UACE Physics paper 1 set1 guide

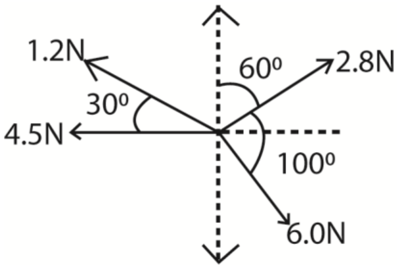
1. (a) (i) Distinguish between scalar and vector quantity. (01 mark)
A scalar quantity is a physical quantity with magnitude but no direction
A vector quantity is a physical quantity with both magnitude and direction

(ii) Give two examples of each type of quantity. (02marks)

Examples of scalar quantities: volume area, distance speed

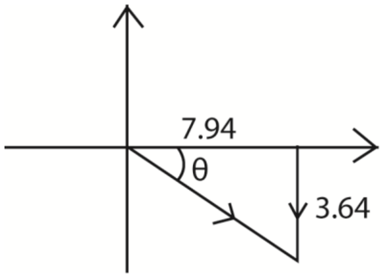
Examples of vector quantities: force, displacement, impulse, momentum, acceleration

(b) A body of mass 0.2kg at rest is acted on by four forces of 2.8N, 6.0N, 4.5N and 1.2N as shown in the figure below.



Calculate

(i) Resultant force on the body (04marks)
F_x = 4.5 + 6cos70 + 2.8cos30 -1.2cos 30 = 7.94N
F_y = 0 - 6sin 70 + 2.8 cos 30 + 1.2 sin 30 = -3.64N
Magnitude of the resultant force = $\sqrt{7.942 + (-3.64)^2}$ = 8.73N
Direction



tan θ = $\frac{3.64}{7.94}$; θ = 24.6^0

The resultant force is 8.73N in a direction 24.60 below the horizontal axis.

(ii) Distance moved in 4s (02marks)
Using F = ma
8.73 = 0.2a
a = 43.65ms^{-1}
s = ut + ½ at^2

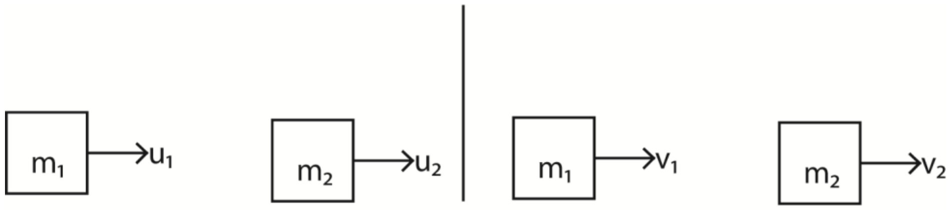
= 0 x 4 + ½ x 43.65x 4^2
= 349.2m

(c) State Newton's law of motion and use them to derive the law of conservation of momentum. (06marks)

- A body continues in its state of 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 applied force and takes place in the direction of the force
- For every action, there is an equal and opposite reaction

Derivation of the law of conservation of momentum

Let m_1, m_2 be the masses of two bodies initially moving in the same direction with velocities u_1 and u_2 which collide after time t, and gain velocities v_1 and v_2 respectively when $u_1 > u_2$.



Beforecollision After collision

During collision, each body exerts a force of impact on each other according to Newton's second law of motion.

Let I be the I impulse on A, then the impulse on B = -I.

$I = M_1v_1 - m_1u_1$ .... (i)

$-I = m_2v_2 - m_2u_2$ .... (ii)

Equation (i) + equation (ii)

$0 = M_1v_1 - m_1u_1 + m_2v_2 - m_2u_2$

$m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2$

Alternatively

From F =ma = $\frac{m(v-u)}{t}$

Force exerted by body of m_1 on body of mass m_2 = F_1 = $\frac{m_1(v_1-u_1)}{t}$

Force exerted by body of m_2 on body of mass m_1 = F_2 = $\frac{m_1(v_1-u_1)}{t}$

Using Newton's third law, the forces are equal and opposite

$F_1 = F_2$

$$\frac{m_1(v_1-u_1)}{t} = \frac{m_1(v_1-u_1)}{t}$$

$m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2$

(d) A body of mass 800kg moving at $30ms^{-1}$ collides with another of mass 400kg moving in the same direction at $25ms^{-1}$. The two bodies stick together after collision. Calculate the

(i) common velocity just after collision (02marks)

$m_1u_1 + m_2u_2 = (m_1 + m_2)v$

$(800 \times 30) + (400 \times 25) = (800 + 400)V$

$v = 28.3ms^{-1}$

(ii) kinetic energy lost during collision (03marks)

Kinetic energy lost = kinetic energy before – kinetic energy after

$= \frac{1}{2}\ x\ 800\ x\ 30^2 + \frac{1}{2}\ x\ 400\ x\ 25^2 - \frac{1}{2}\ x\ 1200\ x\ 28.3^2$

= 4,466J

2. (a) Define moment of force and give its SI unit. (02marks)

Moment of force is the product of force and perpendicular distance from the line of action of the force to the pivot. S.I units Nm.

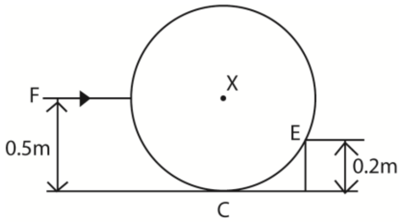
(b) Explain briefly how to locate the centre of gravity of an irregular sheet of cardboard. (04marks)

- three holes are drilled around the edge of the cardboard.
- The cardboard is suspended from a pin through one of the holes. When the cardboard is freely suspended, a plumb line is suspended from the same pin.
- A line is drawn to mark the line where the plumb line passes.
- The procedure is repeated for the other two holes.
- The point of intersection of the three line is the centre of gravity

(c) State the conditions necessary for equilibrium of a rigid body under action of a system of forces. (02marks)

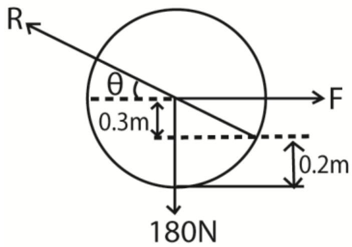
- The sum of clock wise moments about a fixed point is equal to the sum of anticlockwise moments about the same point.

(d) A wheel of radius 0.5m rests on a level surface at point C and makes contact with edge E of a block height 0.2m as shown in the figure below.



A force F is applied horizontally through the axle of the wheel at X to just move the wheel over the block. If the weight of the wheel is 180N, find the

(i) Force exerted at point E (02marks)



Rsinθ = 180

R x $\frac{3}{5}$ = 180

R = 300N

The force exerted = 300N

(ii) Force F (04marks)

F – R$\cos\theta$ = 300cos 69.9^0 = 240N

(e) State the laws of friction and explain each of them (06marks)

- Friction force oppose relative motion between surfaces in contact.
  Explanation; surfaces have projections with small area. When in contact, the surfaces rest on each other's projection. Because of the actual area of contact being small, high pressures exist at the points of contact and a force which opposes motion is developed.
- Friction force is independent of area of contact provided normal reaction is constant.
  Explanation; When the object is turned over so that different surfaces are presented, the actual area of contact is approximately the same
- The friction force is directly proportional to the normal reaction.
  Explanation; when the load increases, the pressure at points of contact increases the actual area of contact producing stronger bonds and increases the degree of interlocks. A greater force is therefore required for motion to take place.

3. (a) Define the following as applied to circular motion:

(i) Centripetal acceleration (01mark)

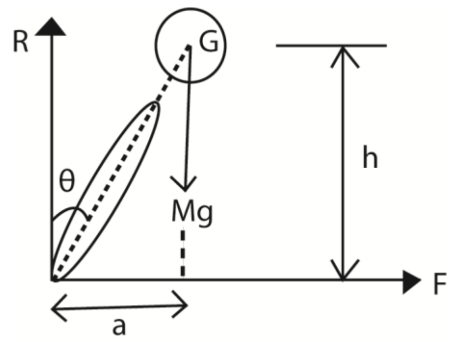
Centripetal acceleration is the rate of change of velocity of a body moving in a circular path.

(ii) Period (01mark)

A period is the time taken to move once round a circular path

(b) (i) Explain why a cyclist bends inward while going round a curved path. (03marks)

(ii) Show that if θ is the angle of inclination of the cyclist to the vertical and μ is the coefficient of limiting friction between the ground and the bicycle tyres, then for safe riding tan θ ≤ μ. (04marks)



Taking moment about G,

F x h = R x a

- tan θ $= \frac{a}{h} = \frac{F}{R}$
- F = Rtanθ

For safe riding, F $\leq$ F_1 (limiting friction)

But F_1 = μR

∴ Rtanθ $\leq$ μR

- $tan\theta = \mu$

(iii) A body of mass 1.5kg moves once round a circular path to cover 44.0cm in 5s. Calculate the centripetal force acting on the body. (04marks)

Radius of circular path, r

Circumference = 2πr = 44cm

r = $\frac{44}{2\pi}$ =7cm

Linear velocity, v = $\frac{0.44}{5s}$ = 0.088ms^{-1}

Centripetal force, $F = \frac{mv^2}{r} = \frac{1.5\ x\ 0.088^2}{7\ x\ 10^{-2}}$ = 0.166N

(c) Define simple harmonic motion (01mark)

Simple harmonic motion is the motion of a body whose acceleration is directed towards a fixed point and is directly proportional to the displacement of the body from a fixed point.

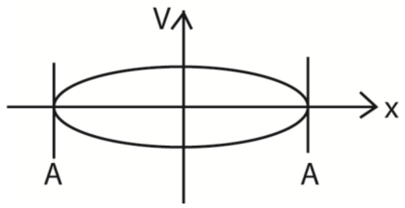
(d) A body executes simple harmonic motion with amplitude A and angular velocity, ω.

(i) Write down the equation for velocity of the body at a displacement x from the mean position (01mark)

$v^2 = \omega^2(A^2 - x^2)$

$v = \omega\sqrt{(A^2 - x^2)}$

(ii) Sketch the velocity-displacement graph for the body in (d)(i) for ω< 1. (02marks



(iii) If the body moves with amplitude 14.142 cm, at what distance from the mean position will be kinetic energy equal to potential energy? (03marks)

Kinetic energy = half of total energy

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

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

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

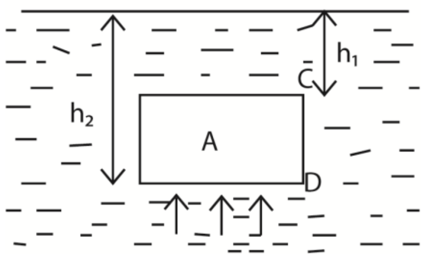
$A^2 - x^2 = \frac{A^2}{2}$

x = $\frac{A}{\sqrt{2}} = \frac{14.142}{\sqrt{2}}$ = 10cm

4. (a) State and illustrate Archimedes' principle. (05marks)

Archimedes' Principle: when a body is wholly or partially immersed in a fluid, it experiences an up thrust force equal to the weight of the fluid displaced.

Illustrating diagram



$F_C = h_1\rho gA$, $F_D = h_2\rho ga$

Net force (up thrust) = $(h_2-h_1)\rho gA$

Volume of liquid displace = $h_2-h_1)A$

Weight of liquid displaced = $h_2-h_1)\rho gA$

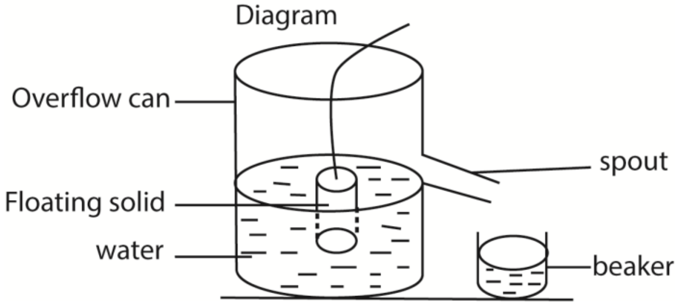
Hence up thrust = weight of liquid displaced

(b)(i) State the law of flotation (01 marks)

A floating body displaces its own weight of fluid in which it floats.

(ii) Describe an experiment to verify the law in (b)(i). (05marks)

Diagram



- Overflow can is filled with water up to spout level
- An object is lowered in the can until it floats.
- The displaced water is collected in the beaker.

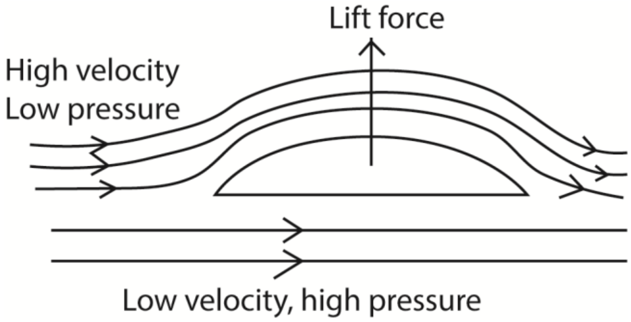
- The weight of the displaced water is determined and found to be equal to the weight of the object.

(c) (i) Write Bernoulli's equation and define each term in the equation. (02marks)

P + $\frac{1}{2}\rho v^2 + h\rho g$ = constant

Where P= pressure, $\frac{1}{2}\rho v^2$ = kinetic energy, hρg = potential energy per unit volume.

(ii) Explain the origin of lift force on the wings of a plane. (03marks)



- Air flows above the wing of a plane at high velocity hence low pressure.
- Below the wings, air flows at low velocity and hence high pressure.
- The difference in pressure cause a lift force, therefore net upward force.

(iv) Air flows over the upper surfaces of the wings of an aeroplane at a speed of 120ms^{-1}, and past the lower surface of the wings at 110ms^{-1}.Calclate the lift force on the aeroplane if it has a total wing area of 20m^2. Density of air = 1.29kgm^{-3})

P = $\frac{1}{2}\rho(v_2^2 - v_1^2)$

F = PA = $\frac{1}{2}x1.29(120^2 - 110^2)\ x\ 20$ = 2.97 x 10^{4}N

Section B

5. (a) (i) State any three properties of ultraviolet radiation.(03marks)
- Produces ionization
- Produces fluorescence
- Affects photographic films
- Produces photoelectric effect
- Absorbed by glass
- Can be polarized
- Promotes chemical reactions

(ii) What is a black body? (01mark)

A black body is one that absorbs all radiations incident on it without reflecting nor transmitting any.

(b) A cylindrical metal rod with a well- insulated curved surface has one end blackened and then exposed to thermal radiation from a body at a temperature 500K. If the equilibrium temperature of the blackened end is 400K and the length of the rod is 10cm, calculate the temperature of the other end. [Thermal conductivity of the metal = 500Wm^{-1}K^{-1}] (04marks)

Power absorbed = σA($T_2^4 - T_1^4$)

= 5.67 x 10^{-8}A(500^4 – 400^4)

= 2092.13A

Power conducted = $\frac{Q}{t}$ = $KA\frac{\Delta\theta}{L}$

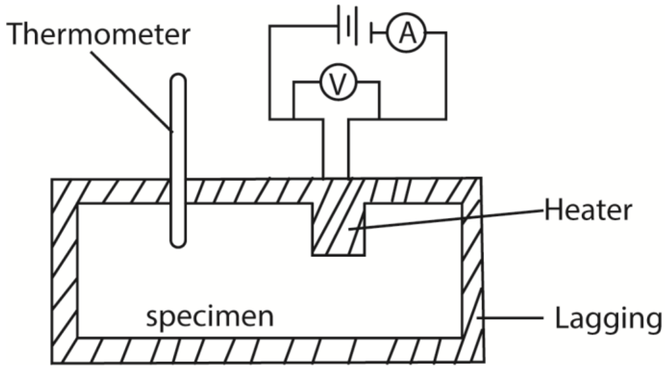
$= \frac{A(400-T)}{10} \; x\; 500 = 50(400-T)A$

Power absorbed = power conducted

$50(400-T)A$ =2092.13A

T = 358.16K

(c) (i) Describe Electrical method of determining the specific heat capacity of a good conducting solid. (06marks)



- Two holes are drilled into the specimen solid of mass m.
- A thermometer is inserted in one of the holes and an electric heater into the other hole. The holes are then filled with a good conducting fluid, e.g. oil to ensure thermal contact.
- The apparatus is insulated and initial temperature θ_0 is recorded.
- The heater is switched on at the same time a stop clock is started.
- The steady values of ammeter reading, I and voltmeter reading, V are recorded.
- After considerable temperature rise, the heater is switched off and stop clock stopped.
- The highest temperature θ_1 recorded and time t taken noted.
- The specific heat capacity, c, of the conducting solid is calculated from

$c = \frac{IVt}{m(\theta_1 - \theta_0)}$

(ii) Give two reasons why the value obtained using the method in (c)(i) may not be accurate. (02marks)

- some heat is lost to the surrounding through the insulator
- some heat is absorbed by the thermometer and heater
- the solid expands during heating and so external work is done against atmospheric pressure.

(d) Explain why cloudy nights are warmer than cloudless ones.

During day, radiation is absorbed from the sun by earth. At night, the earth radiated heat into the atmosphere.

On a cloudless night, the radiated heat is lost. On cloudy night, the clouds form blanketing layer which reflects back the heat to the earth and warmth feeling.

6. (a)(i) What is meant by a reversible process? (02marks)

A reversible process is a process that can proceed in a reverse direction by very small change in conditions making it take place through exactly same steps.

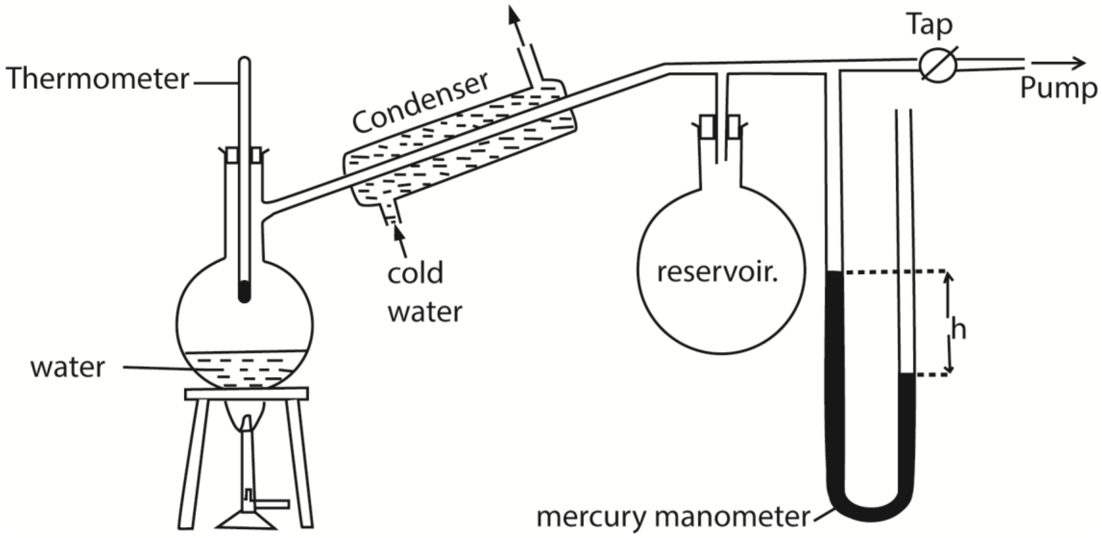
(ii) Distinguish between a saturated vapour and unsaturated vapour. (02marks)

A saturated vapour is one that is a dynamic equilibrium with its own liquid while unsaturated vapour is not in dynamic equilibrium with its own liquid.

(iii) Explain why evaporation causes cooling(03marks)

When a liquid vaporizes, it absorbs latent heat of vaporization from the body from which evaporation occurs. Hence the body cools.

(b) Describe an experiment to determine the temperature dependence of saturated vapour pressure of water. (07marks)



- The pressure of the air in R is shown by the mercury manometer; if its height is h, the pressure in mm mercury is P = H-h, where H is the barometer height.
- The tap is opened and the pressure above water varied using the pump to a suitable value.
- The tap is closed and water in the flask in heated until it boil.
- The temperature θ and difference in mercury levels, h, are noted and recorded.
- The saturated vapour pressure, P = (H$\pm h$) is calculated
- The procedure is repeated other values of θ and h
- A graph of P versus θ is plotted and it shows that saturated vapour pressure, P, increases with temperature, θ.

(c) (i) State Dalton's law of partial pressures. (07marks)

Dalton's law states that the total pressure of a mixture of gases that to not react chemically is equal to the sum of the partial pressure of the components of a gas.

(ii) A sealed container has liquid water, water vapour and air all at 27^{0}C. The total pressure inside the container is 69cmHg. When the temperature is raised to 85^{0}C, the total pressure changes to 96cmHg. If the saturated vapour pressure of water at 27^{0}C is 5cmHg and water vapour remains saturated, calculate the saturated vapour pressure of water at 85^{0}C. (05marks)

T_1 = 27 + 273 = 300K

T_2 = 85 + 273 = 358K

Partial pressure at T_1; P_1 = 69-45 = 64cmHg

Partial pressure at T_2, P_2 = (96 –P) cmHg

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

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

P = 19.63cmHg

7. (a) Define the following:

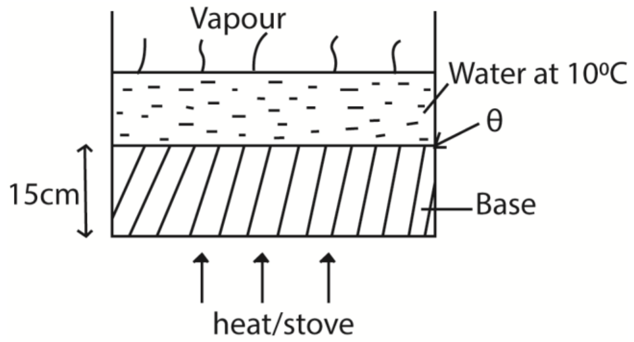
(i) Thermal conductivity. (01marks)

Thermal conductivity s the rate of heat flow per unit cross section area per unit temperature gradient

(ii) Specific latent heat of vaporization. (01mark)

Specific latent heat of vaporization is the amount of heat energy required to change 1kg of a liquid to vapour at constant temperature.

(b) A boiler with a base made of rod steel 15cm thick, rests on a hot stove. The area of the bottom of the boiler is 1.5×10^3 cm^2. The water inside the boiler is at 100^0C. If 750g of water is evaporated every 5 minutes, find the temperature of the surface of the boiler in contact with the stove. [Thermal conductivity of steel = 50.2Wm^{-1}K^{-1}, specific latent heat of vaporization of water = 2.26×10^6Jkg^{-1}]



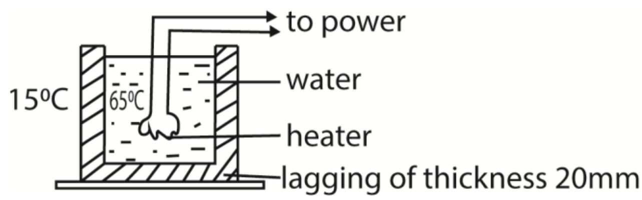
Rate of heat flow through the boiler = Rate of heat supplied to vaporize water

$$kA\frac{\Delta\theta}{L} = \frac{ml_v}{t}$$

$$\frac{502 \ x\ 0.15(\theta-100)}{15\ x\ 10^{-2}} = \frac{0.75\ x\ 2.26\ x\ 10^6}{5\ x\ 60}$$

θ = 2128^0C

(c) Hot water in a metal tank is kept constant at 65^0C by an immersion heater in the water. The tank has lagging all around it of thickness 20mm and thermal conductivity0.04Wm^{-1}K^{-1} and its surface area is 0.5m^2. The heat lost per second by the lagging is 0.8W per degree excess above the surroundings. Calculate the power of immersion heater if the temperature of the surroundings is 15^0C. (05marks)



K = 0.04Wm^{-1}K^{-1}, A = 0.5m^2, L = 20×10^{-3}m

Let θ be the temperature of the lagging

Excess temperature = (θ – 15)

Heat lost per second = 0.8(θ – 15)

The rate of heat flow = $KA\frac{\Delta\theta}{L} = 0.04\ x\ 0.5\ x\ \frac{(65-\theta)}{20\ x\ 10^{-3}}$

At steady state

Heat lost per second = Rate of heat flow

$0.8(\theta - 15) = 0.04\ x\ 0.5\ x\ \frac{(65-\theta)}{20\ x\ 10^{-3}}$

$\theta = 42.8^0C$

Power of heater = 0.8(42.8 – 15) = 22W

(d)(i) Define thermometric property (01mark)

Thermometric property is a physical measurable property that varies linearly and continuously with temperature and is constant at constant temperature.

(ii) Define how a liquid-in-glass thermometer can be used to measure temperature in degrees Celsius. (04marks)

- A bulb is inserted in pure ice-water mixture.
- After some time, the length l_0 of mercury thread is recorded.
- The bulb is inserted in steam and constant length l_{100} of mercury thread is recorded.
- When l_θ is the length of mercury thread inserted in an unknown enclosure of temperature, θ^0, then;
  $\theta = \left(\frac{l_\theta - l_0}{l_{100} - l_0}\right) x\ 100^0C$

(iii) A thermometer is constructed with a liquid which expands according to relation. $V_t = V_0(1 + \alpha t + \beta t^2)$. Where V_t is the volume at t^0C and V_0 is the volume at 0^0C on the scale of the gas thermometer and α and β are constants.
Given that $\alpha = 1000\beta$, what will the liquid thermometer read when the gas thermometer reads 50^0C.
Using $\theta = \left(\frac{V_\theta - V_0}{V_{100} - V_0}\right) x\ 100^0C$
$V_{50} = V_0(1 + \alpha(50) + \beta(50)^2)$.
$V_{100} = V_0(1 + \alpha(100) + \beta(100)^2)$.
$\theta = \left(\frac{V_0(1+50000\beta+2500\beta) - V_0}{V_0(1+100000\beta+10000\beta) - V_0}\right) x\ 100^0C$
$= 47.73^0C$

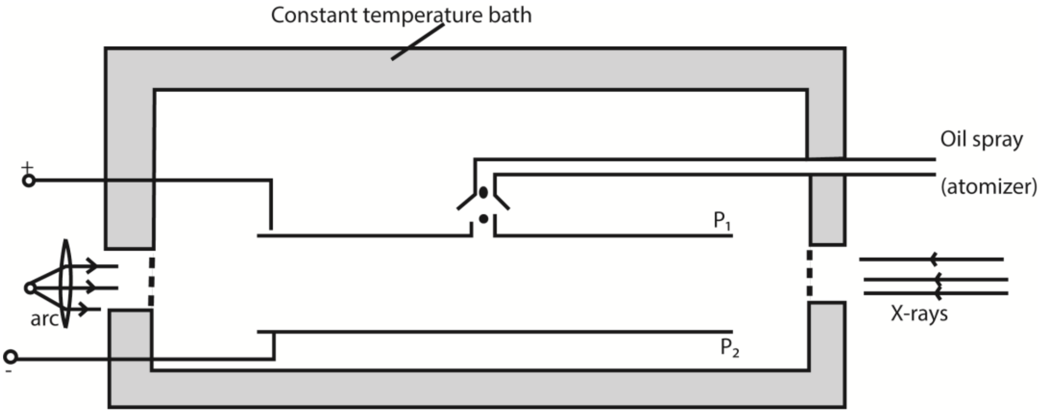
Section C

8. (a) (i) What are cathode rays? (01marks)
Cathode rays are streams of fast moving electrons
(ii) State two properties of cathode rays (01mark)
- They are negatively charged
- Travel in straight lines
- Travel with the same speed
- Affect photographic plates

(iii) Explain two disadvantages of using the discharge tube in producing cathode rays. (02marks)

- a discharge tube is operated at very high voltage which is not safe to handle
- gas required at very low pressure which may not be achieved practically

(b) With the aid of a diagram, describe Millikan's experiment to determine the charge on an oil drop (07marks)



- Separation between the plates P_1 and P_2 is measured
- Oil is sprayed through the hole in plate P_1.
- Oil drops are ionized by friction and /or X-rays
- With no p.d applied a drop is selected and its terminal velocity v_1 is calculated
- For known density ρ of oil, density σ of air and coefficient of viscosity, η of air, radius 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 between the plates and varied until the selected drop remain stationary
- The p.d V is read and recorded.
- The charge Q carried by the drop is determined from
  Q = $\frac{6\pi r v_1 d}{V}$

(c) A beam of electrons is accelerated through a potential difference of 1.98kV and directed mid-way between two horizontal plates of length 4.8cm and separated by a distance of 2.0cm. The potential difference applied across the plates is 80.0V.

(i) Calculate the speed of the electrons as they enter the region between the plates (03marks)

From $\frac{1}{2}mu^2 = eV$

$\frac{1}{2} x\ 9.11\ x\ 10^{-31} x\ u^2 = 1.6\ x\ 10^{-19}\ x\ 1.98\ x\ 10^3$

u = $2.64 \times 10^7 ms^{-1}$

(ii) Explain the motion of the electrons between the plates (02marks)

- The horizontal velocity is unaffected because the net force is zero
- The vertical component of velocity changes with time due to electric force. Thus electron beam describes a parabolic path.

(iii) Find the speed of electrons as they emerge from the region between the plates (04marks)

$v_x = 2.64 \times 10^7 ms^{-1}$

From v = u + at; t = $\frac{L}{u}$

$v_y = \frac{Ee}{m}.\frac{L}{u} = \frac{80\ x\ 1.6\ x\ 10^{-19}\ x\ 4.8\ x\ 10^{-2}}{2\ x\ 10^{-2}\ x\ 9.11\ x\ 10^{-31}\ x\ 2.6\ x\ 10^7}$ = $1.277 \times 10^6 ms^{-1}$

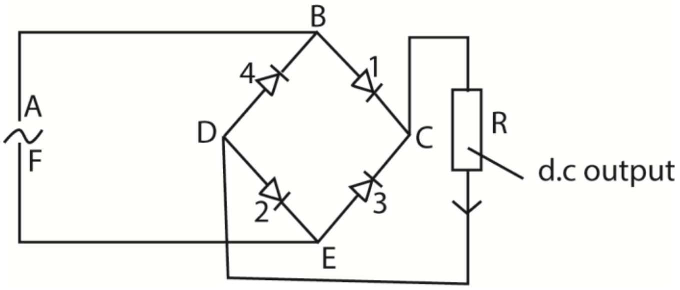
Speed of the electron

v = $\sqrt{(v_x^2 + v_y^2)}$ = $\sqrt{(2.64\ x\ 10^7)^2 + (1.277\ x\ 10^6)^2}$ = 2.643 x 10^7ms^{-1}

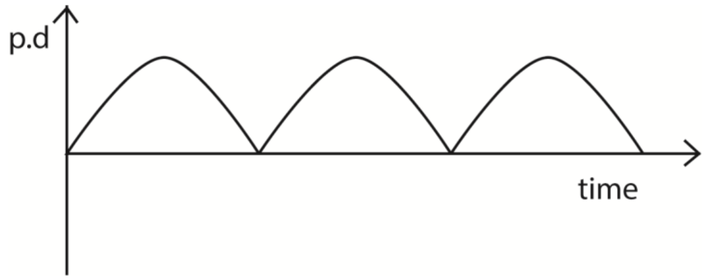
9. (a)(i) What is meant by thermionic emission? (01marks)

Thermionic emission is the ejection of electrons from metal surface when heated

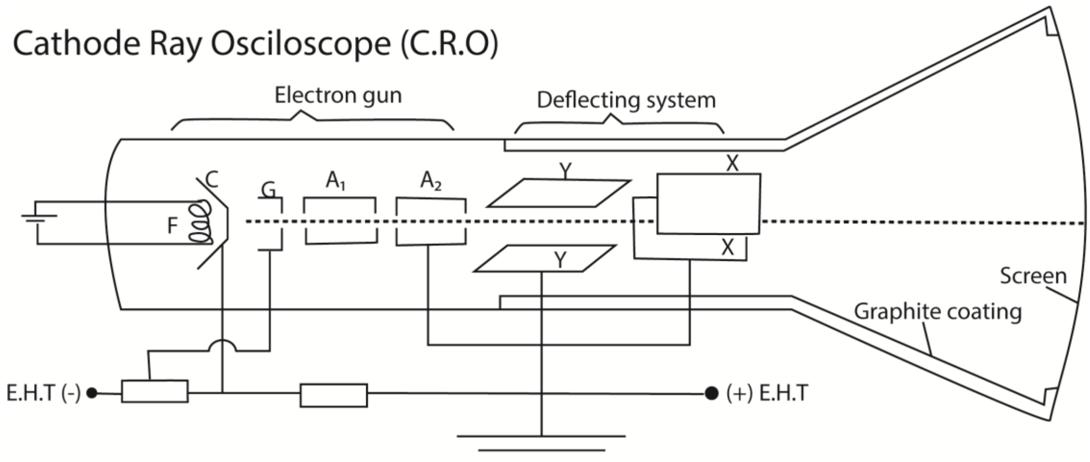
(ii) Describe how full-wave rectification of a.c can be achieved using four semiconductor diodes. (04marks)



- Four diodes are arranged n a bridge network as shown above.
- If A s positive during the first half cycle, diode 1 and 2 conduct and current takes the path ABCRDEF
- In the next half cycle when F is positive, diode 3 and 4 conduct and current flows through the path FECRDBA
- Once again current flows through R in the same direction during both cycle of input and d.c output is obtained.



(b) (i) Draw a labelled diagram to show the main parts of a cathode ray oscilloscope (C.R.O) (03marks)

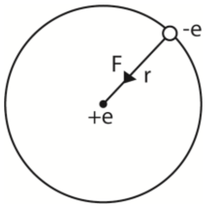


(ii) Describe how a C.R.O can be used as an a.c voltmeter. (02marks)

- Unknown a.c voltage V is connected to the Y-plates.

- The Y-sensitivity gain setting is adjusted to a suitable value V_0 volts per centimeter
- When the time base is off, the vertical line on the screen is centered and its length L measured
- The unknown a.c voltage, $V = V_0L$

(c) (i) an electron of charge –e and mass m moves in circular orbit round a central hydrogen nucleus of charge +e. Derive an expression for total energy of electron in an orbit of radius r. (05 marks)



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

From circular motion,

Centripetal force = electrostatic force

$\frac{1}{2}mv^2 = \frac{e^2}{4\pi\varepsilon_0 r^2}$

$mv^2 = \frac{e^2}{4\pi\varepsilon_0 r}$

Multiplying by ½ both sides

Kinetic energy = $\frac{1}{2}mv^2 = \frac{e^2}{8\pi\varepsilon_0 r}$

Electrical energy = $\int_{\infty}^{r} Fdx = \int_{\infty}^{r} \frac{e^2}{4\pi\varepsilon_0 x^2}dx = \frac{-e^2}{4\pi\varepsilon_0 r}$

Total energy E = K.E + P.E

$= \frac{e^2}{8\pi\varepsilon_0 r} + \frac{-e^2}{4\pi\varepsilon_0 r}$

$= \frac{-e^2}{8\pi\varepsilon_0 r}$

(ii) Why is this energy always negative (01marks)

The energy is always negative because the electron s bound to the nucleus by electrostatic force.

(d) (i) what is meant by excitation potential of an atom? (01marks)

Excitation potential of an atom is the potential required to raise atom from ts ground state to excited state.

(ii) Some of the energy levels in mercury spectrum are shown in the figure below.

Calculate the wavelength of the radiation emitted when electron makes a transition from level A to level C. (03marks)

$E_A – E_C = hf = \frac{hc}{\lambda}$

$\lambda = \frac{6.6 \times 10^{-34} \times 3 \times 10^{8}}{(0-10.4) \times 1.6 \times 10^{-19}} = 1.19 \times 10^{-7}$m

10. (a) What is meant by the following as applied to radioactivity?

(i) Activity (01marks)

Activity is the number of atoms disintegrating per second

(ii) Half-life of a radioactive material (01marks)

Half-life is the time taken by the number of atoms to decay to half original value.

(b) Using the radioactive decay law N = $N_0e^{-\lambda t}$, show that the half-life $T_{\frac{1}{2}} = \frac{1}{\lambda}$ (02marks)

From N = $N_0e^{-\lambda t}$

t = T ½ , N = $\frac{N_o}{2}$

$\frac{N_o}{2} = N_0 e^{-\lambda T_{\frac{1}{2}}}$

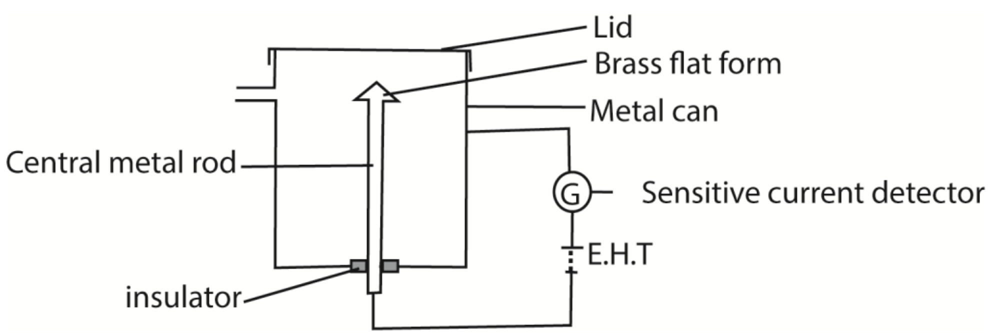
$\frac{1}{2} = e^{-\lambda T_{\frac{1}{2}}}$

$In\frac{1}{2} = -\lambda T_{\frac{1}{2}} Ine$

In2 = $\lambda T_{\frac{1}{2}}$

$T_{\frac{1}{2}} = \frac{0.693}{\lambda}$

(c) With the aid of a labelled diagram, describe the action of an ionization chamber. (05marks)



- A radiation source on the brass flat form causes ionization of air in the chamber producing electrons and positive ions.
- The electrons move to the metal can and positive ions drift to the central metal rod.
- Movement of the ions to the electrodes causes discharge and current pulse flows in external circuit.
- The current sensitive detector detects current.
- The magnitude of current detected shows the extent to which ionization takes place.

(d) What is meant by unified atomic unit and electron volt? (02marks)

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

Electron volt is the kinetic energy gained by electron which has been accelerated through a p.d of 1volt.

(e) (i) The nucleus $^{212}_{83}Bi$ decays by alpha emission as follows

$$^{212}_{83}Bi \rightarrow {}^{208}_{81}Tl + {}^{4}_{2}He$$

Calculate the energy released by 2g of $^{212}_{83}Bi$. (05marks)

Mass defect= Δm (cannot be obtained since unified atomic mass units of the products are not given.

Energy released = Δmc^2

(ii) Explain two uses of radioactive isotopes. (04marks)

- Carbon dating: activity of fresh and dad material samples are obtained and the age of the dead material obtained.
- Treatment of cancer, A dose of the radioactive isotope is administered to a patient. The isotope emits radiation which destroy cancer cells
- Detection of leakage in underground sewage and water pipes.