ANANDA COLLEGE - COLOMBO 10

01 E I

G.C.E. A/L Examination 2022

Final Term Test - October 2022

Physics - I

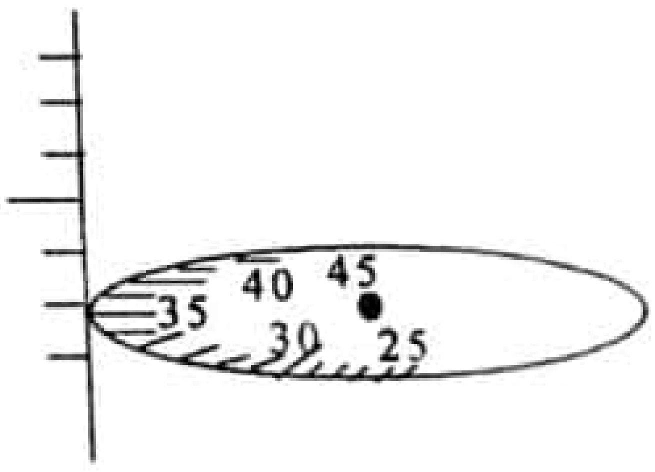
Grade 13 — Time : 2 hrs.

Important :
- *Answer all the questions.*
- *Use of calculators is not allowed*
- *Write your Index Number in the space provided in the answer sheet.*
- *Follow the instructions given on the back of the answer sheet carefully.*
- *In each of the questions 1 to 30, pick one of the alternatives from (1), (2), (3), (4), (5) which is correct or most appropriate and mark your response on the answer sheet with a cross (X) in accordance with the instructions given on the back of the answer sheet.*

01. What is the physical quantity which has unit kg s^{-2} ?

(1) Tension (2) Energy (3) surface Tension
(4) Power (5) Heat conductivity

02. The circular scale of a spherometer with 1 mm pitch is divided into 100 parts. The magnitude of the measurement shown in the figure is,



(1) 1.35 mm (2) 2.65 mm (3) 2.35 mm
(4) 1.65 mm (5) 0.65 mm

03. (A) Radio waves (B) Micro waves (C) γ (gama wave) (D) X- rays

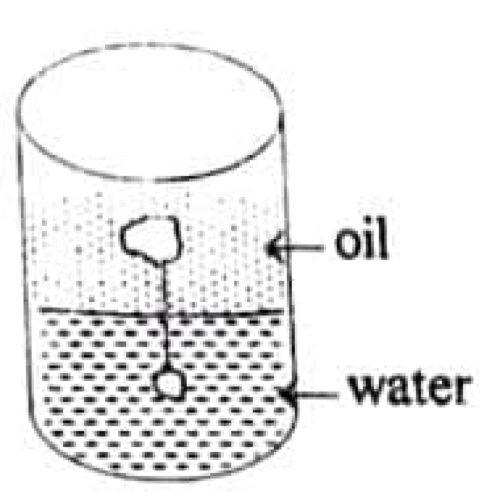
According to the above types of waves which has the maximum and minimum wave lengths respectively.

(1) A and C (2) A and D (3) B and D (4) A and B (5) All

04. When a ball is projected down wards it will collide against the ground at 20m below and rebound to the same height. If the 50% of the energy is lost in the collision the projecting velocity will be

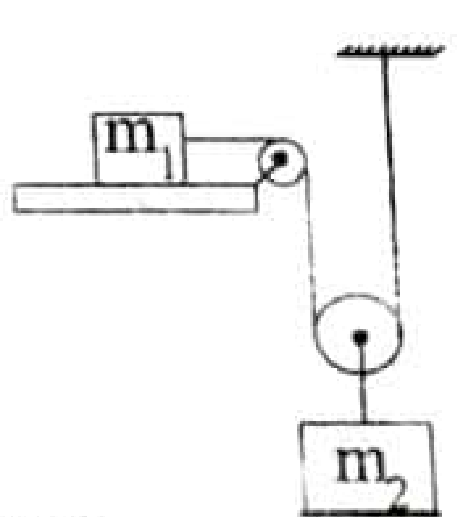
(1) 40 m s^{-1} (2) 20 m s^{-1} (3) 15 m s^{-1} (4) $10\sqrt{2}$ m s^{-1} (5) 10 m s^{-1}

05. A piece of ice was immersed in a oil which float on water as shown in the figure, by connecting a metal sphere to the other end of the string which connected to the piece of ice. After the piece of ice was completely melted what can happen from the following?



(1) Water level and oil level both are rise up.
(2) Water level is rise up and oil level is rise down.
(3) Oil level is not change and water level is rise up.
(4) Oil level rise up to the same volume of the water level rise up.
(5) Oil level rise down to the same volume of the water level rise up.

06. What is the acceleration of the m_2 in the given figure? The plane and the pulley are smooth and the string and pulleys are light. (g-gravitational acceleration)



(1) $\frac{m_2g}{4m_1+m_2}$ (2) $\frac{2m_2g}{4m_1+m_2}$ (3) $\frac{2m_2g}{m_1+4m_2}$ (4) $\frac{2m_1g}{m_1+m_2}$ (5) g

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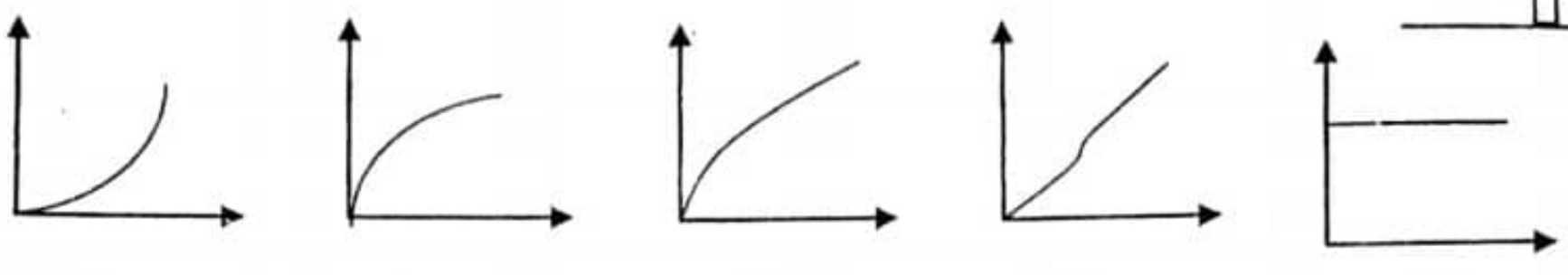
07. As shown in the figure a chain of length L (h > L) is kept on a smooth horizontal table and release. If the motion is start at time t = 0, the graph which shows the variation between the velocity (v) and time (t) until the chain touch the ground is,

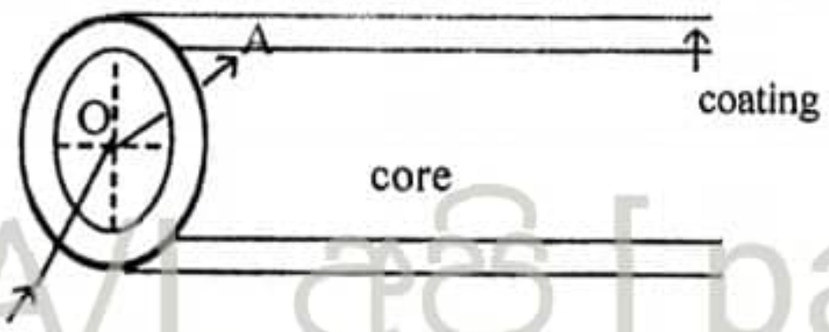


(1) (2) (3) (4) (5)

08. A capacitor of the capacitance C is connected to a battery and charged to a potential V. After removing the battery a connection, earthed the capacitor and after that the distance between the plates reduced to half. Then the new capacitance and new potential of it will be.

(1) C and 2V (2) 2 C and V (3) 2 C and 2 V (4) $\frac{C}{2}$ and V (5) 2 C and $\frac{V}{2}$

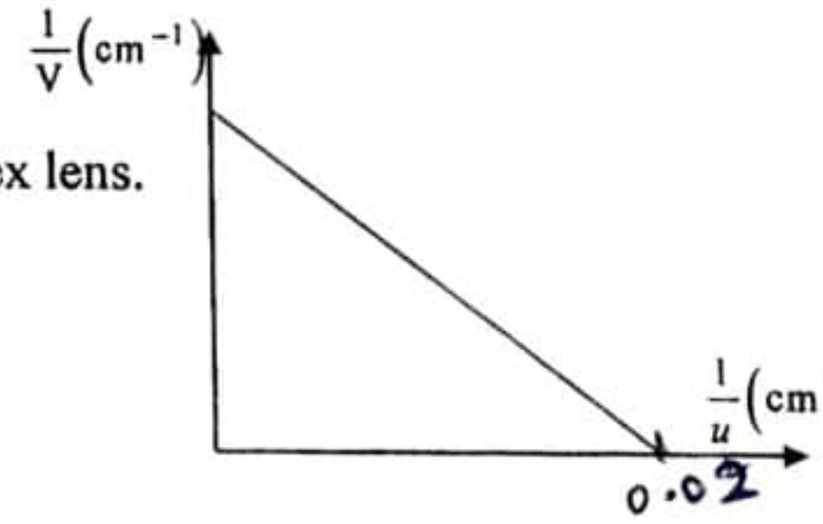
09.



The above figure shows an optical fibre with a core of $\sqrt{3}$ refractive index and coating with 1.5 refractive index which kept on air. The incident angle on optical fibre to have a total internal reflection at A.

(1) Should be greater than 30°
(2) Should be in between 0 and 30°
(3) Should be in between 30° and 60°
(4) Should be less than 60°
(5) Should be greater than 60°

10. The following figure shows a graph drawn in an experiment done by paradox method to find the situation of images formed by convex lens. The power of the lens will be



(1) + 5D (2) + 0.02D (3) +2D
(4) + 0.5D (5) + 2.5D

11. Consider the following statements express on optical instruments.

(A) The angular magnification of a combined microscope is not depend on the position of the object.
(B) The image formed in not belongs to normal adjustment condition of combined microscope is virtual and upright.
(C) To obtain the high angular magnification from a telescope in normal adjustment condition have to use an eye piece lense with higher diameter.

The accurate statement from the above will be,

(1) Only B (2) Only C (3) Only A and B (4) Only B and C (5) All A,B and C

12. A real imagine of a magnification 4 is formed 20 cm distance from a convex lense. What is the distance of the object which should place from the lense to obtain a virtual image with same magnitude?

(1) 6 cm (2) 12 cm (3) 16 cm (4) 20 cm (5) 40 cm

13. A person with short distance eye defect has a 200 cm far point and a 20 cm near point. When he wear pair of spectacles to clearly see the distance objects his ~~far~~ near point will

(1) displaced 22.22 cm distance from the eye.
(2) displaced 2.22 cm distance from the eye.
(3) displaced 19.2 cm distance from the eye.
(4) displaced 0.2 cm distance from the eye.
(5) displaced 0.22 cm distance from the eye.

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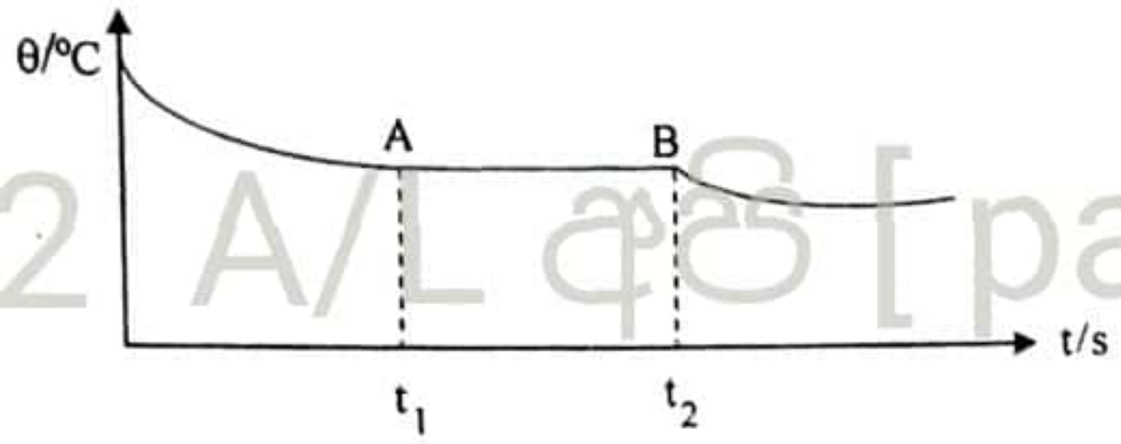
14. Shown below is a cooling curve which drawn using a **m** mass of melted paraffin, and allowed it to cool naturally.



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After constructing suitable tangents to the cooling curve, the cooling rates Q_A and Q_B were obtained at the positions which the paraffin start to melt A, and the position that paraffin finished the melt is B. If the specific heat capacity of the liquid paraffin is CA and the solid Paraffin is C_B, the latent heat of fusion of paraffin will be

(1) $(C_A + C_B)(t_2 - t_1)$ (2) $m\frac{(C_A + C_B)}{2}\theta$ (3) $\frac{(C_A Q_A + C_B Q_B)(t_2 - t_1)}{2}$

(4) $\frac{(Q_A + Q_B)}{2}\ \frac{(C_A + C_B)}{2}(t_2 - t_1)$ (5) $(Q_A + Q_B)(C_A + C_B)(t_2 - t_1)$

15. Only the water vapours are included in a closed container. The relative humidity of it is H. Now its volume is reduced up to $\frac{1}{4}$ by keeping the temperature constant, then the relative humidify in the container is H_2. If the vapours in the container is in unsaturate condition through out the time, the ratio of H_1/H_2 will be

(1) $\frac{1}{4}$ (2) $\frac{1}{2}$ (3) $\frac{2}{3}$ (4) 1 (5) $\frac{3}{4}$

16. The surface area of the foot of an animal standing on the ice is 0.005 m^2 and its foot maintaining a good heat contact with ice at 0°C. The blood vessels of the foot are at 2mm above the ice. The temperature of the blood is at 35 °C steady value and the heat conductivity of the foot is 6×10^{-3} w m^{-1} k^{-1}. The heat absorbing rate of ice through the foot will be,

(1) 0.575 w (2) 0.675 w (3) 0.775 w (4) 0.765 w (5) 0.525 w

17. Consider the following statements given about the change of the melting point and the boiling point of a substance due to external pressure.

(A) The melting point is slightly increase when pressure is increasing in volume decreasing liquids is while converting solid state to liquid states.

(B) The melting point is slightly increase when pressure is increasing in volume increasing liquids while converting solid state to liquid states.

(C) The boiling point is slightly increase when external pressure is increasing in any liquid.

The correct statements from the above are,

(1) Only A and B (2) Only A and C (3) Only B and C
(3) All A, B and C (5) None of them

18. The radius of the Earth is R and the gravitational acceleration on the surface of the earth is g. Increasing of the gravitational potential energy, when bringing an object of mass m from an external point at R distance from surface of the earth to an external point at 2R distance from surface of the earth will be

(1) $\frac{mgR}{6}$ (2) $\frac{mgR}{3}$ (3) $\frac{mgR}{2}$ (4) mgR (5) 2 mgR

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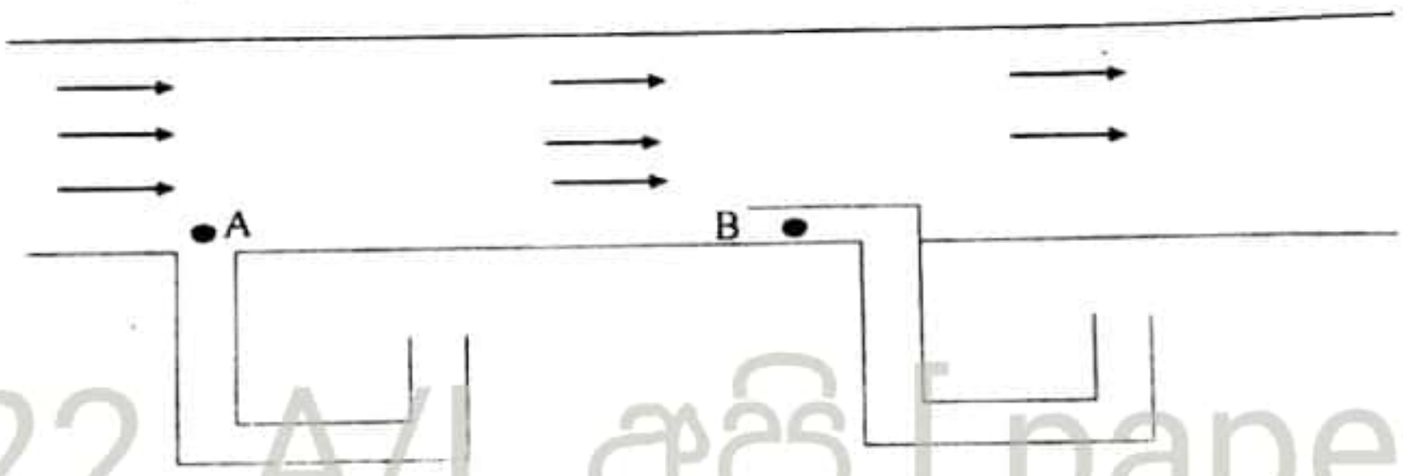
19. X and Y are two objects which floating in a liquid. $\frac{1}{4}$ of the volume of X is at above the liquid level and $\frac{2}{3}$ of the volume of Y is immersed in the liquid. The ratio of density of X : density of Y will be

(1) 3 : 2 (2) 4 : 3 (3) 5 : 2 (4) 5 : 3 (5) 9 : 8

20. A non-viscos incompressible fluid with density ρ is flowing through a tube with velocity V. P_1 and P_2 are the pressures at A and B respectively



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Consider the following statements

(A) The fluid flowing velocity (V) $\alpha\sqrt{(P_2 - P_1)}$

(B) $V_A > V_B$

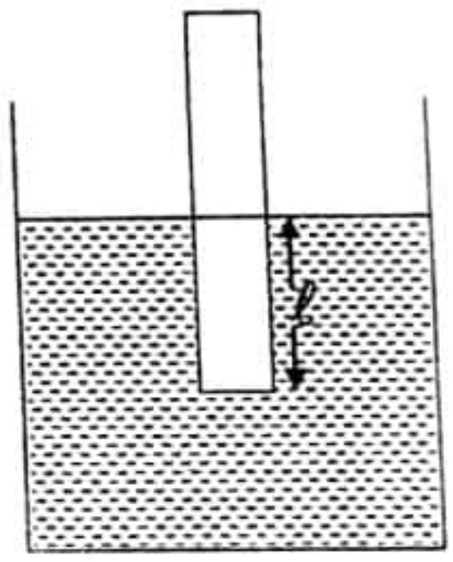
(C) $P_A > P_B$

Accurate statements from the above are,

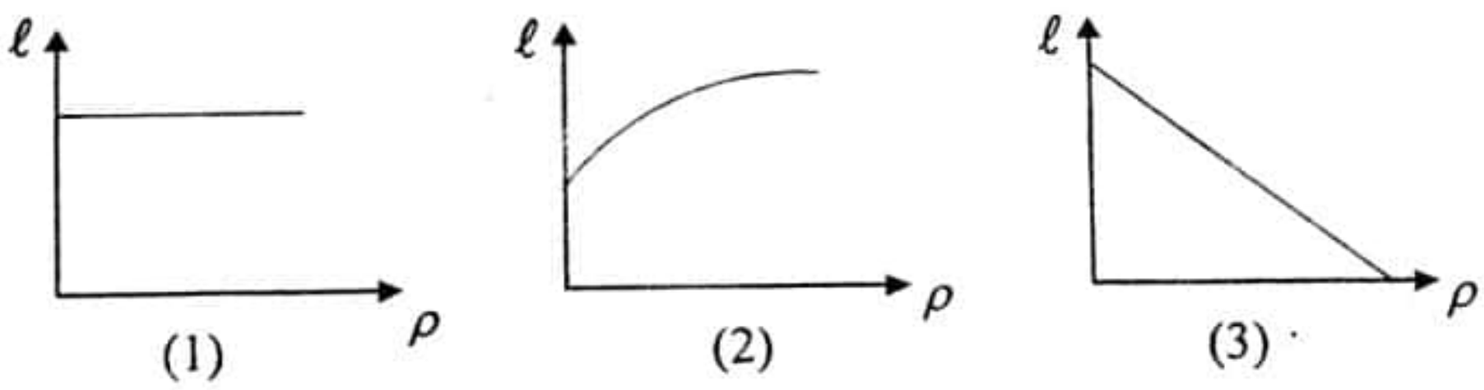
(1) Only A (2) Only B (3) Only C

(4) Only A and B (5) All A, B and C

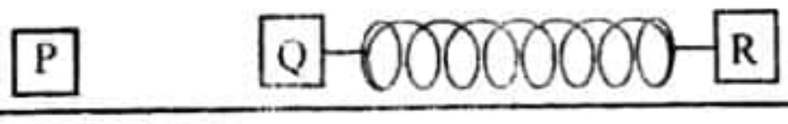
21. As shown in the figure an object with uniform crossection is vertically float on several liquids. A graph is drawn between the density of the liquid (ρ) and immersing length (ℓ).



The graph shows the accurate variation is



22.



P, Q, R three objects with identical mass are on a smooth plane. The object P is moving with velocity V and elastically collide with Q. If the spring constant of the spring connected to Q and R is k, the maximum compression of it will be,

(1) $\sqrt{\frac{m}{2k}}$ (2) $\sqrt{\frac{m}{k}}$ (3) $\sqrt{\frac{mV}{k}}$ (4) $\sqrt{\frac{2m}{kV}}$ (5) $\sqrt{\frac{m}{2kV}}$

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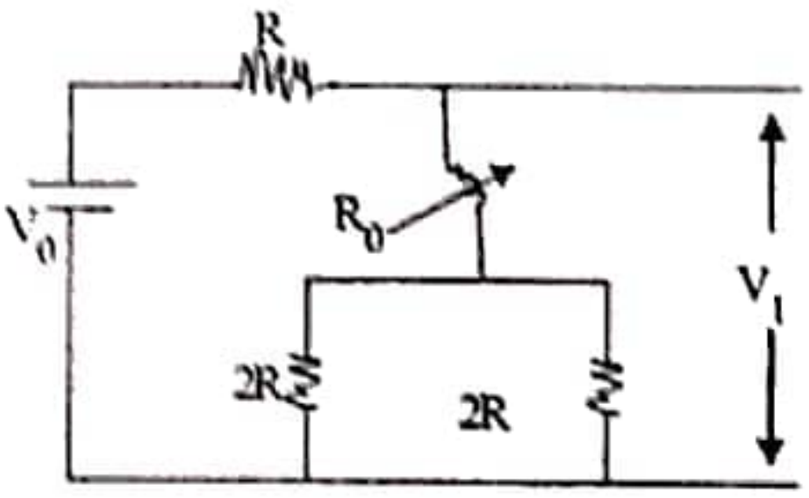
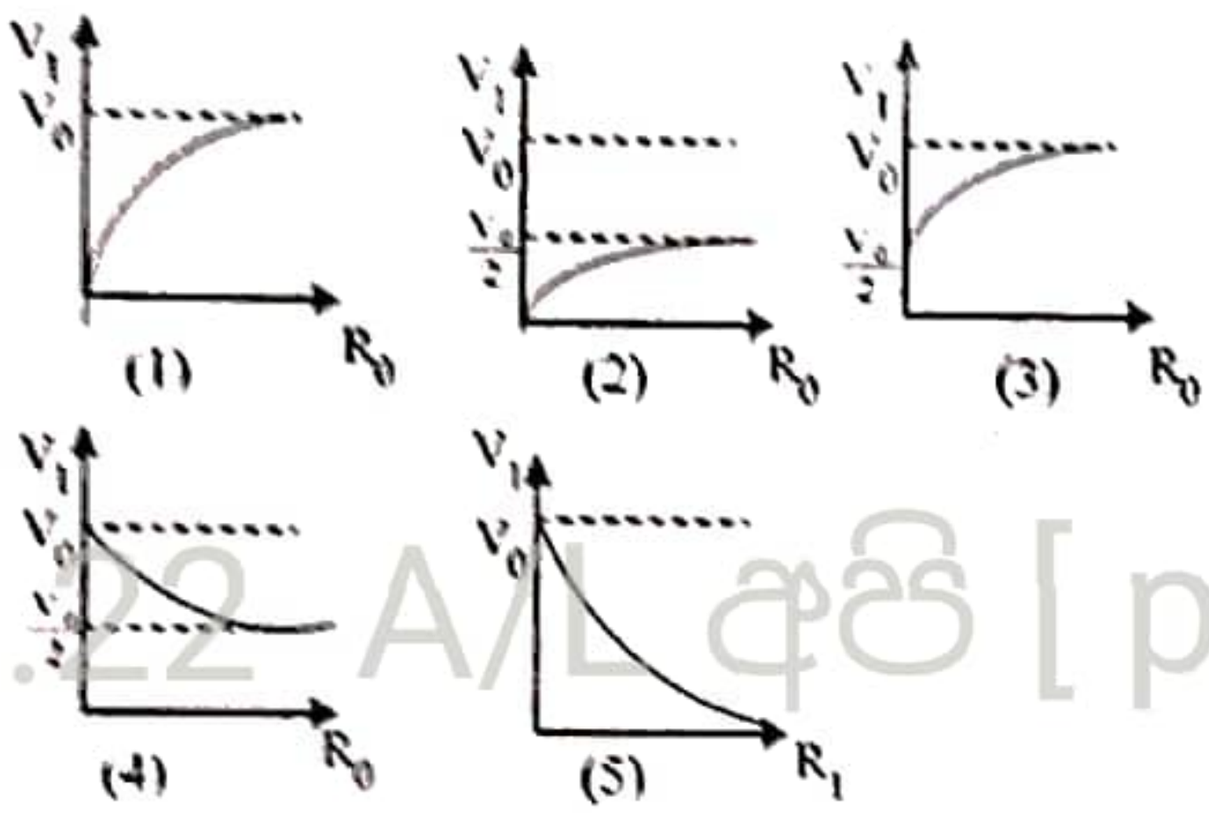
If the energy need to obtain a velocity 5 m s^{-1} from rest to an object is u. The energy need to increase of it, velocity from 5 m s^{-1} to 10 m s^{-1} will be

(1) $\frac{u}{2}$ (2) u (3) $\frac{3u}{2}$ (4) $2u$ (5) $3u$

24. What gives from the following by the Bernoul's theorem?
(1) The linear momentum is consistence.
(2) The energy is consistence
(3) The mass is consistence
(4) The kinetic energy and pressure is consistence.
(5) The kinetic energy and potential energy is consistence.

25. The R_0 resistance is changed from zero to infinity in the given electrical circuit. Then the curve which represent the variation of potential difference V_1 with R_0 will be





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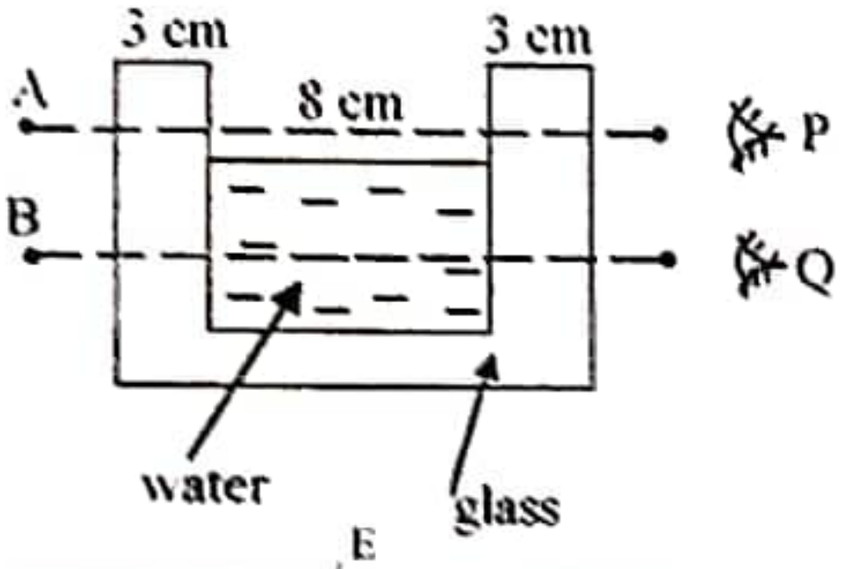
26. One end of a capillary tube of internal radius 1 mm and external radius 2 mm is hang by a spring balance and the lower end of the tube is lowered to a liquid as it just contact the liquid. After observing the reading of the spring balance at that moment further insert another 4 cm the tube into the liquid, then the spring balance given the same early reading. If the density of the liquid is 1000 kg m^{-3}, find the surface tension of the liquid in N.m. (Neglect the capilary rise)

(1) 0.2 (2) 0.4 (3) 0.6 (4) 1.0 (5) 0.8

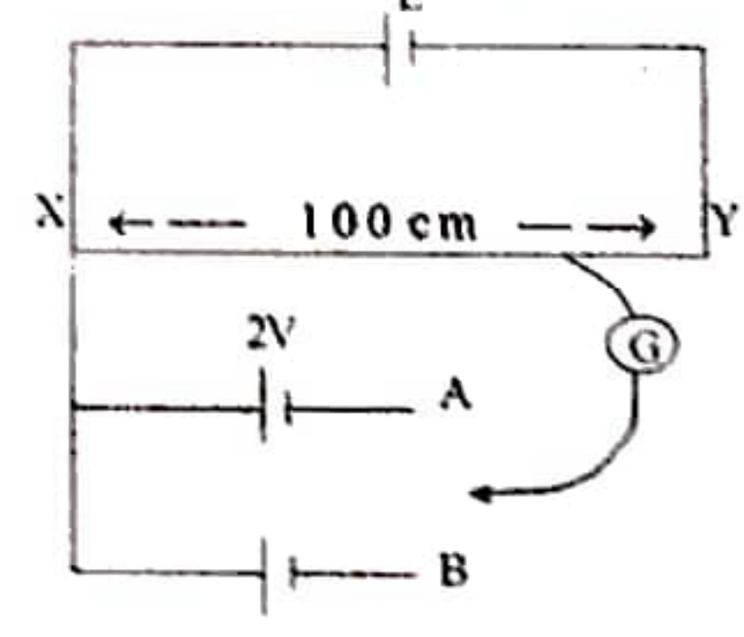
27. The separation of the internal walls of a glass container with thickness 3 cm is 8 cm as shown in the figure. The water is included in the container. If the refractive index of the water and the glass are $\frac{4}{3}$ and $\frac{3}{2}$ respectively what is the horizontal separation of the images of A and B two objects seen by the P and Q two eyes?



(1) 2 cm (2) 4 cm (3) 2.5 cm
(4) 4.5 cm (5) 6 cm

28. In the given potentiometer circuit when the key P is connected to A the balancing length is 50 cm.
When connected to B the balancing length is 80 cm, then the electro motive forces of E and E_0 will be .

(1) 2V, 1.2V (2) 4V, 3.2V
(3) 3.2V, 4V (4) 4V, 2V
(5) 4V, 4V



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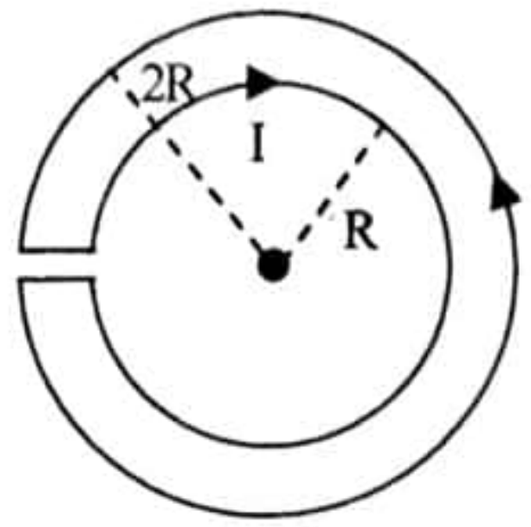
29. The false statement about the LASER rays will be

(1) it consist with photons
(2) it travel with same phase
(3) illuminate than sunlight
(4) coherent
(5) not exist as same wave length

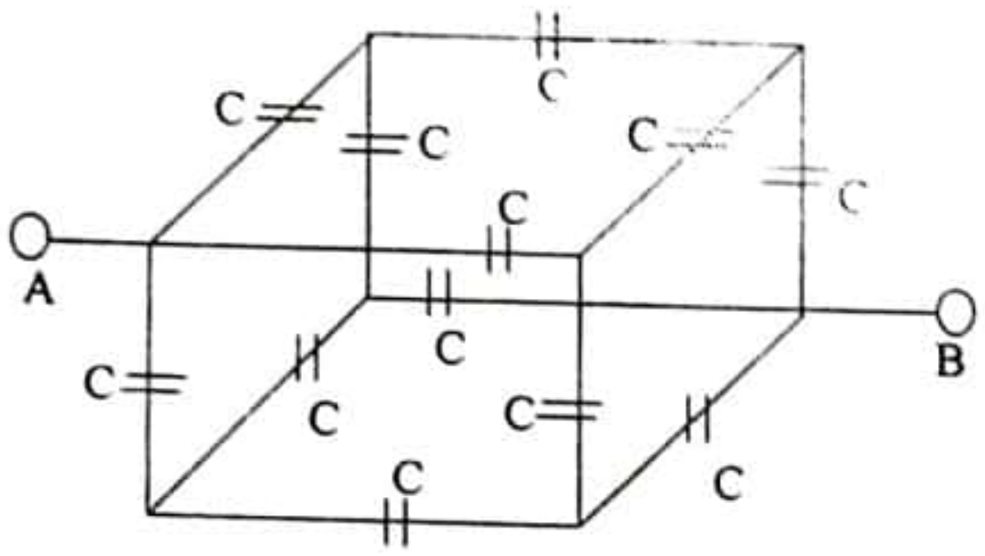
30. The same current I is flowing through two loops of circular conductors of radius R and 2R at same plane and concentric. The magnetic flux density at the centre will be



(1) $\frac{\mu_0 I}{8R}$ (2) $\frac{\mu_0 I}{4R}$ (3) $\frac{\mu_0 I}{2R}$

(4) $\frac{3\mu_0 I}{4R}$ (5) $\frac{\mu_0 I}{R}$

31.



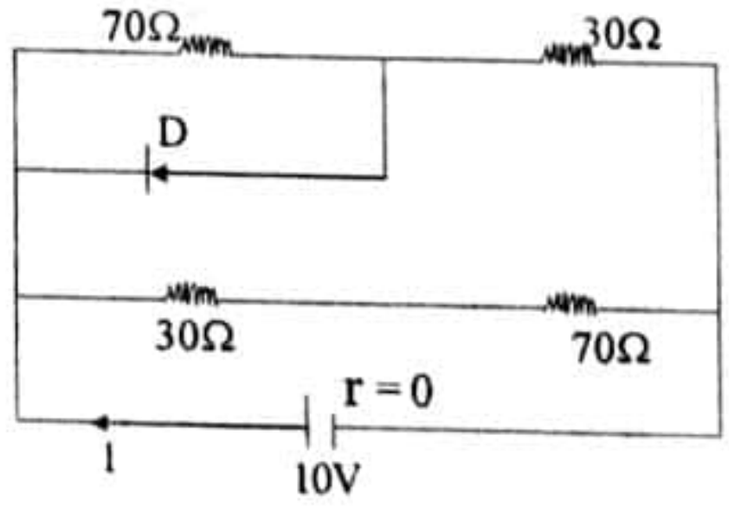
The equivalent capacitance between A and B of the given circuit will be

(1) C
(2) 5C
(3) $6C/5$
(4) 1.2C
(5) $\frac{5}{6}C$

32. The combination of the quark particle *n* will be

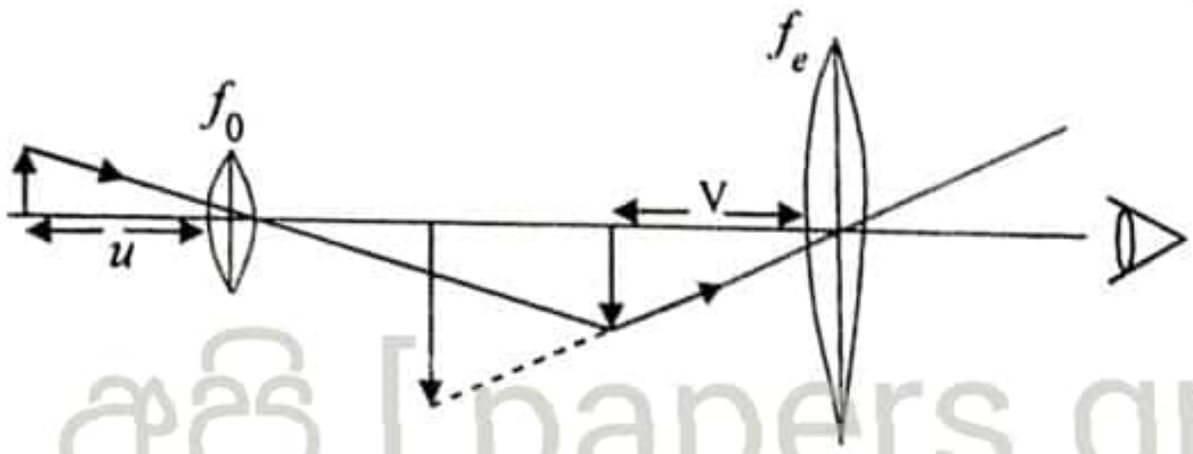
(1) $udd\bar{}$ (2) $\bar{u}dd$ (3) uud (4) udd (5) udu

33. A real diode (0.7V) is shown by D in the given circuit. The current emit by the battery will be



(1) 10 mA (2) 20 mA (3) 200 mA
(4) 100 mA (5) 2 mA

34. The focal length of object piece and eye piece are f_0 and f_e in respectively of a combine microscope. If the object distance to object piece is u and to eye piece is V when it at normal adjustment, select the correct statement.



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(1) It should be $f_0 > u > 0$ and $f_e > V > 0$
(2) It should be $2f_0 > u > f_0$ and $f_e > V > 0$
(3) It should be $\infty > u > 2f_0$ and $2f_e > V > f_e$
(4) It should be $2f_0 > u > f_0$ and $2f_e > V > f_e$
(5) It should be $2f_0 > u > f_0$ and $\infty > V > 2f_e$

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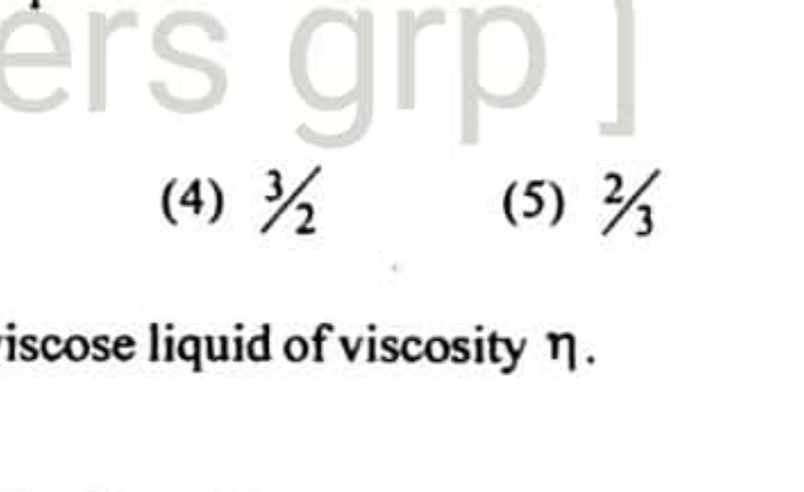
35. A current is obtained by a small direct current motor when 200V is supply to it. The maximum speed of it is 2500 r.p.m. If the resistance of the armature is 7Ω the electromotive force of the motor will be

(1) 149 V (2) 159 V (3) 169 V (4) 179 V (5) 189 V

36. The e.m.f of the battery connected to this circuit is 2V and its internal resistance is very small as negligible.
The resistance of the voltmeter is 80Ω . Then the reading of the Voltmeter will be



(1) 0.8 V (2) 1.6 V (3) 1.33 V
(4) 2.9 V (5) 2 V

37. A lens is cut into equal two parts as shown in the figure. The initial focal length of the lense is f, after cutting the new focal lengths are f and f ′, the ratio of $\frac{f}{f'}$ will be,

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(1) 1 (2) ½ (3) 2/1 (4) 3/2 (5) 2/3

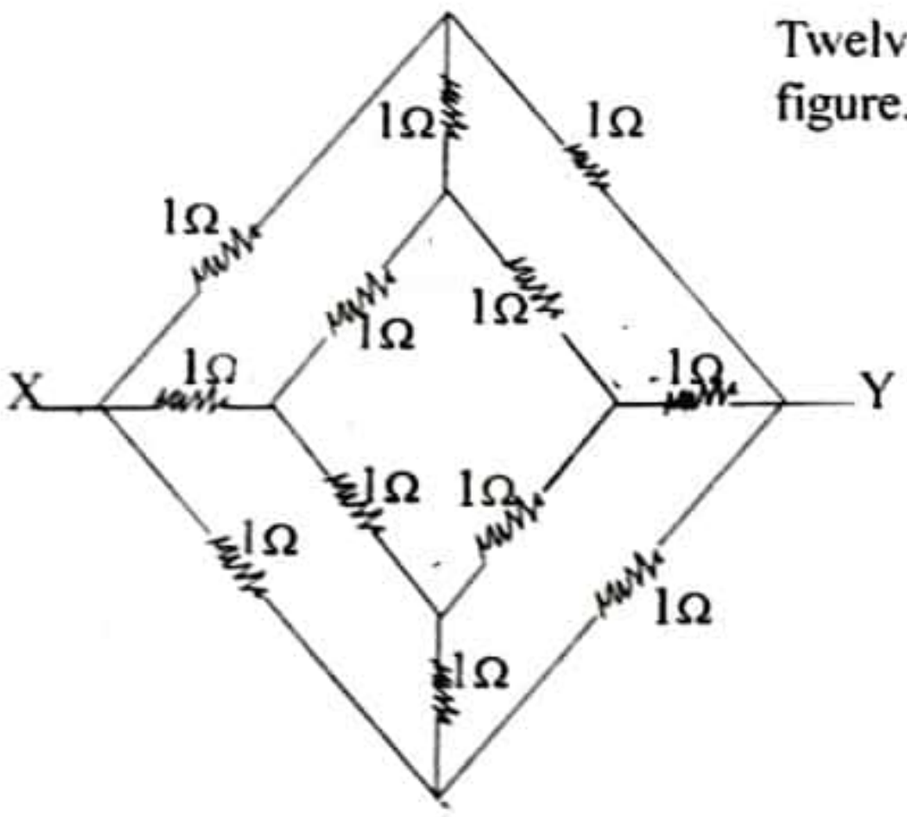
38. A solid sphere of radius *R* is falling down with velocity *V* within a viscose liquid of viscosity η.
If the decelerating viscose force acting on the sphere is *F*.

(1) $F \alpha R$ and $F \alpha \frac{1}{V}$ (2) $F \alpha R$ and $F \alpha V$

(3) $F \alpha \frac{1}{R}$ and $F \alpha \frac{1}{V}$ (4) $F \alpha \frac{1}{R}$ and $F \alpha V$

(5) $F \alpha R^2$ and $F \alpha V^2$

39.

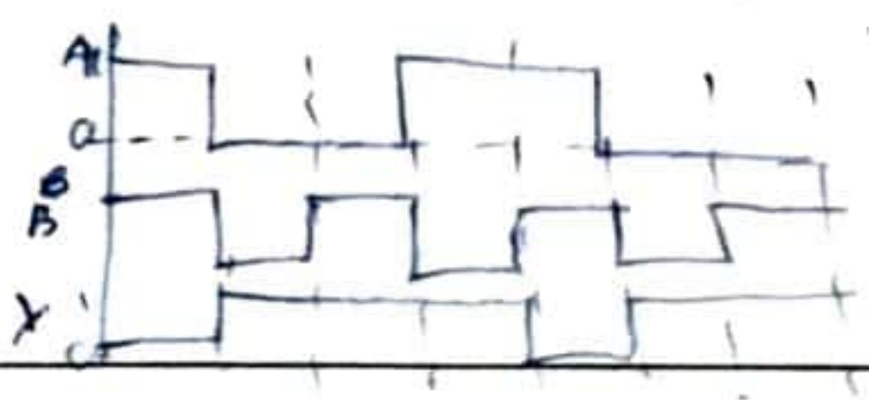


Twelve resistors of each 1Ω are connected together as shown in the figure. The value of the equivalent resistance between X and Y will be

(1) $\frac{2}{3}\Omega$ (2) $\frac{3}{4}\Omega$ (3) 1Ω
(4) $\frac{4}{3}\Omega$ (5) $\frac{3}{2}\Omega$

40. The figure shows a logic gate with two inputs (A and B) Its output is Y. The variation between the time and the voltage wave belongs to the A and B inputs and Y output was graphically represented. This logic gate is equivalent to a

(1) NOR gate (2) X - OR gate (3) OR gate (4) AND gate (5) NAND gate



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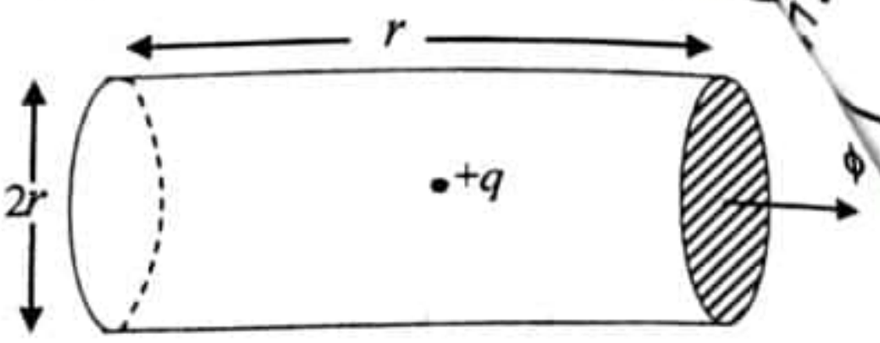
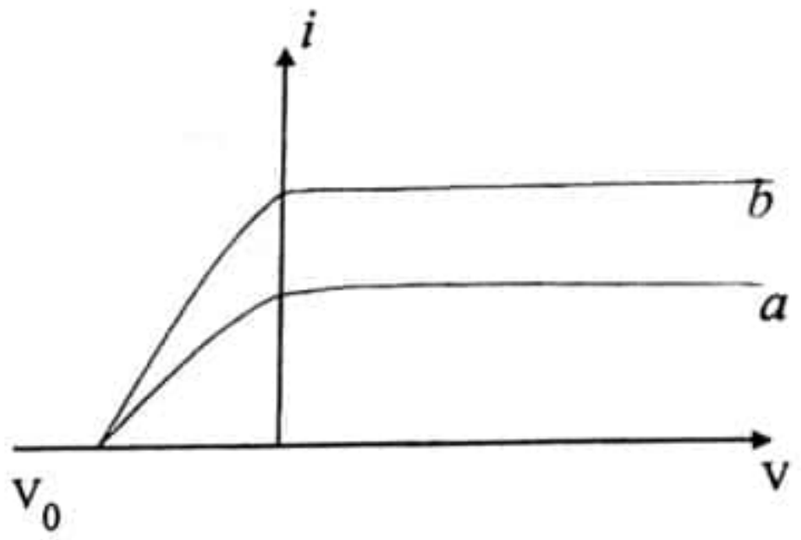
41. A gausian surface to cover the charge +q is shown in the figure. The electric flux passing through the shaded surface will be



(1) $\frac{q}{\varepsilon_0}$ (2) $\frac{q}{2\varepsilon_0}$ (3) $\frac{2q}{3\varepsilon_0}$

(4) $\frac{1}{4}\frac{q}{\varepsilon_0}$ (5) $\frac{3}{4}\frac{q}{\varepsilon_0}$

42. The way of the optical current vary with the potential of the optical battery belongs to two radiations of a certain metal is shown by the below graph. The intensity of each radiation is I_a and I_b and frequency is f_a and f_b. The graph predicted as



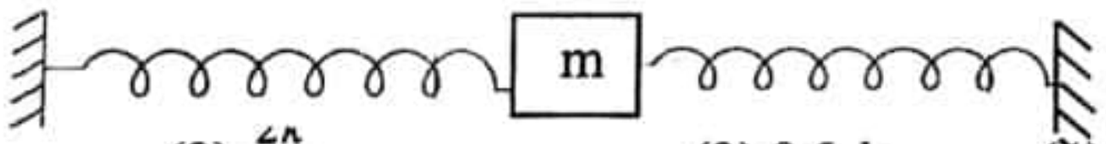
(1) $f_a > f_b$, $I_a > I_b$ (2) $f_a > f_b$, $I_a = I_b$ (3) $f_a = f_b$, $I_a > I_b$

(4) $f_a = f_b$, $I_a < I_b$ (5) $f_a = f_b$, $I_a = I_b$

43. Three conducting hollow spherical shells radius R, 2R and 3R were kept in concentrically and Q_1, Q_2 and Q_3 charges were given to them respectively. Finally it was found that surface charge density of external surfaces of all spheres are equal. If so the ratio of the charges given to the spheres $Q_1 : Q_2 : Q_3$ will be

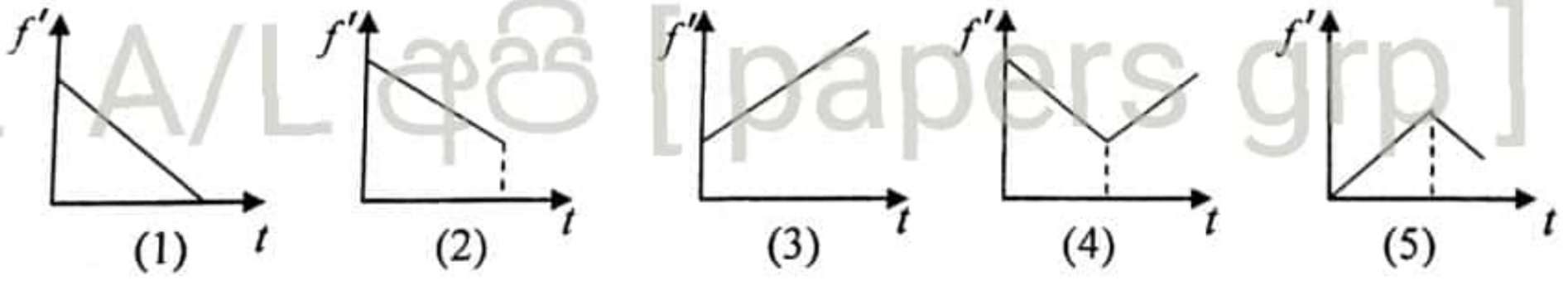
(1) 1 : 2 : 3 (2) 1 : 3 : 5 (3) 1 : 4 : 8 (4) 1 : 4 : 9 (5) 1 : 8 : 18

44. A light spring of spring constant K is cut into two pieces of ratio 1 : 2. Then two pieces are connected to a mass as shown in the figure below. The equivalent spring constant of the system is,



(1) $\frac{k}{3}$ (2) $\frac{2k}{3}$ (3) 0.5 k (4) $3k$ (5) 4.5k

45. A car heading north at uniform velocity 30 m s^{-1} suddenly views police jeep heading towards it in approach direction at uniform velocity 10 m s^{-1} when they have a separation of 300 m police jeep's siren emits sound at a frequency 'f'. When the car just views the police jeep it retardates with 3 m s^{-2} till it stops. Which one of the followings best represents variation of the apparent frequency with that heard by the car till it stops.



.22 A/L අපි [papers grp]

6. Consider the following statements made about stationary waves,

(A) Oscillation of a stationary wave cannot be longitudinal.

(B) A stationary wave does not travel.

(C) A stationary wave pattern always has nodes at both ends.

Correct statements of above

(1) Only A (2) Only B (3) Only A and B

(4) Only B and C (5) All A, B and C

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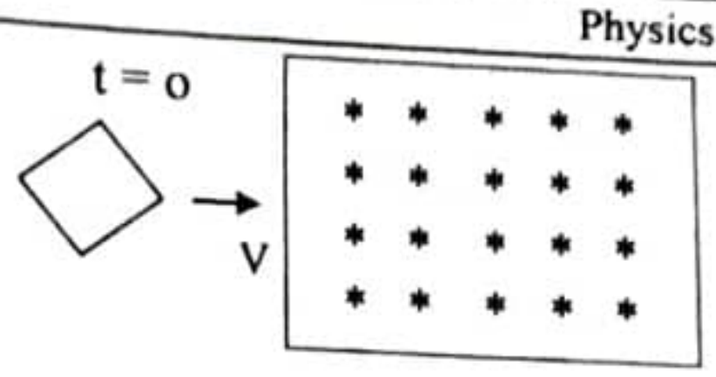
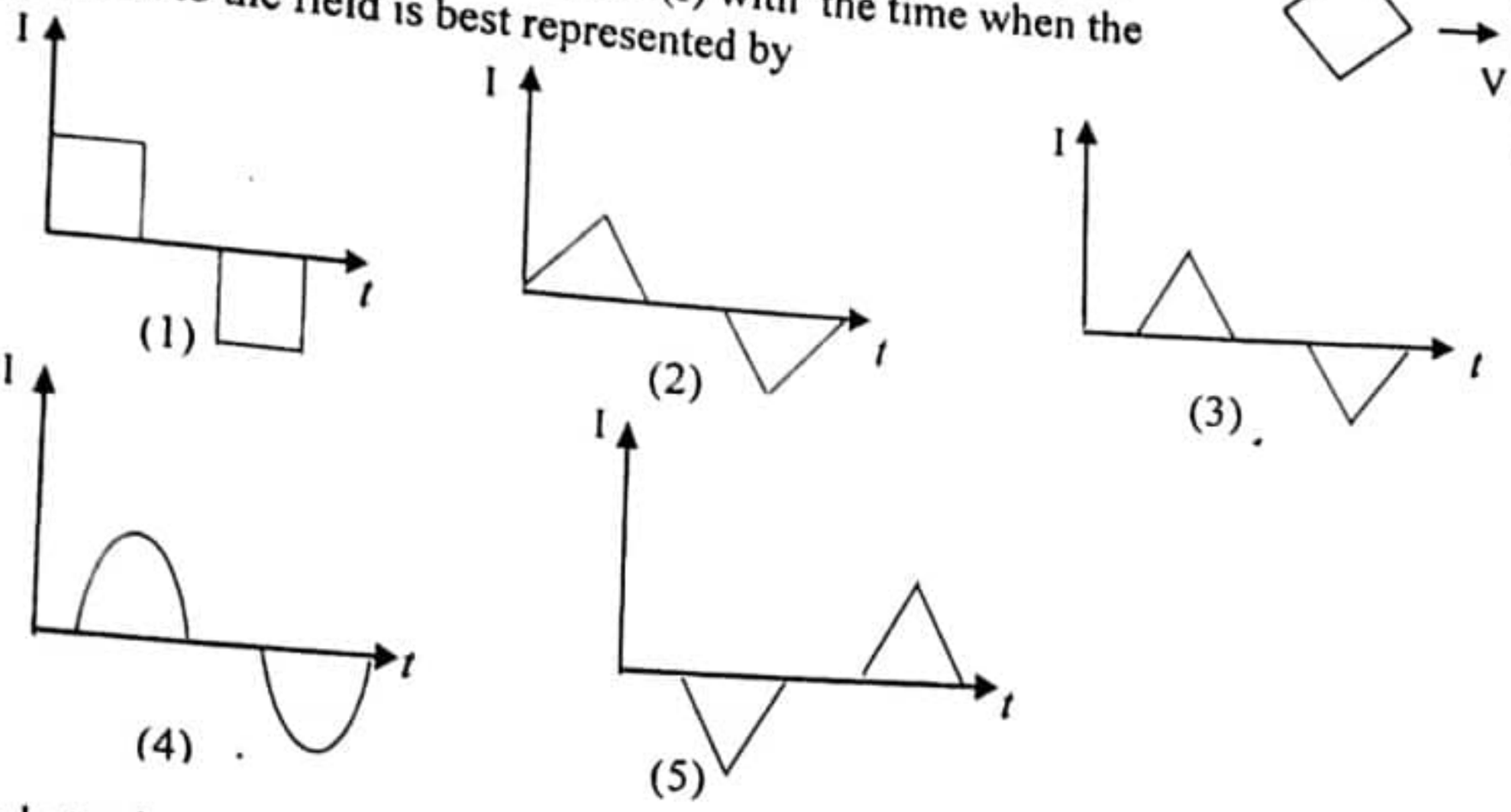
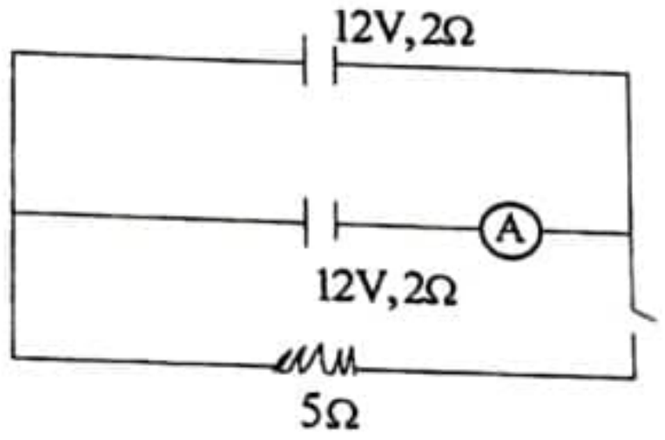
47. As shown in the figure a square shape conducting wire loop moves perpendicularly to the magnetic field with uniform velocity V. The variation of the induced current (I) with the time when the loop insert to the field is best represented by





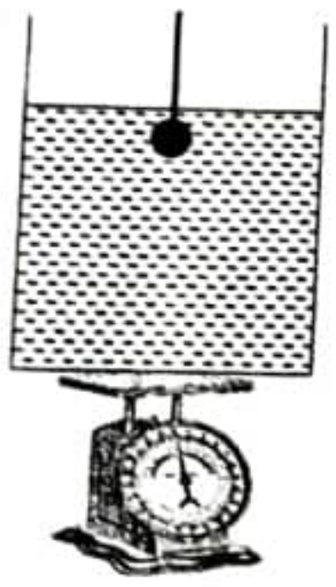
48. Two batteries are used in the given circuit and the resistance of the ammeter is 0Ω. The reading of the ammeter when switch S is closed will be



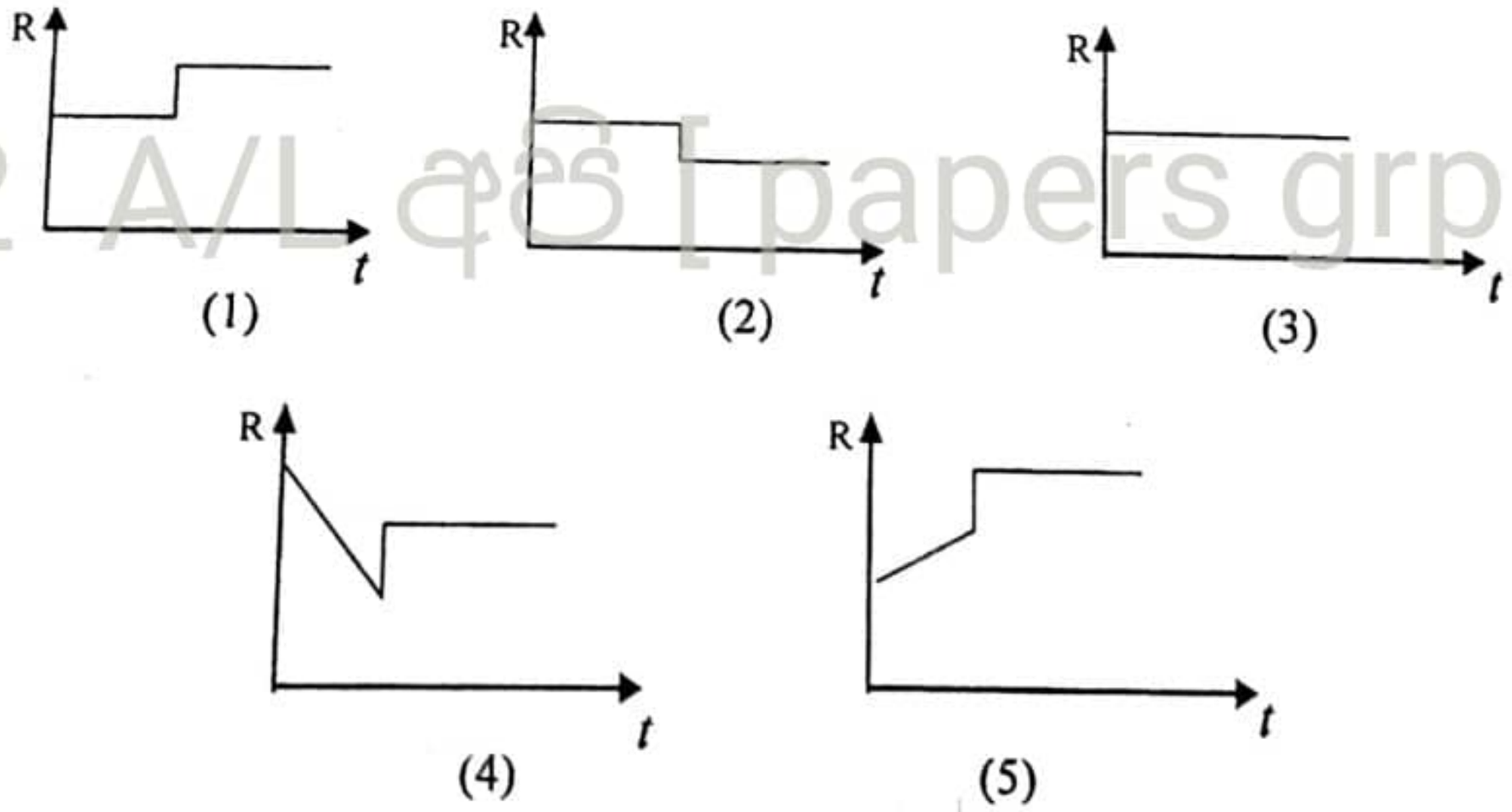
(1) 0.5A (2) 0.4A (3) 0.6A
(4) 0.8A (5) 1A

49. It was found that the room temperature is 25°C and the dew point is 8°C in a certain day. If the saturated. Vapour pressures at 8°C and 25°C are 0.654 Hg cm and 1.75 Hg cm respectively the relative humidity at that moment in approximately will be

(1) 37% (2) 40% (3) 41% (4) 43% (5) 45%

50. 

The figure shows a small metal sphere which hang from a string and immersed in the water just below the free water surface in a rest water container which is kept on a weighing balance. The variation of the reading of the balance (R) with time after smoothly cut the string will be represented by



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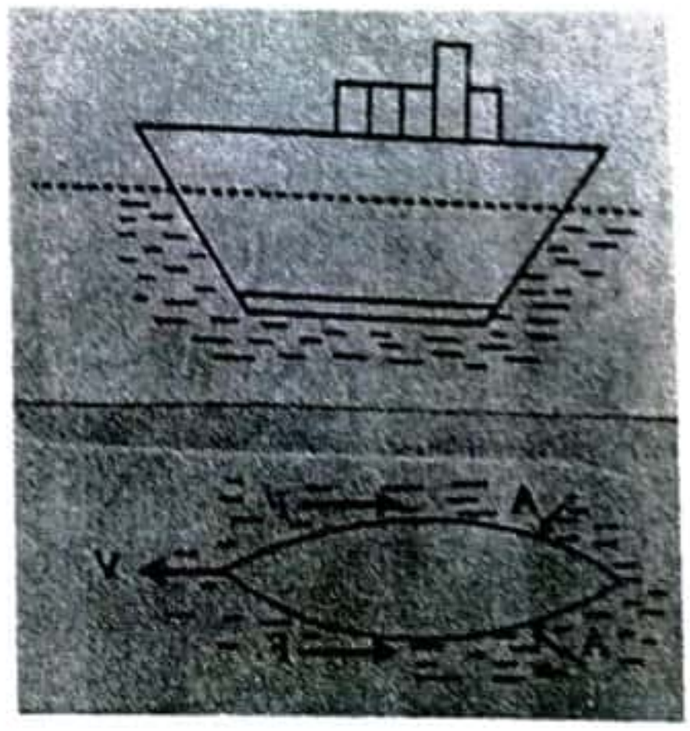
Part B – Essay
Answer only four questions

(05) What are the factors upon which upthrust depends upon a floating object in a liquid at rest?

(a) Shown in the above figure is a ship floating in the rest sea. Label the points where weight (mg) of the ship acts and upthrust (u) acts as G and G′ respectively. (Copy the diagram onto your sheet and label those forces)



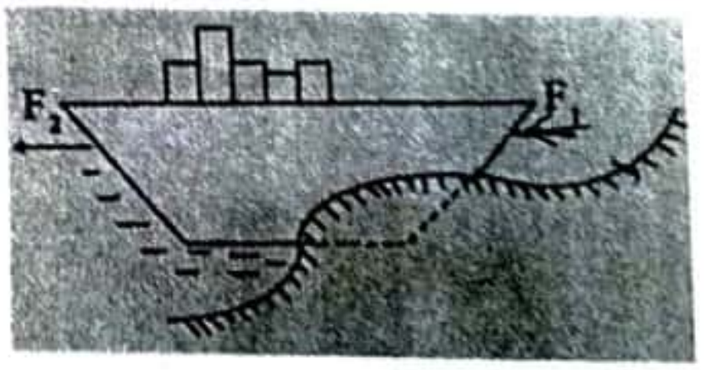
(b) Cross-sectional area of above ship at the sea level is 4600 m^2 and cross-sectional area of the bottom is 4400 m^2. Considering the depth that the ship has sunk is 10 m, cross-section reduces gradually from top to bottom, density of the water is 1000 kgm^{-3},

(i) Find the area of mean cross-section.
(ii) Find the mass of the ship with its content.

(c) If the resistive force acting upon the ship when the ship is sailed at uniform velocity V is F, $F = 10^2 AV^2$. A – area that ship has contacted with the water in one side.

Find the force exerted by the engine such that $V = 2\ ms^{-2}$, $A = 4000\ m^2$

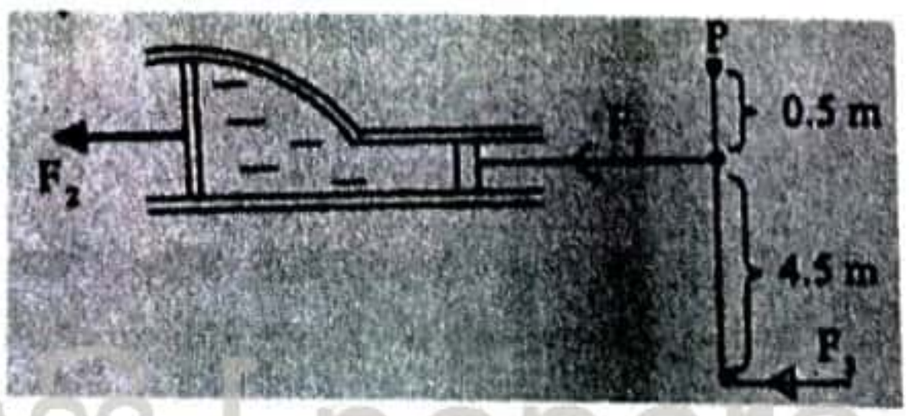
(d) When above ship sails, its resultant velocity becomes 10 ms^{-1} as the ship met with a storm. At this situation captain was unable to control the ship. As a result, ship deviates from its moving direction and moves a distance of 40 m into a sand berg whilst it gets close to the seashore. Find the effective resistive force that the sand berg will make against the motion.



(e) It was hard to take the ship out of the sand berg. All the efforts executed to rescue the ship were unsuccessful. It was decided to exert two forces. One force is to be exerted upon the ship from the land, other force to be exerted by another ship towards the this ship. Figure depicts how those forces are exerted

(i) What is the minimum value of effective force exerted on the ship in above way.

(ii) If a maximum force of $F_2 = 3.25\times10^7$ N is exerted by the second ship, following alternative method is adopted to exert force F1, Relevant figure for this is given below.



.22 A/L ලක්ෂ [papers grp]

The lever shown in the figure is pivoted at P smoothly. A_1 and A_2 are cross-sectional areas of large cylinder and small cylinder. If $A_1 = 2\ m^2$, $A_2 = 0.01\ m^2$ PQ = 0.5 m QR = 4.5 m Find the forces F_1 and F_3

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(06)

a)(i) Write down sign convention for the lenses clearly.

(ii) Graphically represent the variation between 1/V and 1/U considering image distance (V) and object distance (U) of a convex lens.

b)(i) When using a convex lens of focal length 10 mm as a simple microscope, calculate distance from the optical center of the lens that the object should be kept in order to form the final image at the least distance (25 cm) of distinct vision.

(ii) Represent the above situation by a ray diagram.

(iii) Write down an expression for the magnification of simple microscope.

(iv) Find the angular magnification corresponding to above situation.

c) A compound microscope is formed adopting another convex lens of focal length of 15 mm with the lens of 10 mm used above.

(i) Name the objective lens and eye piece lens.

(ii) If the objective and eye piece is interchanged such that final image of the object is formed at the infinity. Represent by a ray diagram the path that the rays travel from the uppermost point of the object which is at 12 mm from the objective.

(iii) Calculate the magnifying power of the compound microscope in this situation.

(iv) Then what is the distance between the objective lens and eye piece lens ?

(v) At what distance will the cross wires exist from the objective ?

(vi) Image of the objective formed by the eye piece is known as eye ring. Explain 'keeping the eye at the eye ring is more suitable.'

(vii) Find the distance from the objective to the place where the eye ring of above compound microscope exists.

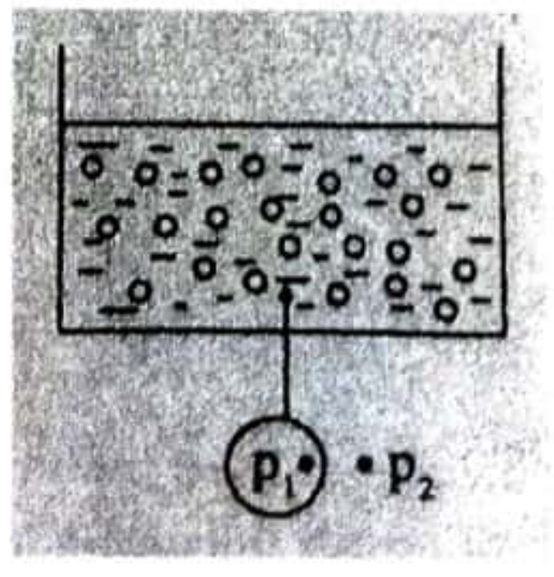
.22 A/L ඉසී [papers grp]

(07) Name two physical factors upon which tension of a liquid surface at rest depends.

(a)

(i)Shown in the figure is several air bubbles which have trapped inside water container. Consider they are in equilibrium. The internal radius of a bubble selected is r, internal pressure of the bubble is P_1, the pressure in the liquid closer to the bubble is P_2, surface tension of the liquid is T, show that

$P_1 - P_2 = 2T/r$



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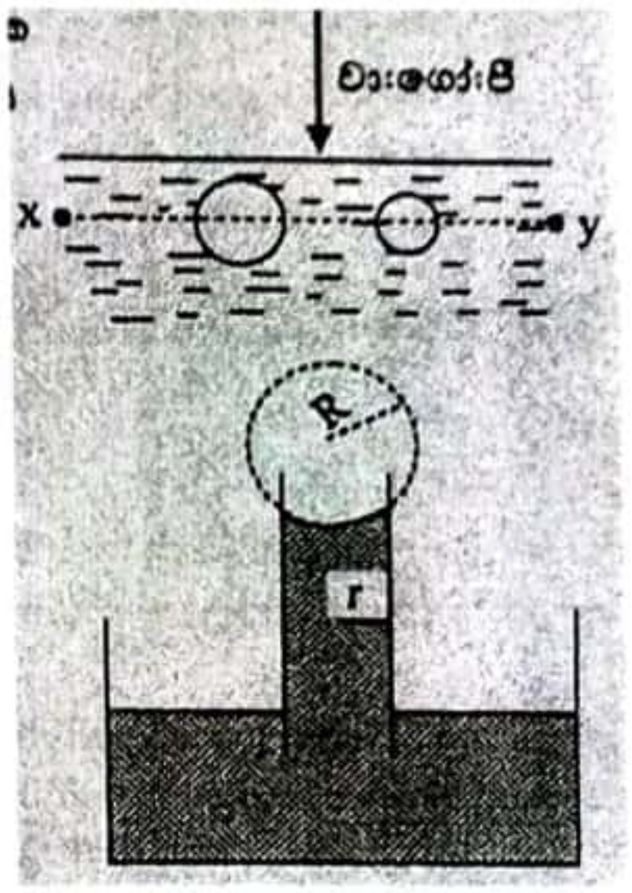
(ii) If coefficient of surface tension of the liquid is 0.08 Nm^{-1}, find the excess pressure of an air bubble of radius 0.5 mm.

(iii) The line connecting centres of two bubbles of different radii not in contact is horizontal. Represent the variation of the pressure along XY in a graph.



(b) Shown in the figure how a capillary tube of internal radius r shows the capillary rise of height h when it is immersed in a liquid. If angle of contact is θ, $(0<\theta<90)$ if radius of the meniscus is R and density of liquid is ρ

(i) Construct a relationship between R, h, ρ, g, T considering the pressure difference across the meniscus. T is surface tension.

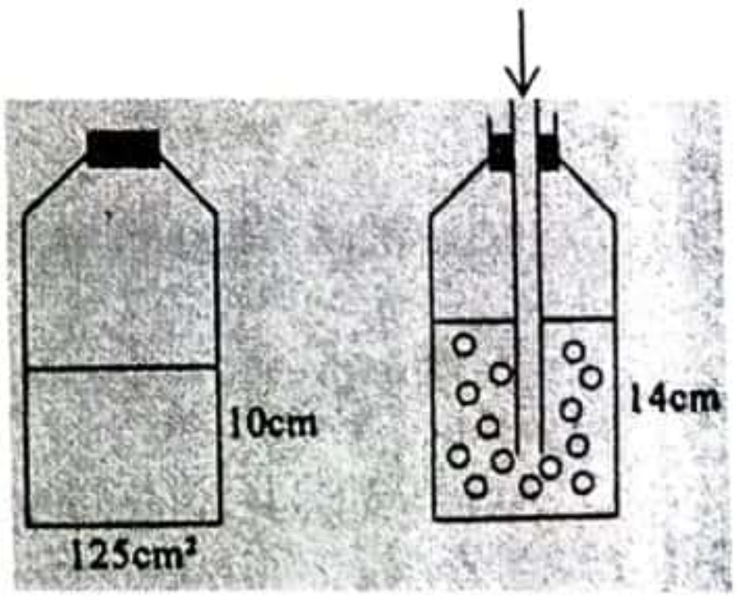
(ii) Write down a relationship between angle of contact (θ), R and r.

(iii) Construct an expression for T independent from R.

(iv) If $\theta = 60^0$, $\rho = 800$ kg m^{-3}, g = 10 ms^{-2} and T = 0.075 Nm^{-1}, find h

r = 0.2 mm

(b) Shown in the figure is a bottle of inner cross-sectional area of the base 125 cm2 containing liquid upto height 10 cm. When air is pumped into the liquid by a thin tube, the effective liquid level rises upto 14 cm due to a lot of air bubbles formed inside the liquid. Considering that all bubbles do not contact one another, mean radius of a bubble is 0.5 mm, density of the liquid is 3000 kgm^{-3}.



(1) Determine the number of bubbles formed

(2) Find the surface tension of the liquid using conservation of energy.

(08) The gravitational field intensity at a point inside a spherical mass is given by $g = \frac{GM}{r^2}$ where r is the distance from the centre to that point and m is the mass of the sphere of radius r.

Accordingly find the gravitational field intensity of a solid sphere of mass M and radius R at a distance r from the center.

i) A (r < R)

ii) B (r = R)

iii) C (r > R)

.22 A/L අපි [papers grp]

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b) Imagine a hole is drilled through the centre of the earth of radius R and mass M.
A mass m_0 is dropped from one end of the hole

i) Find the force acting on the mass (m_0) when it is at a distance x from the center of the earth.

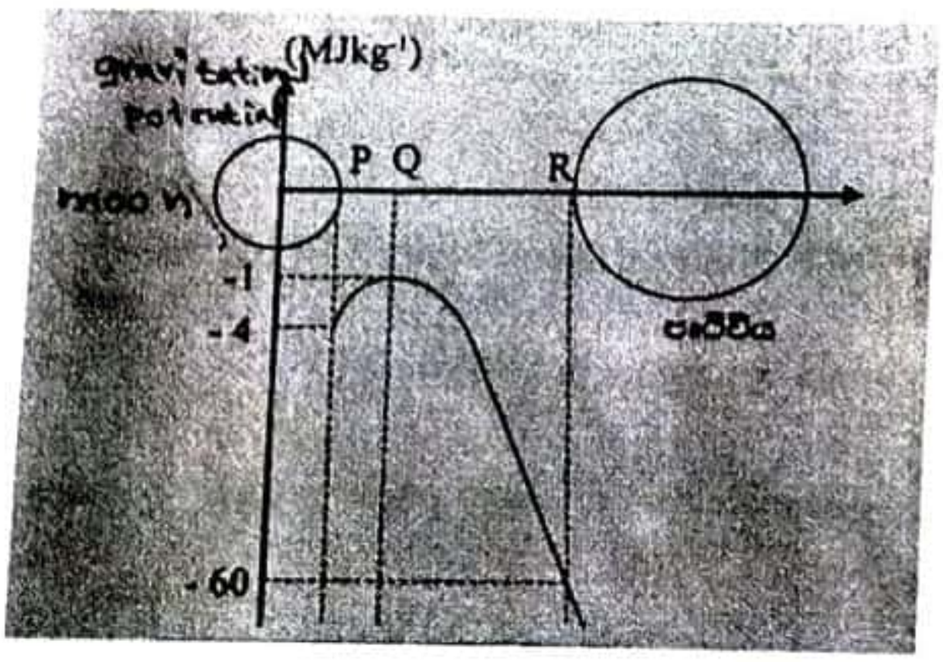
ii) Find the force on the Earth's ~~sentence~~ surface in terms of gravitational field intensity g

iii) Show that the mass undergoes simple harmonic motion and show that its periodic time is given by $T = 2\pi\sqrt{\frac{R}{g}}$

.22 A/L අපි [papers grp]

c) Some meteorites that have fallen to the Earth appear to resemble rocks on the moon. They are thought to have fallen from volcanoes on the moon.

The gravitational potential from the moon to the earth varies as shown in the graph below



i) What is the point of highest gravitational potential in given points? What is the value ?

ii) At what point is the gravitational field intensity becomes zero in given points.

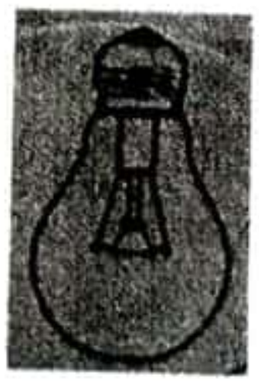
iii) What is the gradient of the graph at point R.

iv) What is the escape velocity at a moon rock with a mass of 10 kg that must be given on the moon to land on the earth.

Answer only for A part or B part.

(9) A

Several decades ago Filament bulbs are mostly used in houses in Sri Lanka. When such bulb is manufactured, a thinner wire with a higher resistance is used as the filament.



(a) It is labeled on such a bulb as 230 V / 100 W.

(i) What is the total power ?

(ii) What is the resistance when the bulb is lighted up ?

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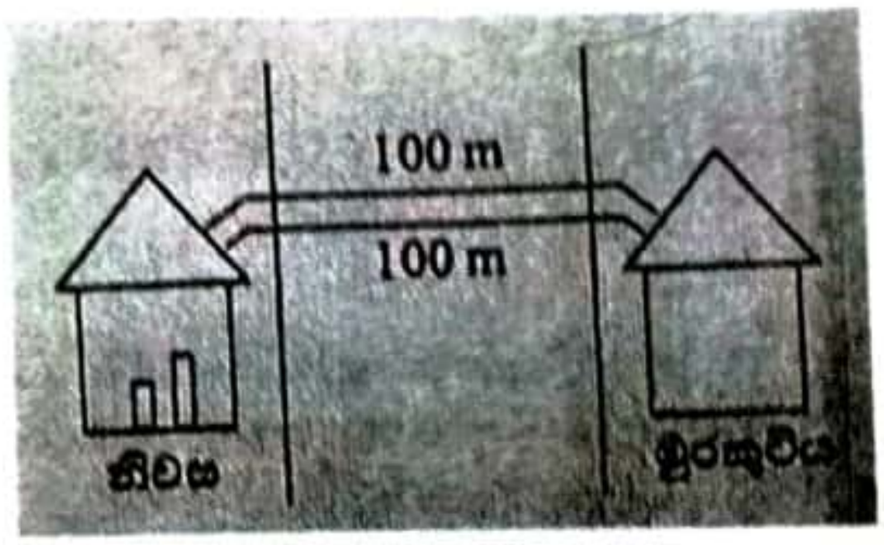
(iii) The cross section of the wire used to manufacture the filament of the bulb is 0.25 mm^2 and resistivity is $2.645 \times 10^{-3}\ \Omega m$. Find the length of filament.

(iv) The company which manufactured those bulbs labeled the lifetime of 1000 hours. What is electric energy released by the bulb within this time ?

(b) As shown in the figure, there is a house near a one river bank and a guard room near the other river bank. The bulb mentioned in (a) above is to be lighted up inside the guard room using two electric wires each having a length 100 m.



Resistance per unit length of the wire is 2.645 $\Omega\ m^{-1}$ and bulb is to be switched on by a switch in the house.

(i) What is the resistance of one electric wire running across the river?

(ii) What is the potential difference across it when the bulb lights up?

(iii) Find the power that the bulb lights up.

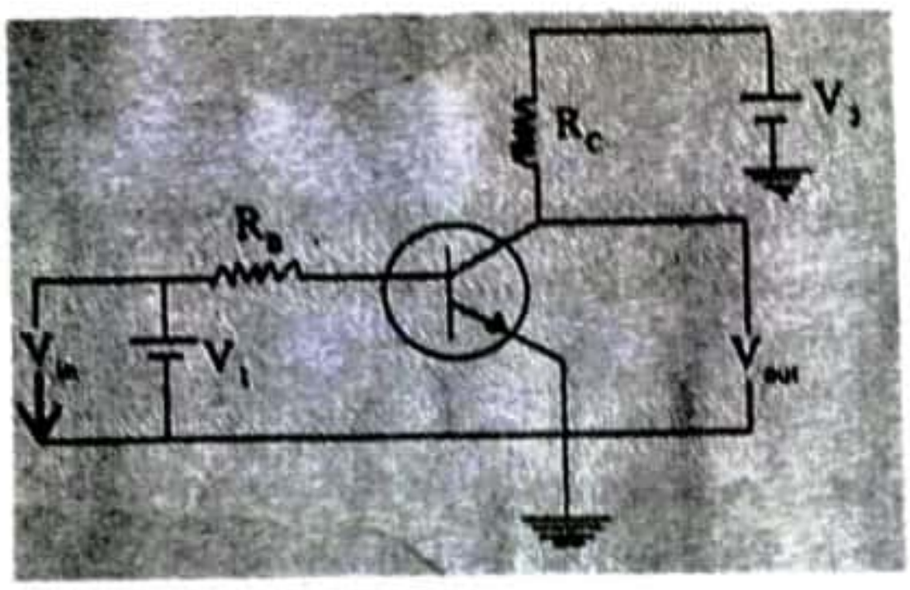
(iv) Explain the reason for the difference between the power that the bulb in the house and the bulb in the guard room light up.

(9) B

.22 A/L අයි [papers grp]

(1) What is intended by biasing of a transistor?

A figure of npn Si transistor is shown in the figure. $\beta = 200$, $R_B = 5\ k\Omega$, $R_C = 650\ \Omega$, $V_2 = 15\ V$, $V_1 = 1\ V$, $V_{BE} = 0.7\ V$



(2) Calculate I_B and I_C

(3) Calculate V_{CE} and V_{CB} ($I_B = 0$)

(4) State the biases across junction BC and junction EB using above calculated reading. Hence show that transistor is biased in active mode.

(b) An operational amplifier used to have inverting output is shown in the figure below.

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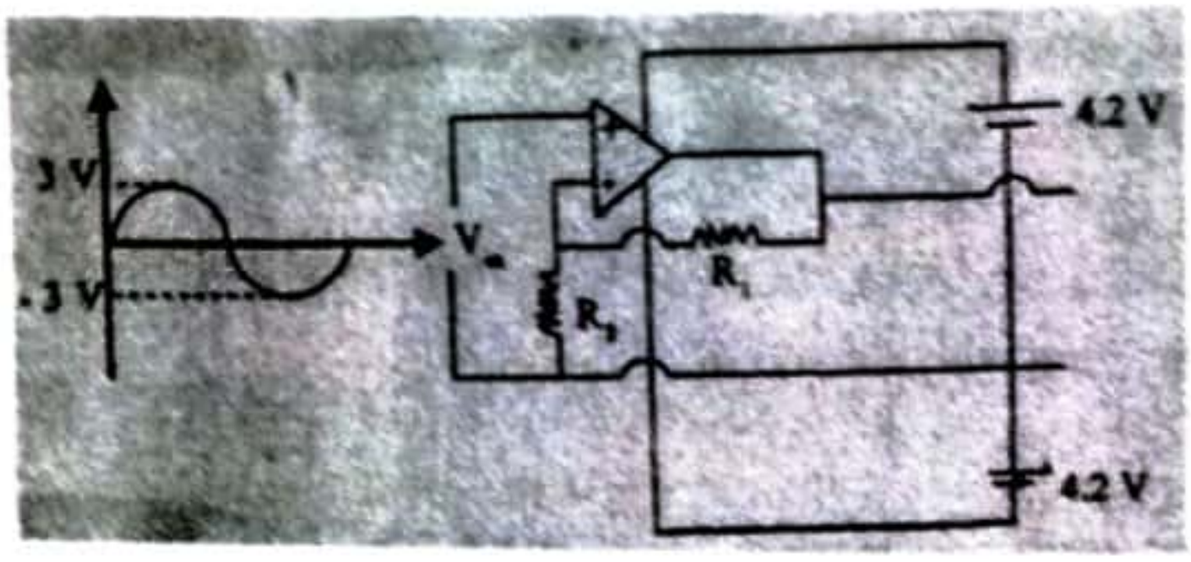


(1) Write down an expression for V_{out} using standard symbols.

(2) If resistors 100 Ω, 200 Ω, 300 Ω, 500 Ω State separately resistors that can be selected to amplify the signal without a distortion.

(3) State maximum and minimum voltage gains using only above resistors.

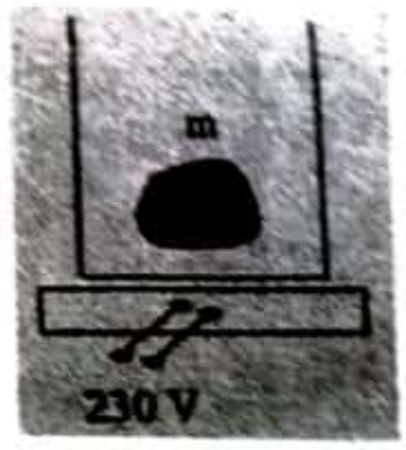
Answer only for A part or B part.

.22 A/L ලකී [papers grp]

(10) A

Define the specific heat capacity and latent heat of fusion of a substance.

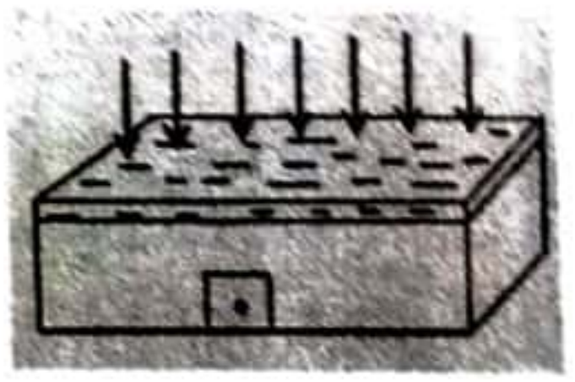
(a) Shown in the figure is an ice block of mass m which exists at 0 ^{0}C. The container with the ice block is kept on a hot plate having a constant power P. If the time taken to completely melt down is t_1, time taken to reach 100 ^{0}C is t_2 when it gets warm, latent heat of fusion of ice is L, specific heat capacity of water is C (Consider that container does not absorb the heat)



(1) Construct an expression for power P of the hot plate.

(2) Find the value of P if m = 2 kg, C = 4200 Jkg^{-1}K^{-1}, L = 2.3×10^5 J kg^{-1}, t_1 = 750 s, t_2 = 550 s

(b) The figure shows how ice layer has deposited on a horizontal roof top of a house in a cold country. In a day with a low ambient temperature, weak sunlight is falling normal to the roof top.



If the thickness of the ice layer is 5 cm and density of the ice is 900 kg m^{-3}, Ice takes 2.3×10^4 s to melt down completely. Latent heat of fusion of ice is 2.3×10^5 J kg^{-1}, area of the roof top is 800 m^2.

(i) The rate at which sunlight falls on the ice layer.

(ii) What is the mass of water makes when ice melts down.

(iii) Find the contraction in the volume when ice at 0^{0}C becomes water at 0^{0}C (Density of water at 0^{0}C is 960 kg m^{-3})

(iv) Find the new volume when water at 0^{0}C becomes water at 4^{0}C (Density of water at 4^{0}C is 1000 kg m^{-3})

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(v) Find the volume and density of water when water reaches 100^0C (Real expansivity of water is 4×10^{-4} K^{-1})

(vi) Represent variation of density and volume with the temperature of water in two separate graphs using above information. Show the variation of density and volume of ice at minus temperature on these graphs too.

.22 A/L අයි [papers grp]

(10) B

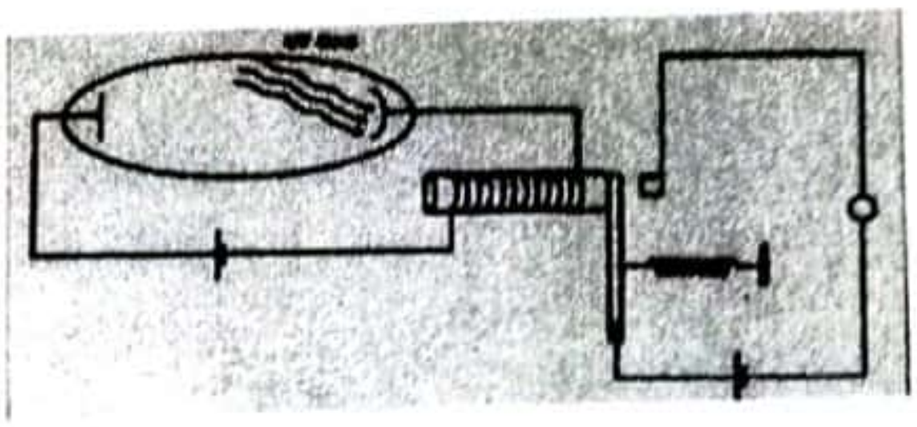
(a) Explain the process of the photo electric effect in terms of Einstein's theory of photon.

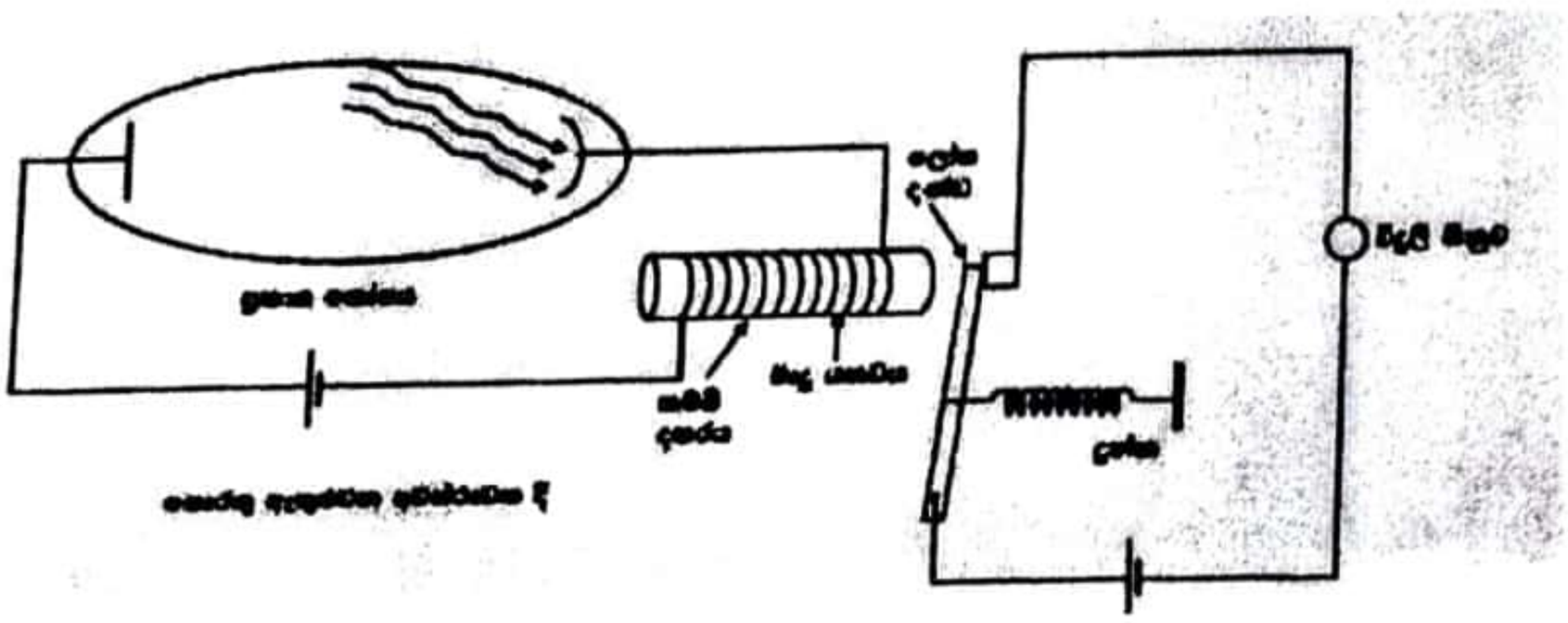
(b) State two factors as to why it was unable to explain the photo electric effect using the wave theory.

(c) Define the work function of a metal.

(d) Write the Einstein's photo electric equation and introduce the terms.

(e) The bell 'Burglar arm' which can detect the intrusion of a robber is an important application of photo electric effect. A UV ray which is not visible to naked eye is used instead of visible light in this device. An electric magnet is activated by the rays coming to the photo sensitive cathode from the UV source. No current flows in the second circuit as metal rod is attracted. If a person moves across the light beam, it will be blocked to fall on to the photo sensitive plate, electric magnet deactivates. Then metal rod which has already attracted to the magnet, detaches. As a result, current will flow through second circuit and alarm will ring. A simplified diagram of the device is shown below.





When alarm once rings, it will continue ringing till it is stopped.

(i) What are the steps that can be taken to enhance the strength of the electric magnet?

(ii) State one disadvantage of this instrument.

(iii) A student created a setup to demonstrate above theory where above instrument is used.

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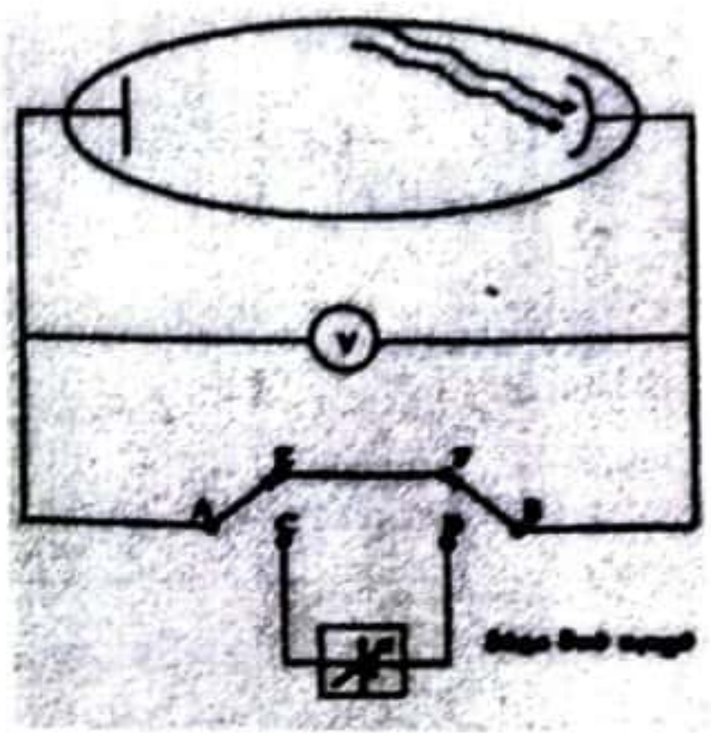
When two terminals A and B are respectively connected to terminals E and F,

1. Frequency of electromagnetic wave which is incident on photosensitive metal is gradually increased, a current is noted at a certain instance. What is the specific name used for the frequency of that radiation
2. If the wavelength of that radiation is 600 nm, what is the energy of a photon of this radiation ? ($h = 6.6\times10^{-34}$ Js , $C = 3\times10^{8}$ ms^{-1})



(f) When above radiation is aimed, two terminals A and B is connected to the variable voltage source, then a current higher than the previous situation is noted.

(i) State whether to what terminals, terminals A and B are connected.

(ii) Explain this process when potential difference is increased after interchanging, it is noted that photo current becomes zero at a particular situation.

1. State the reason for that
2. Potential difference across the cell in this situation is -1 V, how this potential difference is known.
3. Find the maximum kinetic energy of electrons released from the photo cathode. (1.6×10^{-19} C = charge of an electron)
4. Find the work function of the substance of photo cathode in electronvolts.

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