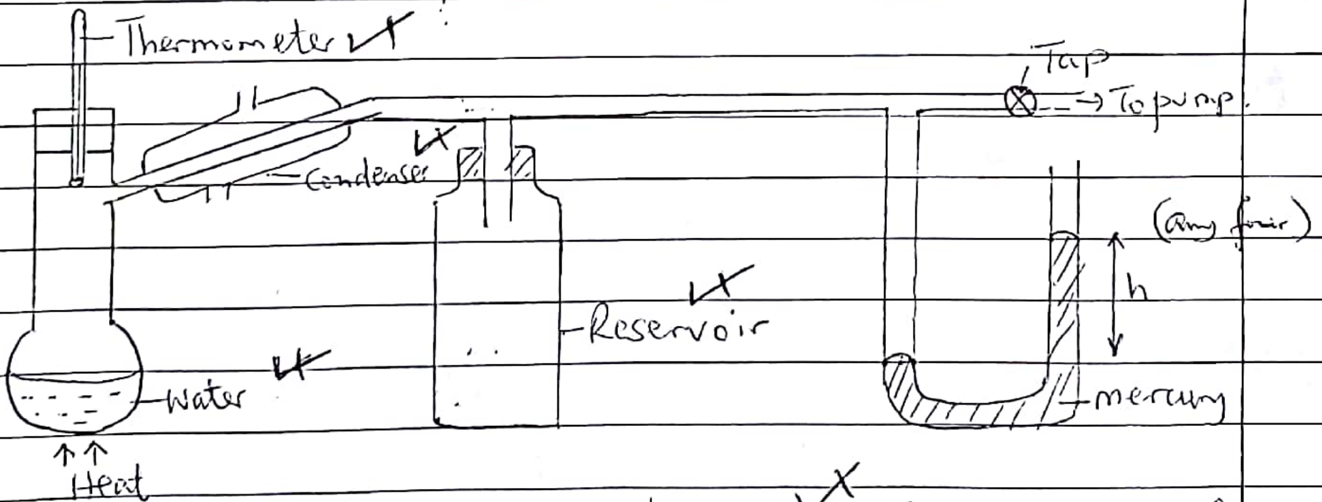
6a(i) Reversible process is the process that can proceed in a reverse direction by very small changes in conditions making it take place through exactly the same steps (2)

(ii) Saturated vapour is one that is dynamic equilibrium with its own liquid. While unsaturated vapour is a vapour that is not in dynamic equilibrium with its own liquid (2)

a(iii) mols in a liquid are in continuous random motion with varying ke's

The most energetic escape leaving the less energetic mols. since ke ∝ T, the temp of the liquid lowers hence liquid cools. (3)

(b)




Atmospheric pressure, H is obtained. Tap is opened and pressure above water is varied using the pump to a suitable value. Tap is closed and water heated until it boils. The temp, θ and difference in mercury levels h are noted and recorded.

The saturated vapour pressure, P = (H ± h) is calculated. Procedure is repeated to obtain corresponding values of θ and P

UACE

Do not write in this margin

Candidate's Name ....................................................................................

Signature ....................................................................

Subject ................................ Paper code ............./......

| Random No. | | | | | |
|---|---|---|---|---|---|
| Personal Number | | | | | |

A graph of P against θ is plotted. The graph shows that P increases with increase in θ (7)

c) (i) Dalton's law states that the total pressure of a mixture of gases that do not react is equal to the sum of the partial pressures of the components of the gas (1)

(ii) $T_1 = 27+273 = 300K$
$T_2 = 85+273 = 358K$

Partial pressure at $T_1$; $P_1 = 69-5 = 64$ cmHg

Partial pressure at $T_2$; $P_2 = (96-P)$ cmHg

$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$ ; $V_1 = V_2 = V$

$\Rightarrow \frac{64V}{300} = \frac{(96-P)V}{358}$

$\therefore P = 19.63$ cmHg (5)

(20)

Alternative;

6a(iii) Liquid absorbs latent heat from the body on which its placed liquid vaporises
Body losses heat and its temp. falls hence cooling. (3)

Do not write in this margin

Candidate's Name ..............................................................................

Signature ..............................................................................

Subject .................................. Paper code ............./......

| Random No. | | | | | |
|---|---|---|---|---|---|
| Personal Number | | | | | |

Do not write in this margin

7(a)(i) Rate of heat flow per unit area of cross section per unit temp. grad. (1)

(ii) Energy required to change 1kg of liquid to vapour at constant temperature. (1)

(b) $KA\frac{(\theta-100)}{L_1} = \frac{m}{t}l_v$

$50.2 \times 0.15 \frac{(\theta-100)}{15\times10^{-2}} = \frac{0.75}{5\times60} \times 2.26\times10^6$

$\theta = \cancel{2\ldots}°C$ $\theta = 212.8°C$ (4)

(c) Let $\theta$ be the temp (°C) of lagging

- Excess temp. $= (\theta-15)°C$
- Heat lost per second $= 0.8(\theta-15)$

Rate of heat flow $KA\frac{\Delta\theta}{L} = 0.04\times0.5\frac{(65-\theta)}{20\times10^{-3}}$

At steady state

$0.8(\theta-15) = 0.04\times0.5\left(\frac{65-\theta}{20\times10^{-3}}\right)$

$\theta = 42.8°C$

Power of heater $= 0.8(42.8-15) = 22W$ (5)

d(i) physical property of substance whose value varies linearly and continuously with temp. (1)

(ii) Insert a bulb in ice-water mixture.

After some time record the length, $l_0$ of mercury thread

Insert bulb in steam record $l_{100}$ of mercury thread

Insert bulb in an enclosure of unknown temp, record $l_\theta$

$\theta = \left(\frac{l_\theta - l_0}{l_{100}-l_0}\right)\times100°C$

(4)

Signature .................................................................... Random No.

Subject ................................ Paper code ............./...... Personal Number

(iii) $\theta = \left(\frac{V_\theta - V_0}{V_{100} - V_0}\right) \times 100°C$

$V_{50} = V_0(1 + 5000\beta + 50^2\beta)$

$V_{100} = V_0(1 + 100000\beta + 100^2\beta)$

$$\theta = \frac{V_0(1+50{,}000\beta + 2500\beta) - V_0}{V_0(1+100{,}000\beta + 10{,}000\beta) - V_0} \times 100°C$$ (4)

$= 47.73°C$ (20)

8a(i) Cathode rays are streams of ~~fast~~ moving electrons (1)

(ii) - Cathode rays travel in straight lines

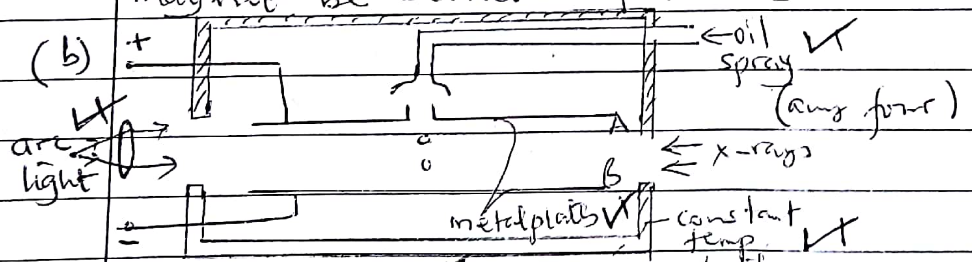
- They are -vely charged (1)

- travel with same speed

- Affect photographic plates (any two)

~~- Have same speed~~

(iii) A discharge tube is operated at very high voltage which is not safe to handle. Gas is required at very low pressure which may not be achieved practically. (2)

(b) 


Separation, d btn plates A and B is measured. Oil is sprayed through a hole in plate A. With no p.d applied a drop is selected and its terminal velocity $V_1$ is calculated. For known density $\rho$ of oil, $\sigma$ of air and coefficient of viscosity $\eta$ of air, radius r of the drop is calculated from $\frac{4}{3}\pi r^3\rho g = \frac{4}{3}\pi r^3\sigma g + 6\pi\eta r V_1$.
The p-d is now applied btn the plates and varied until the selected drop remains stationary.

Scanned by CamScanner

Do not write in this margin

Candidate's Name ..............................................................................

Signature ..............................................................

Subject ................................ Paper code ............./......

| Random No. | | | | | |
|---|---|---|---|---|---|
| Personal Number | | | | | |

Do not write in this margin

The p.d $V$ is read and recorded.
The charge $Q$ carried by the drop is determined from $Q = 6\pi r V_1 d / V$ (7)

c(i) $\frac{1}{2}mu^2 = eV$
$\Rightarrow \frac{1}{2} \times 9.11 \times 10^{-31} u^2 = 1.6 \times 10^{-19} \times 1.98 \times 10^3$
$\therefore u = 2.64 \times 10^7 ms^{-1}$. (3)

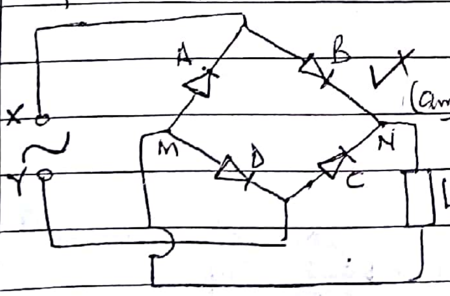
(ii) ·Btn the plates the horizontal motion is unaffected because the net force is zero. The vertical component of velocity change with time due to electric force. Thus electron beam describes a parabolic path (2)

(iii) $V = u + at$
$V_x = 2.64 \times 10^7 ms^{-1}$
$V_y = \frac{Ee}{m} \cdot \frac{L}{u} = \frac{80 \times 1.6 \times 10^{-19} \times 4.8 \times 10^{-2}}{2 \times 10^{-2} \times 9.11 \times 10^{-31} \times 2.64 \times 10^7}$
$= 1.277 \times 10^6 ms^{-1}$

$V = \sqrt{V_x^2 + V_y^2}$
$= \sqrt{(2.64 \times 10^7)^2 + (1.277 \times 10^6)^2}$
$= 2.643 \times 10^7 ms^{-1}$ (4)

20

9 a(i) Thermionic emission is the emission of electrons from a metal surface when heated. (1)




When X is +ve relative to Y, diodes B and D conduct whereas diodes A and C do not.
- When Y is +ve, diodes A and C conduct whereas B and D do not

In each case, the current through the load is in the same (4)

UGANDA NATIONAL EXAMINATIONS BOARD
NOVEMBER - DECEMBER, 2018



UACE

Do not write in this margin

Candidate's Name ..............................................................

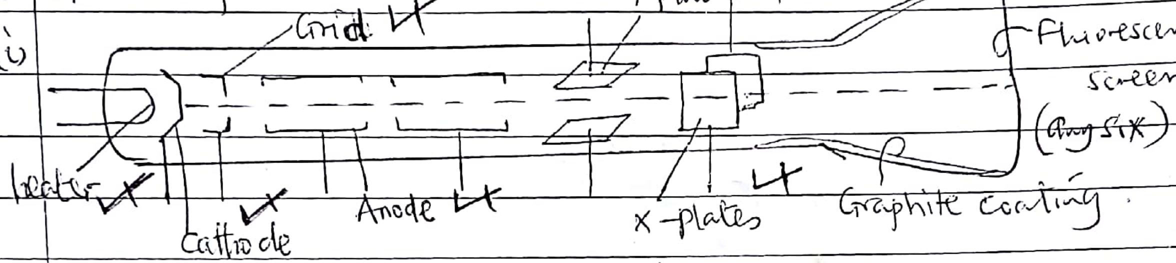
Signature ..............................................................

Subject ................................ Paper code ............./......

| Random No. | | | | | |
|---|---|---|---|---|---|
| Personal Number | | | | | |

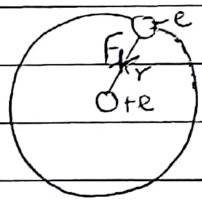
direction from N to M.

b(i)




(3)

(ii) An unknown a.c voltage V is connected to the y-plates. With the time base off, the vertical line on the screen is centred and its length, $l$ measured. The y-sensitivity gain setting is adjusted to a suitable ~~voltage~~ value $V_o$ Volts per cm. The unknown a.c voltage, $V = V_o l$ from which peak value can be obtained. (2)




Kinetic energy $= \frac{1}{2}mv^2$

For circular motion

$$\frac{mv^2}{r} = \frac{e^2}{4\pi\varepsilon_o r^2}$$

$\Rightarrow$ kinetic energy $= \frac{1}{2}mv^2 = \frac{e^2}{8\pi\varepsilon_o r}$

Electric potential energy $= \int_{\infty}^{r} F\,dx = \int_{\infty}^{r} \frac{e^2}{4\pi\varepsilon_o x^2}\,dx = \frac{-e^2}{4\pi\varepsilon_o r}$

Total Energy, $E$ = k.e + p.e

$$= \frac{e^2}{8\pi\varepsilon_o r} + -\frac{e^2}{4\pi\varepsilon_o r}$$

$$= \frac{-e^2}{8\pi\varepsilon_o r}$$

(5)

(iii) The electron is bound to the nucleus by electrostatic force. (1)

d(i) Excitation potential is the potential required to raise an atom from its ground state to an excited state. (1)

(ii) $E_x - E_c = hf = \frac{hc}{\lambda} \Rightarrow \lambda = \frac{6.6\times10^{-34}\times3\times10^{8}}{(0 - -10.4)\times1.6\times10^{-19}} = 1.19\times10^{-7}$ m (3)

Scanned by CamScanner

Do not write in this margin

Candidate's Name ..........................................................

Signature ..........................................................

Subject .................................. Paper code ............/......

| Random No. | | | | | |
|---|---|---|---|---|---|
| Personal Number | | | | | |

10 a(i) Activity is the number of atoms disintegrating per second. (1)

(ii) Half life is the time taken by the no of atoms to decay to half original value. (1)

(b) from $N = N_o e^{-\lambda t}$

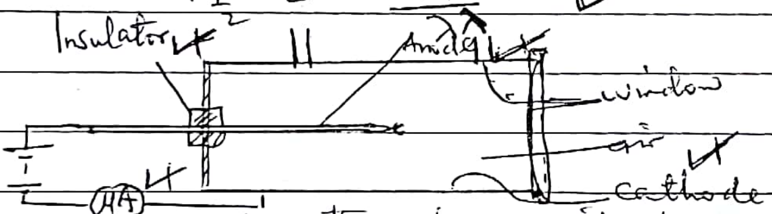
when $t = T_{\frac{1}{2}}$, $N = N_o/2$

$\frac{N_o}{2} = N_o e^{-\lambda T_{\frac{1}{2}}}$

$\ln 2 = \lambda T_{\frac{1}{2}}$

$T_{\frac{1}{2}} = \frac{0.693}{\lambda}$ (4)

(c)




(2)

(c) When radn enters the chamber it ionizes some air mols. The electrons move towards anode and +ve ions move to the cathode. A discharges occurs and current flows in the external circuit. Current is detected by a sensitive current detector. The magnitude of current registered is a measure of the extent (intensity of radn) to which ionisation occurred (8)

(d) Unified atomic mass unit is $\frac{1}{12}$ of the mass of 1 atom of carbon-12 isotope (1)

Electron volt is ke gained by electron which has been accelerated through p.d of 1

e(i) - Carbon dating - Activity of fresh and dead material samples are obtained and the age of the dead material obtained. ( )

- Treatment of cancer; A dose of the radioactive isotope is administered to the patient. The isotope emits radn which destroy cancer cells (4)

- Detection of leakage in underground sewage and water pipes.

(20)