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PHYSICS I

1 | E | I

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Two hours

- Answer all 50 questions.

gravitational field intensity g = 10 Nkg $^{-1}$

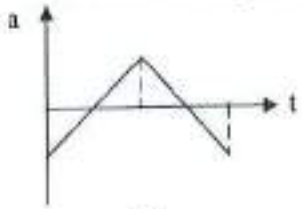
1. What is the dimensional formula for electrical capacity, given the dimensions of electric current A ?

(1) $ML^2T^{-2}A^{-2}$ (2) $M^{-1}L^{-2}T^3A^2$ (3) $M^{-1}L^{-2}T^4A^2$

(4) $M^{-1}L^2T^4A^{-2}$ (5) $M^{-1}L^{-2}T^4A^2$

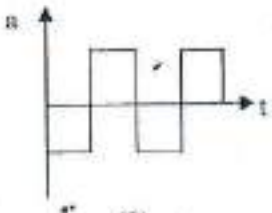
2. Shown here is the velocity – time graph for the motion of an object.

Choose the corresponding acceleration- time graph ,



(1)

(2)



(3)

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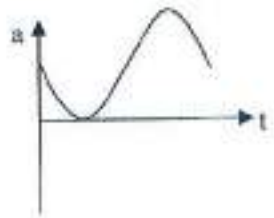


(5)

3. A vibrating string of tension T and length 'l' resonates with the first overtone of a closed tube of length 75 cm. The vibrating string makes four beats per second when vibrated with a tuning fork of frequency f. The beat frequency reduced to 2 Hz , when the tension of the string is increased. Speed of sound in air 340 ms^{-1} . Find the frequency of the tuning fork.

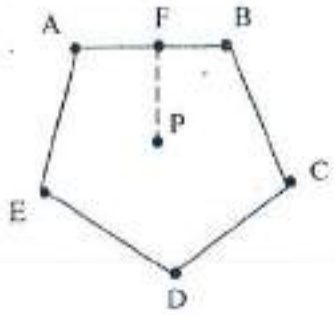
(1) 344 Hz (2) 336 Hz (3) 117.3Hz (4) 109.3 Hz (5) 340 Hz

4. A ray of light incident from air on to a liquid surface undergoes both reflection and refraction. The angle between the reflected ray and the refracted ray is 90^0. Refractive index of the liquid $\sqrt{3}$. The incident angle of the ray is ,

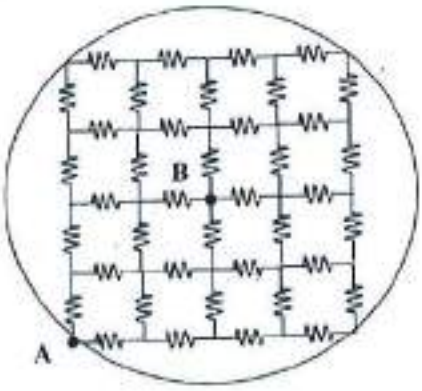
(1) 0^0 (2) 30^0 (3) 45^0 (4) 60^0 (5) 90^0

5. Five isolated particles each of mass m are placed at the vertice of a regular pentagon. The distance from the midpoint (p) of the pentagon to each vertex is r. Resultant gravitational field intensity at pis ,

(1) G.$\frac{m}{r^2}$ along EP
(2) 2 G.$\frac{m}{r^2}$ along EP
(3) G.$\frac{m}{r^2}$ along PF
(4) 2 G.$\frac{m}{r^2}$ along PF
(5) Zero



6. Shown here is a network of resistors each of resistance R . Equivalent resistance across AB is ,

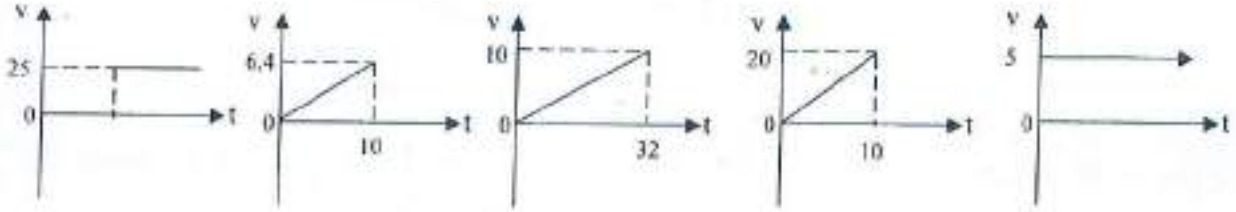


(1) $\frac{7R}{40}$ (2) $\frac{25R}{48}$ (3) $\frac{21R}{40}$ (4) $\frac{9R}{16}$ (5) $\frac{29R}{48}$

7. A spherical drop of water , falls down through air from a very high distence h starting from rest , and strikes ground at v speed. Which of the following relationships between v and h is true ?

(1) $v \alpha h$ (2) $v\alpha\sqrt{h}$ (3) $v \alpha \frac{1}{h}$ (4) $v \alpha h^0$ (5) $v \alpha \frac{1}{\sqrt{h}}$

8. An object of weight 64N placed on a horizontal rough surface (initially at rest) is continuously acted on by a horizontal force.At t=0 the object gets on the verge of motion due to this hori'ontal force.Coefficients of static and dynamic friction are 0.6 and 0.4 respectively.Velocity time graph for the motion of the object is ,



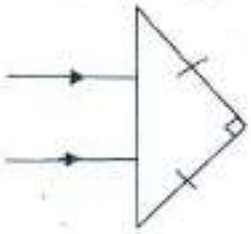
(1) (2) (3) (4) (5)

9. Which of the following statement/s is/are true about mercury-glass thermometer ?

a. It's bulb is made of a very thin glass to allow efficient heat transfer
b. The thermometer functions over a wider range of temperatures as mercury is used..
c. The thermometric property used here is more accurate than that used in gas thermometers.

(1)b only. (2) a only (3) a and b only
(4) all a, b and c (5) b and c only.

10. Shown here is a rectangular isosceles prism made of a transparent material of refractive index $\sqrt{3/2}$ and two parallel incident rays.The angle between their corresponding emergent rays is .



(1) 45^0 (2) 60^0 (3) 30^0 (4) 90^0 (5) 15^0

11. Which of the following factors determine the no of minority carriers in a P type semiconductor ?

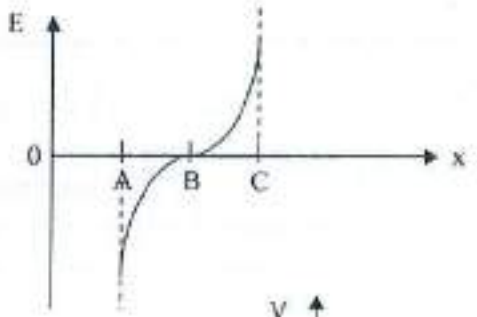
(1) No of donor atoms.
(2) Temperature.
(3) No of accepter atoms.
(4) Impurity used for doping.
(5) Level of doping.

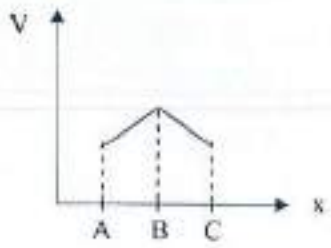
12. Which of the following conditions is/are required for the production of laser .?

(a) . Population inversion.
(b) . There should be 2 or more energy levels in the laser medium.
(c) . There should at least be one meta stable state.

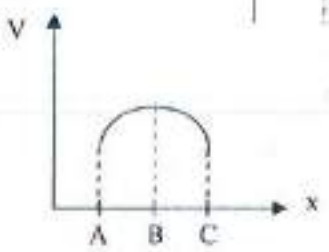
(1) a only
(2) a and b only
(3) a and c only
(4) b and c only
(5) all a, b ,c

13. Shown here is the variation of electric field Intensity (E) with distance x.Which of the following graph correctly depict the corresponding variation of electric potential(v) with distance(x) ?





(1)



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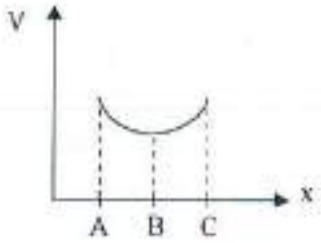

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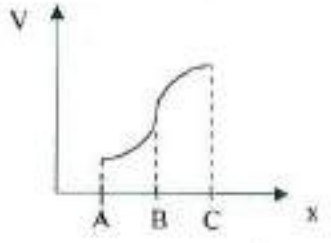

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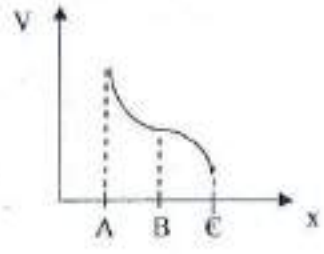
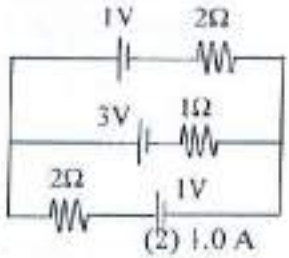


(5)

14. P and Q are two points at x horizontal separation.Two particles are projected simultaneously from the two points P and Q,towards each other at $u$and $u/\sqrt{3}$speeds and at $60^0$and 30^0 angles to the horizontal respectively.After what time lapse(t) the horizontal separation between the two point become zero ?

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

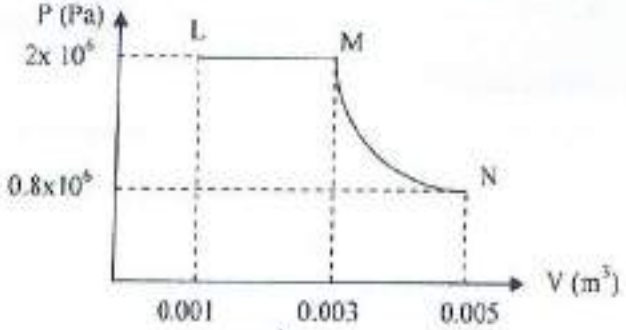
15. Cells connected in this circuit are of negligible internal resistance. Current through 1Ω resistor is ,

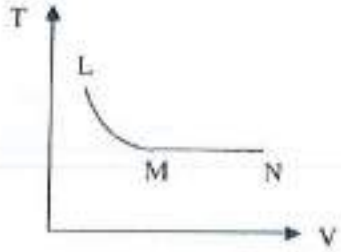


(1) 0.5 A (2) 1.0 A (3) 2.0 A (4) 2.5 A (5) 3.0 A

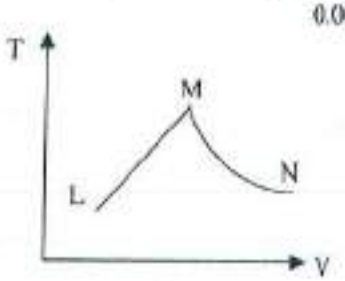
16. Shown here is the variation of pressure and volume of a fixed mass of an ideal gas.

Which of the following shows the corresponding variation of volume (V) and absolute temperature(T) ?

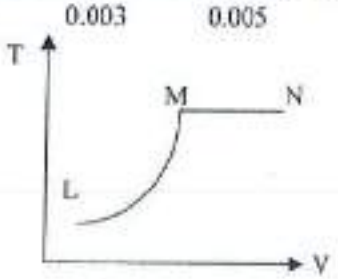




(1)



(2)



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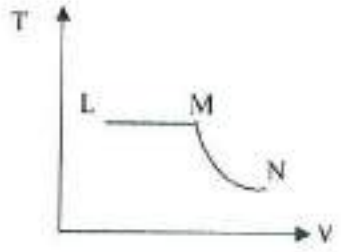

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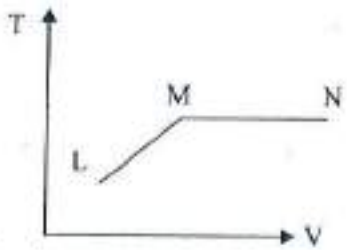


(5)

17. A convex lens of focal length 18 cm and a concave lens of focal length 6 cm are placed coaxially , at separation x.Rays coming from an object at infinity , incident on the convex lens, undergoes refraction through the system of lenses and forms the final image at infinity. x is equal to ,

(1) 24 cm (2) 6 cm (3) 18 cm (4) 3 cm (5) 12 cm

18. Three identical resistors are connected across a cell of negligible internal resistance.Power dissipation of the circuit is 10W.What is the power dissipation when only one of the 3 resistors is connected across the cell ?

(1) 10/3 W (2) 10 W (3) 20 W (4) 30 W (5) 90 W

19. Which of the following statement/s is/are true ?
a. A force is acting on any charged particle moving in a magnetic field.
b. An electron , entering at an angle to a magnetic field takes a circular path inside the magnetic field.
c. In hall effect , the drift velocity of charges depends on the magnitude of the charge.

(1) a only (2) b only (3) c only (4) a and c only (5) all a, b ,c false

20. A rope moves along a linear path on , a horizontal smooth plane under constant acceleration due to a constant 'F' force acting on the rope. Tension at its' mid pont is T ,
a- If the string is heavy $\frac{T}{F} = \frac{1}{2}$
b- If the string is light $\frac{T}{F} = 1$
c- If the string is uniform and heavy $\frac{T}{F} = \frac{1}{2}$

Which of the following staement/s about T and F is/are true ?

(1) a andb (2) b andc (3) c only (4) b only (5) all a,b,c false

21. An ideal gas at 27^0 C temperature and 10^5 Pa pressure contains 2.48×10^{25} no of molecules in $1m^3$ volume.When its' temperature changed to 17^0C and pressure 10^{-2} Pa , What no of atoms contained in $1m^3$ volume ?

(1) 6.2×10^{25} (2) 4.8×10^{28} (3) 5.7×10^{29} (4) 3.4×10^{30} (5) 2.4×10^{32}

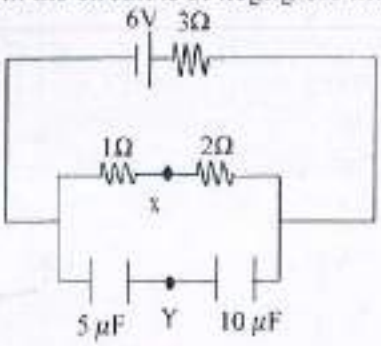
22. A sonometer string , under a tension due to a 9 kg mass hanging from its' free end,produces a stationary wave with 5 antinodes with a tuning fork at 'l'separation between its' knife edges.Now , 9kg mass is replaced with another 'M' mass and its' 'l' length vibrates with the same tuning fork producing 3 antinodes.Mass 'M' in kg ,

(1) 25 (2) 5 (3) 12.5 (4) 1\25 (5) 1\5

23. Two spherical water droplets are of volumes V_1 and V_2 .What is the ratio between their excess pressures?

(1) $\left(\frac{V_2}{V_1}\right)^{\frac{1}{3}}$ (2) $\left(\frac{V_2}{V_1}\right)^{\frac{1}{2}}$ (3) $\left(\frac{V_2}{V_1}\right)^{\frac{2}{3}}$ (4) $\left(\frac{V_2}{V_1}\right)$ (5) $\left(\frac{V_2}{V_1}\right)^{\frac{3}{2}}$

24. What is the potential of point Y with respect to point X in the circuit shown here?The cell connected in the circuit is of negligible internal resistance .

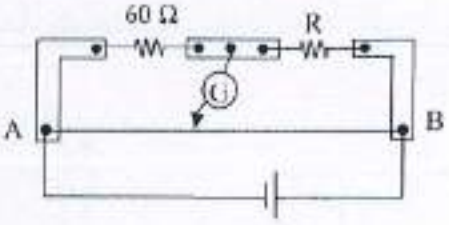


(1) 0 V (2) 1 V (3) -1V (4) 3 V (5) -3V

25. An electric kettle contains 1.5 kg of water at 100 ^{0}C .Water is being heated by its' thermo coil of power 2kW .Specific latent heat of vaporization of water 2000 kJkg^{-1}.If the thermostat of the kettle falls to operate , how long does the kettle takes to boil dry ?

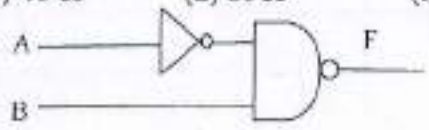
(1) 500 s (2) 1000 s (3) 1500 s (4) 2000 s (5) 2500 s

26. Shown here is a meter bridge circuit .The wire of 1m length ,is of uniform resistance all along its'length. When the contact key is at 20 cm distance from the end A , the galvanometer shows zero deflection. The value of R is ,

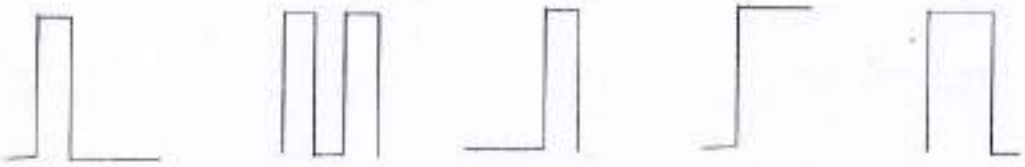


(1) 15 Ω (2) 60 Ω (3) 120 Ω (4) 240 Ω (5) 300 Ω

27.

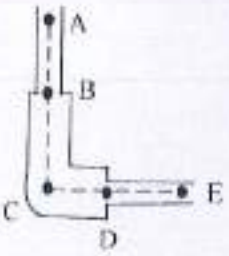


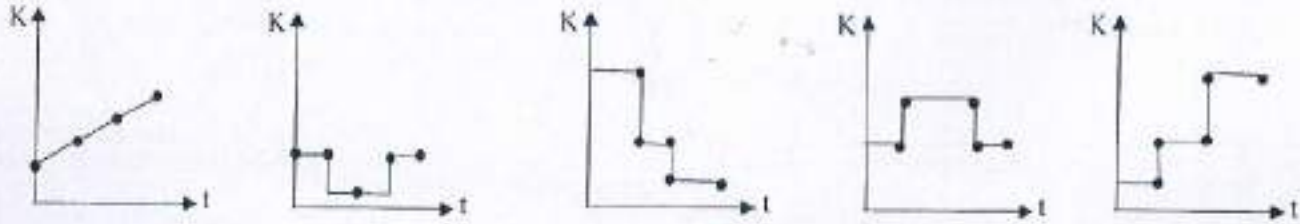
When the signals A and B are input to the logic gates system shown here, its' F output would be ,



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

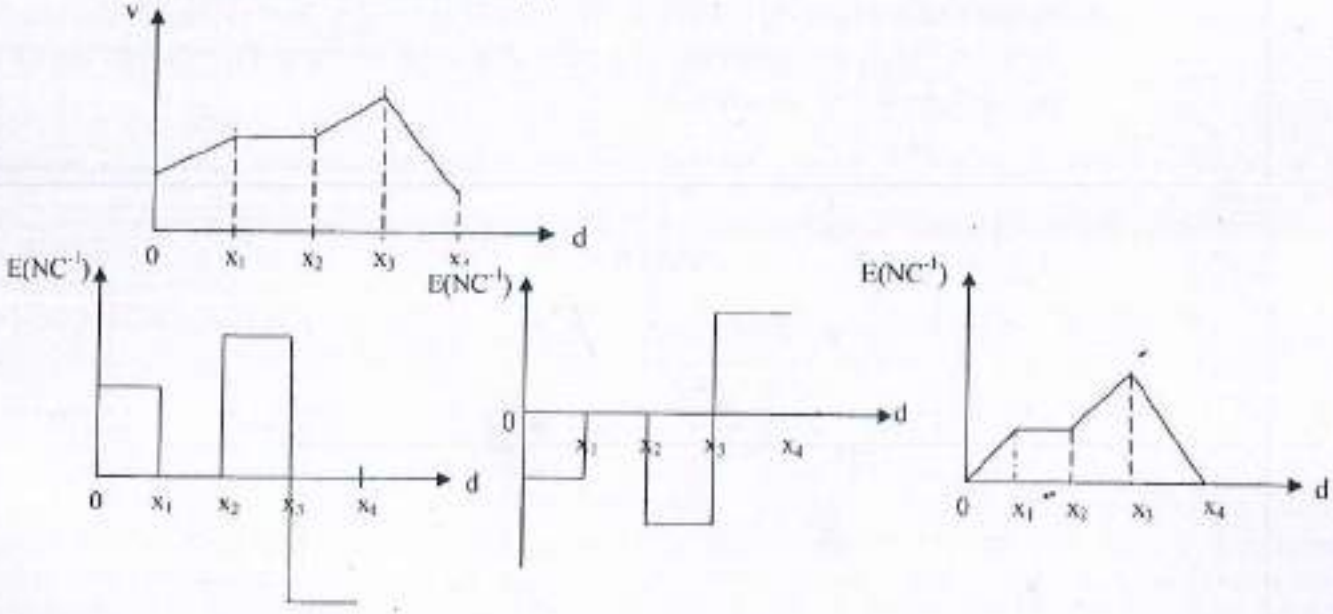
28. Water flows steadily at a constant rate through the horizontal tube of flow shown here. Which of the following graphs correctly Depict the variation of kinetic energy along the axis of the tube (k) with time (t).



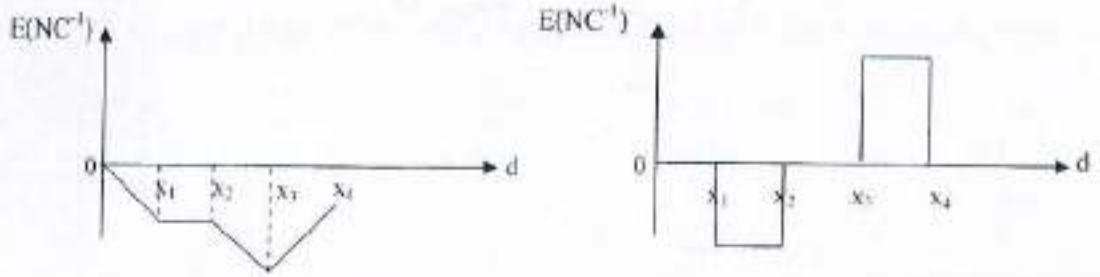


(1) (2) (3) (4) (5)

29. Shown here is the variation of electrostatic potential (v) with distance (d) for a certain electro static field.Which of the following grapgh correctly depict the corresponding variation of electric field intesity (E) with diatance(d) ?



(1) (2) (3)



(4) (5)

30. An object is at 10 cm distance from a coaxial combination of A and B lenses,which are in contact with each other .The lens combination produces a real image of magnification x3.Lens B is a concave lens of focal length 30 cm .What is the type and focal length of lens A ?

(1) Convex ,12 cm
(2) Concave ,12 cm
(3) Convex , 6 cm
(4) Convex ,18 cm
(5) Convex ,7.5 cm

31. A closed tube resonates at its' first overtone with a certain vibrating source. When the tube's closed end is opened , it resonates at second overtone , which is 500 Hz more than the fundamental frequency of the closed tube (f_0) Ignore the end corrections.f_0 is equal to ,

(1) 600 Hz (2) 500 Hz (3) 400 Hz (4) 200 Hz (5) 100 Hz

32. What is the absolute humidity of a closed volume of relative humidity 50% and temperature 27^0C ? Molar mass of water 18g , R= 8 $Jmol^{-1}K^{-1}$ SVP of water at 27^0 C 3.6 kPa.

(1) 8.6 gm^{-3} (2) 13.5 gm^{-3} (3) 26 gm^{-3} (4) 33 gm^{-3} (5) 47 gm^{-3}

33. There is a radial magnetic field in a galvanometer .Its' coil inside shows 20^0 deflection when 5A current flows through the galvanometer .What current should be sent through the galvanometer in order to make 40^0 angle between the coil and the field ?

(1) 2.5 A (2) $5\sqrt{2}$A (3) 7.5 A (4) 10 A (5) $10\sqrt{2}$A

34. The uniform potentiometer wire is of resistance 10 Ω .The cell connected is of 2V e.m.f and 1Ω internal resistance. A resistor R should be connected in the circuit in order to maintain 100 mV potential difference across the wire R is equal to ,

1990 Ω (2) 1890 Ω (3) 378 Ω (4) 199 Ω (5) 189 Ω

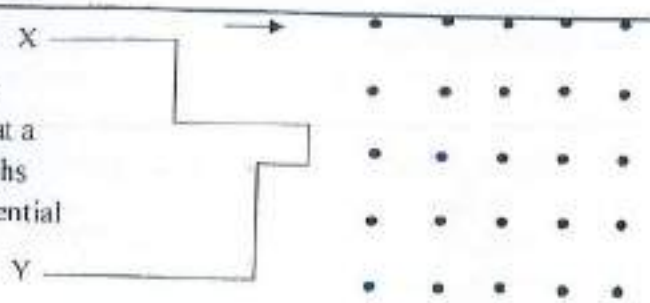
35. Na metal of work function 2.28 eV is illuminated with monochromatic light.All the photo electrons thus ejected can be stopped by applying a – 1.51 eV potential.The energy of one such photon is equal to ,

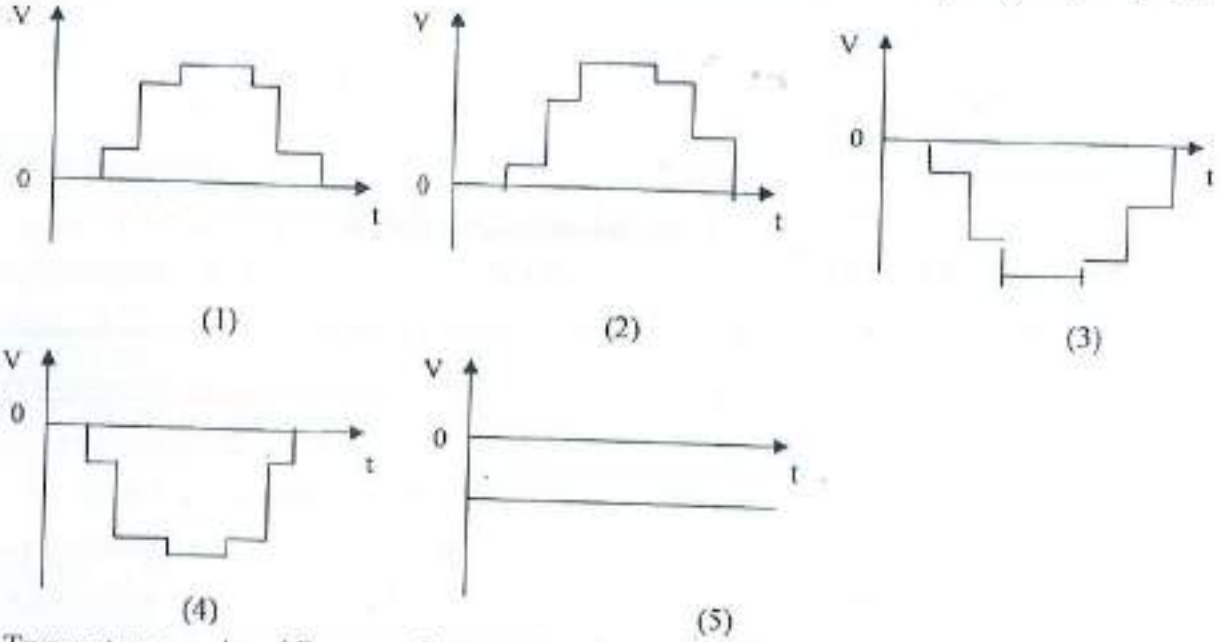
(1) 0.77 eV (2) 1.51 eV (3) 1.77 eV (4) 2.28 eV (5) 3.79 eV

36. A crater of fruits of total mass 35 kg and of specific heat capacity 3600 $Jkg^{-1}K^{-1}$ is sliding down a rough inclined plane of length 7.6 m starting from rest.The crater starts from the top of the plane and acquires 2ms^{-1} speed as it reaches the foot of the plane.The plane is 30^0 inclined to the horizontal.What is the change in temperature of the crate of fruits as it reaches the foot of the plane from top ?

(1) 0.01^0C (2) $38/3600^0$C (3) $1/1800^0$C (4) 0.1^0C (5) 1.0^0C

37. A uniform metal wire shaped as shown here Enters and leaves a uniform magnetic field at a Constant speed. Which of the following graphs correctly depict the variation of induced potential of X with respect to Y(V) with time (t) ?

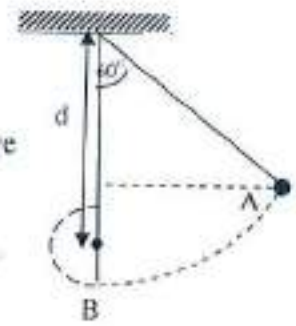




38. Two motor cars A and B approaches a stationary source of sound C which emits a frequency of 165 Hz. A moves at 22 ms^{-1} speed tooting its' hone at 176 Hz. The driver of B doesn't hear beats. The speed of the car B is ,(speed of sound in air = 330 ms^{-1})

(1) 33 ms^{-1} (2) 22 ms^{-1} (3) 0 (4) 11ms^{-1} (5) 44 ms^{-1}

39. A nail is hinged at 'd' distance right below the point of suspension of a simple pendulum. The pendulum of length 1m is being released at 60^0inclination. Which of the following condition/s is/are to be satisfied for the pendulum bob just to move in a circular path around the nail ?



(a) Speed at B$\sqrt{2g(1-\cos 60^0)}$

(b) Speed at B$\sqrt{5(1-d)g}$

(c) d =0.8 m

(1)a only (2) a and b only (3) b and c only (4) c only (5) b only

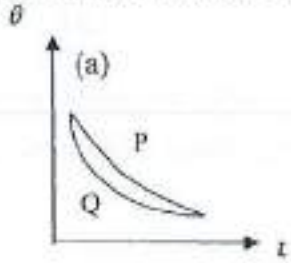
40. A rod made of a metal of Young's modules 2×10^{10} Nm^{-2} under goes 0.06% strain. The strain energy stored in it's unit volume in Jm^{-3} is.

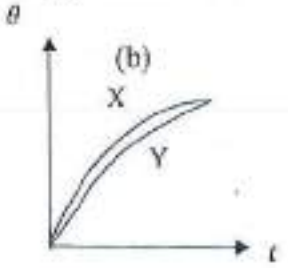
(1) 3600 Jm^{-3} (2) 7200Jm^{-3} (3) 10800Jm^{-3} (4) 14400Jm^{-3} (5) 17600Jm^{-3}

41. The separation between the objective and eye piece of an astronomical telescope at its' normal adjustment is 100 cm , when the magnifying power is 24.The focal lengths of the objective and eye piece of this telescope respectively are ,

(1)90 cm , 60 cm (2) 96 cm , 4 cm (3) 50 cm , 50 cm
(4) 80 cm , 20 cm (5) 4 cm , 96 cm

42. A and B are two identical calorimeters. External surface of A has been well polished where as that of B is made matt black.Equal volumes of hot water at 80^0 C poured to both calorimeters A and B are noted down every 0.5 s interval.Graphs obtained thus are shown in (a) .Then the two calorimeters are emptied and equal volumes of water at 0^0 C poured to both ,and their temperature change with time is plotted as shown in (b).Which of the following is correct ?



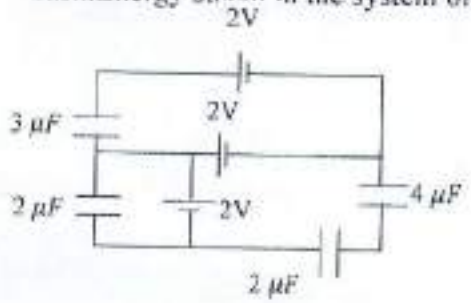


(1) Graphs P and X corresponds to B
(2) Graphs P and Y corresponds to A
(3) Graphs Q and X corresponds to B
(4) Graphs P and X corresponds to A
(5) Graphs Q and Y corresponds to B

43. An object of volume V and density ρ is completely immersed and remains still in a liquid of density ρ' .What is the change in the object's potential energy when it is raised 'h' height with in the liquid?

(1) Increases by $hV(\rho - \rho')g$
(2) Increases by $hV(\rho' - \rho)g$
(3) Increases by $hV\rho g/\rho'$
(4) decreases by $hV\rho g/\rho'$
(5) Doesn't change.

44. Shown here is a system of four capacitors connected to 3 cells of zero internal resistence each.Energy stored in the system of capacitors is .



(1) 4 μJ (2) 24 μJ (3) 28 μJ (4) 32/3 μJ (5) 0 J

45. An ideal transformer consists of 1000 windings (turns) in its' primary coil and 3000 in its' secondary coil. Primary coil is connected to 80 V ac potential supply. What is the potential difference across one turn of the secondary coil ?

(1) 240 V (2) 80 V (3) 0.24 V (4) 0.08 V (5) 0.06 V

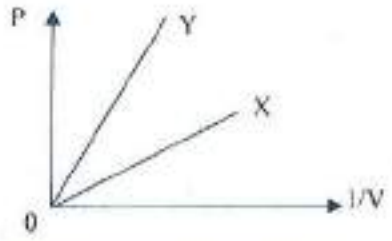
46. Wave length corresponding to maximum intensity of thermal radiation from the sun is λ_1 and that from the moon is λ_2.The ratio (solar surface temperature /lunar surface temperature) is equal to ,

(1) $\frac{\lambda_1}{\lambda_2}$ (2) $\frac{\lambda_2}{\lambda_1}$ (3) $\left(\frac{\lambda_1}{\lambda_2}\right)^2$ (4) $\left(\frac{\lambda_2}{\lambda_1}\right)^2$ (5) $\sqrt{\frac{\lambda_2}{\lambda_1}}$

47. Original length of an extensible string is L and its' force constant k.It is extended to a small length x and is further extended by another small length y. The work done during the second extension is equal to ,

(1) $\frac{1}{2}ky^2$ (2) $\frac{1}{2}k(x^2+y^2)$ (3) $\frac{1}{2}k(x+y)^2$ (4) $\frac{1}{2}ky(2x+y)$ (5) $\frac{1}{2}k(2x+y)$

48. X and Y are two ideal gases which obey Boyle's law as depicted in the graph here. Which of the following statement/s is/are true about X and Y ? (molar mass of Y > molar mass of X)



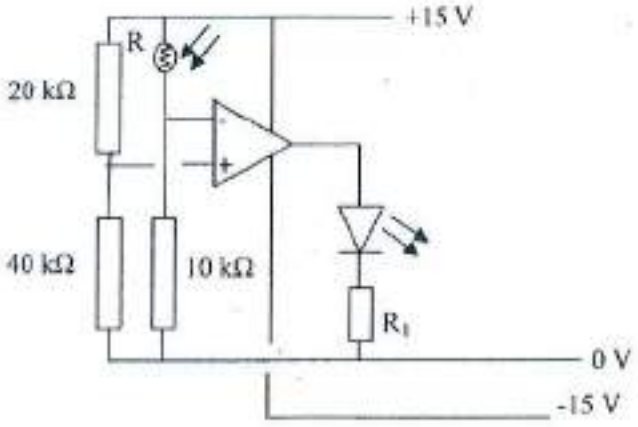
(a) If both gases remain at the same temperature . no of Y gas molecules is greater than the no of X gas molecules.

(b) If the masses and absolute temperature of both X and Y are equal , the graph X and Y too are similar ,

(c) If the masses of both X and Y are equal , Y always remain at a higher temperature to that of X.

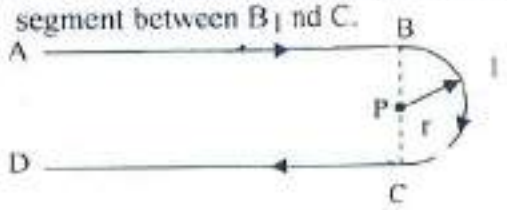
(1) a only (2) b only (3) c only (4) a and c only (5) b and c only

49. The light emitting diode connected in the Op –amp circuit shown hera, glows in the dark.R is a light sensitive resistor of resistance?

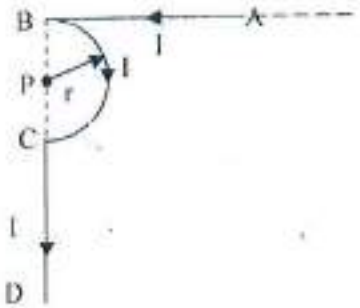


	(1)	(2)	(3)	(4)	(5)
In the dark(KΩ)	50	40	15	2.5	1
In the daylight (KΩ)	15	20	25	30	35

50. I current flows through a very long conductor A ,B ,C ,D which consists of a semi circular segment between B and C.



Now the shape of the conductor is altered as shown below. What is the corresponding change in magnetic flux density at point P ?



(1) Zero (2) $\frac{\mu_0 I}{4\pi R}$ (3) $\frac{\mu_0 I}{2\pi R}$ (4) $\frac{2\mu_0 I}{3\pi R}$ (5) $\frac{3\mu_0 I}{4\pi R}$

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භෞතික විද්‍යාව II Physics II	01 E II	පැය තුනයි *Three hours*

Name /Class .....

Instructions: * This question paper consists of 10 questions in 17 pages

• This question paper comprises part A and part B. The time allocated for **both parts** is **three hours**

PART A -Structured Essay(pages 2 -8)

* *Answer all four questions on this paper itself*
* *Write your answer in the space provided for each question.Note that the space provided is sufficient for your answer and extensive answers are not expected.*

PART B– Essay (Page 9 - 17)

**Answer four questions only. Use paper supplied for this purpose .*

**At the end of the time allocatedFor this paper, tie the two together so that part A is on the top of part B before handing over the supervisor.*

**Your are permitted to remove only part B of the question paper from the examination hall.*

For Examiner's Use Only

Part	Q. No	Marks
A	1	
	2	
	3	
	4	
B	5	
	6	
	7	
	8	
	9A	
	9B	
	10A	
	10B	
Total		

Final Marks

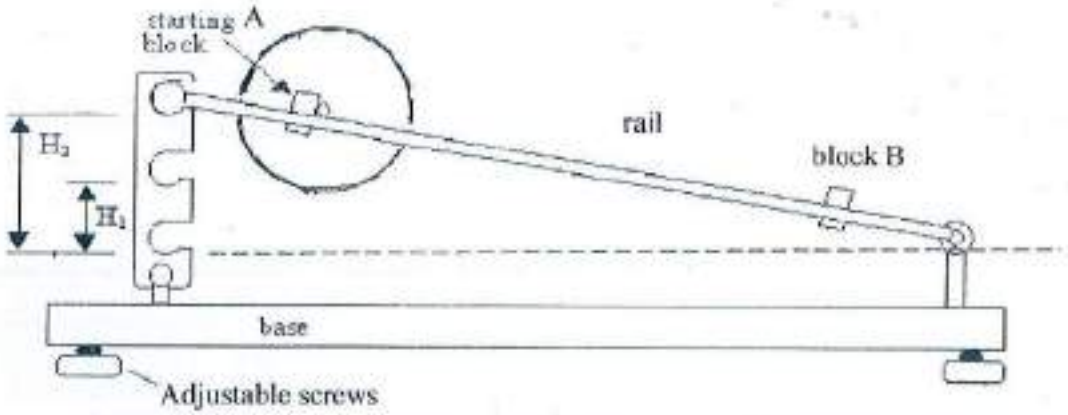
In numbers	
In words	

Code Numbers

Examiner	
Checked by	1.
	2.
Supervised by	

Part A- Structured Essay

1. Figure shows an arrangement used by a student to determine the moment of inertia (I) of a plate having an axle.



A stop watch, a meter rular and a spirit level are also provided. By keeping the free end of the rail at the top most position the plate is released from rest. The axle is rolling down without slipping. Initial and final positions of the axle are marked by keeping wedges *A* and B. Length of the rail is D.

I. Before the practical is carried out the base should be leveled. Briefly explain the levelling procedure.

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II. When the lowest position and the pivoted point are at the same height above the base how do you verify that the base has been levelled.

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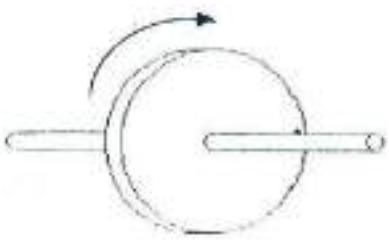
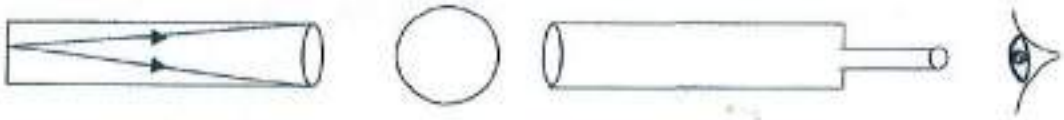
III. Indicate the direction of angular velocity (ω) when the axle is rotating in the direction as shown in the diagram.



IV. A light beam enters through the slit of Q after adjusting P and Q. Complete the path of light beam entering through the slit of Q up to the eye in the diagram given below.



V. The image of the slit can be seen as shown in the figure when adjusting the instrument in part (IV). Draw the orientation of the slit on the given space.

VI. A student is going to use the properly adjusted instrument to determine the angle of minimum deviation. What are the practical steps that she should follow?

(a).....

.....

(b).....

.....

(c).....

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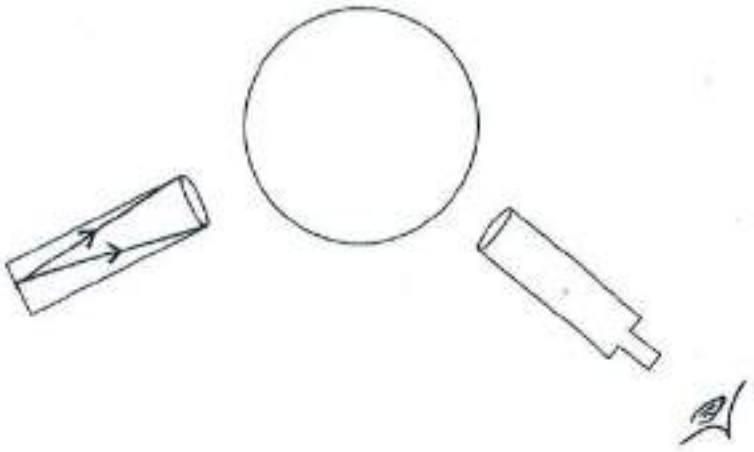
(d).....

.....

VII. Figure shows an arrangement of the spectrometer set to determine the angle of minimum deviation. Draw the position of prism and complete the path of two light rays entering through the slit of Q up to the eye on the diagram given below.



VIII. The corresponding readings taken by using one of the Vernier scales of the spectrometer at the minimum deviation are 005° 38' and 326° 12'. Find the angle of minimum deviation.

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IX. Can you use a filament bulb as the light source for this experiment? Explain.

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X. Another student is asked to use this properly adjusted spectrometer. What is the only adjustment that she needs to do in order to observe a clear image?

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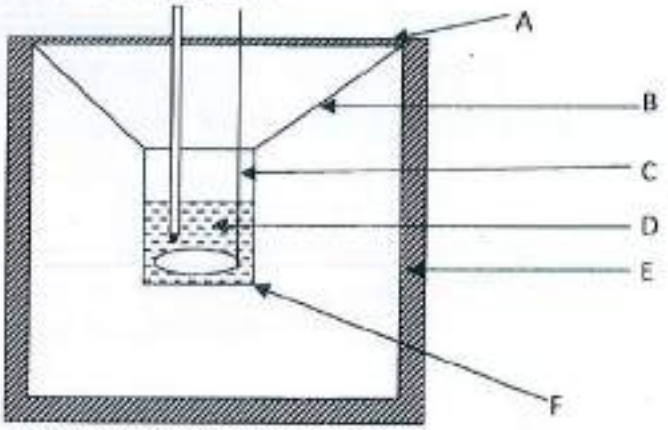
03. The figure shows a setup to determine the specific heat capacity of a liquid using Newton's cooling law.



I. Name A, B, C, D, E and F.

A – ..... B – .....

C – ..... D – .....

E – ..... F – .....

II. Write down three factors affecting the rate of loss of heat from the liquid and the calorimeter.

(1) .....

(2) .....

(3) .....

III. What are the required measuring instruments which are not shown in the diagram.

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IV. What are the physical quantities to be measured by using the given instruments in order to determine the velocity (V) of the plate at B.

(i) .....(α)

(ii) .....(β)

V. Write an expression for the velocity (V) of centre of gravity of the plate in terms of α and β.

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VI. It needs to find the vertical height (h) between A and B. Write an expression for **h** in terms of **H**, α and **D**.

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VII. Derive the expression $I = MR^2(\frac{2gh}{v^2} - 1)$, Where **M** is the mass of the plate with the axle and **R** is the radius of the plate.

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VIII. If the practical is carried out by taking the rail up to the mid position Without changing the separation between A and B what are the physical quantities in the expression mentioned in (VII) which can be changed? State whether those increase or decrease .

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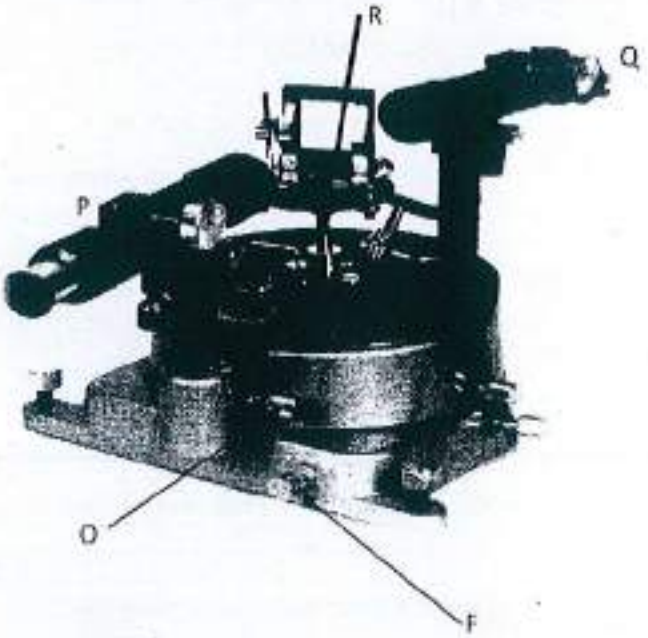
02. Figure shows the diagram of a spectrometer.



I. Name P, Q and R.

P.....

Q - .....

R - .....

II. Write down the functions of screws O and F.

O.....

.....

F.....

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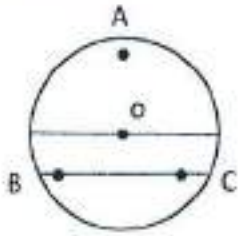
III. Instrument needs to be adjusted before carrying out the practical. Part **R** should be adjusted after adjusting **P** and **Q**. Then mark the correct position of the prism on **R** in the diagram given below.



IV. The vessel F shown in the figure cannot be replaced by a glass vessel. Give a reason.

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V. Two cooling curves for water and liquid are plotted separately in this experiment. What is the relationship between the volume of water and volume of liquid? Give a reason for that.

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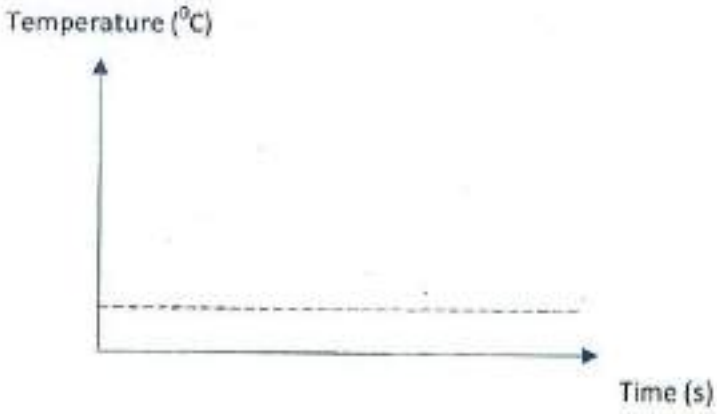
VI. If the specific heat capacity of the liquid is less than that of water sketch two corresponding cooling curves in the space given below and label them.



VII. It needs to extract data from two curves to determine the specific heat capacity of the liquid. indicate the necessary constructions on the above two curves in part (VI).

VIII. Calculate the specific heat capacity of the liquid.

Heat capacity of the vessel F is 50'4 Jk^{-1}

Specific heat capacity of water is 4200 $Jkg^{-1}K^{-1}$

Volume of water and the volume of liquid is 100 cm^3

Time taken to decrease the temperature of the water from 80^0C to 45^0C is 16 minutes and that of liquid is 5 minutes

Density of the liquid is 800 kg m^{-3}.

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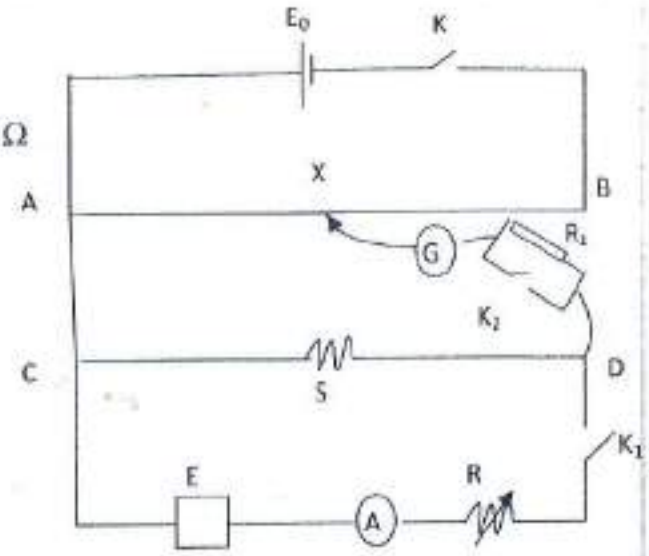
04. The diagram shows the arrangement that a student used to calibrate an Ammeter (A) by using a potentiometer wire of length 100 cm.

E_0 – 2V, r = 0Standard cell
S – Resistor with a constant resistance of 1Ω
R – Rheostat
G– Centre zero galvanometer
K_1, K_2, K – Plug keys
R_1 – Resistor with high resistance
AB –Potentiometer wire



I. Draw the cell (E) in the given box and mark the positive and negative terminals correctly. Assume that the internal resistance of the cell is negligible.

II. What are the plug keys that can be placed first to start the practical?

.....

III. What is the most suitable way to switched on K_2?

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IV. Write down the function of R_1.

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V. The balanced length (AX) of the potentiometer wire is 40 cm, when the reading on the ammeter (A) is set to 0.85 A by changing the value of R.

a. Find the current through CD which is calculated by using the potentiometer.

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b. What is the correction of the ammeter regarding the above current?

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VI. Write down two uses of R.

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VII. If the value of E is equal to 6 V and the internal resistance is negligible, what is the value of R to obtain the current as in part (V)?

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VIII. What is the range of current expected when you change the balanced length from 25 cm to 80 cm.

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Physics II

01 | E | II

Part B- Essay

5. Figure shows a horizontal sketch of turbulent flow of an air in a tornado action.

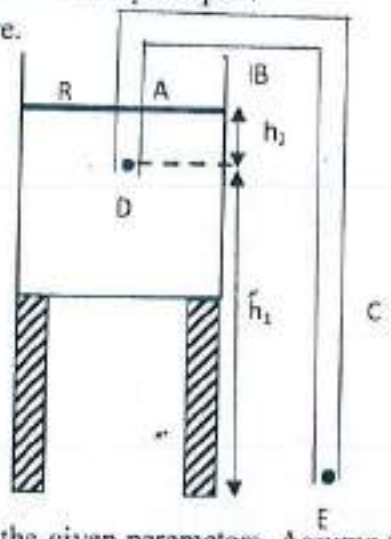
I. This flow of an air propagates forward with a velocity u. The tangential velocity of a particle at 'a' distance from the centre is v. Write an expression for the kinetic energy per unit volume of a fluid flow at distance 'a' from the air flow. (Density of air is ρ)

II. Define the stream line flow/laminar flow.

III. State Bernoulli's equation by introducing the terms.

IV. What is the necessity of the flow to be streamline to apply the Bernoulli's principle ?

V. A syphon used to remove water in fish tank is shown in the figure. The tube ABC having uniform cross-sectional area and totally filled with water is inserted into the fish tank. Then water in the fish tank can be removed. (Assume that water behaves according to Bernoulli's principle)



(a) What is the speed of water inlet at D if the speed of water outlet at E is v?

(b) If the cross-sectional area of fish tank is 100 times as the cross sectional area of tube ABC, find the velocity (V_R) of water at R.

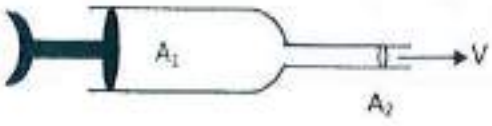
(c) Derive an expression for velocity (v) at E in terms of the given parameters. Assume that the streamline starts at R and ends at E and $v_R << v$.

(d) Calculate 'v' in part (c) where $h_1 = 70$ cm and $h_2 = 10$ cm.

(e) What is the rate of decrease of water level in fish tank when it removes dirty water by syphon. Length and width of the fish tank are 120 cm and 40 cm respectively.

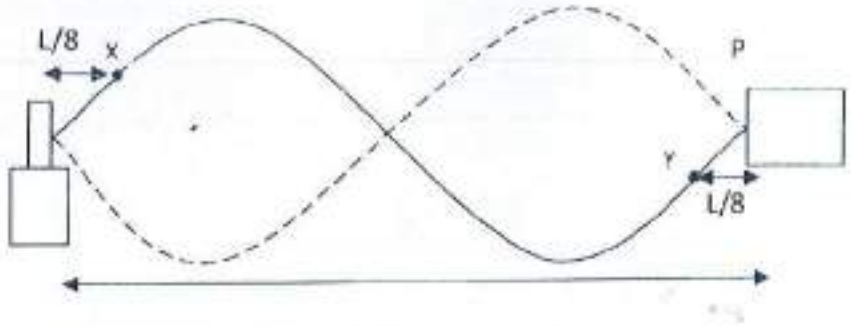
(f) The rate of decrease of water level in the tank needs to be dropped to 1/3 of the rate mention in (e). Find the rate at which water is added to the tank by a tap fixed above the tank.

VI. Figure below shows a syringe having a piston which is able to move with horizontal uniform velocity without any frictional force.



A horizontal force of 4 N is applied on the piston where $A_1 = 25$ mm^2, $A_2 = 0.1$ mm^2 and the density of water = 1000 kgm^{-3}. Find the velocity of water at the open end.

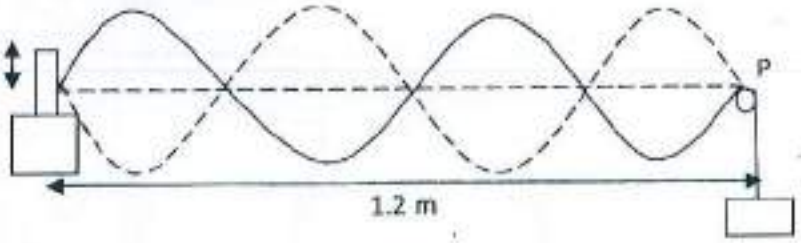
6. I. One end of a string is fixed at P and the other end is connected to a vibrator of variable frequency as shown in the diagram. The distance between the point P and the vibrator is L. The frequency is adjusted to form a stationary wave as shown in the diagram.



Two points X and Y on the string are at 48 cm from the vibrator and the fixed point P respectively. Frequency and the amplitude of X are f and A respectively.

(a) . What is the frequency and the amplitude of Y ?
(b) . What is the phase difference between X and Y?
(c) . Write down an expression for the speed of the wave in terms of f and L.
(d) . What does the speed of a stationary wave really mean?

II. The string shown in the above diagram is sent over a pulley fixed at P and the free end is connected to a mass M as shown below. When the frequency of the variable source is changed to 120 Hz well define wave pattern is formed as shown in the diagram. The distance between the vibrator and the pulley is 1.2 m and the linear density of the string is 1.6 gm^{-1}.



(a) . Write down an expression for the frequency of the wave set up in the string and define the terms.
(b) . Calculate the value of M.
(c) . Keeping the frequency at 120 Hz , M value is changed to 1kg which harmonic is set up in the wire? Explain with necessary calculation($\sqrt{10} = 3.2$)

III. Steel rod of length 1m clamped at the middle is rubbed to form longitudinal wave. Frequency of the 1^{st} overtone is 7500Hz.

(i) Draw the wave pattern for the 1^{st} overtone.

(ii) Write an expression for the frequency of the 1^{st} overtone.

(iii) Find the young's modulus of the steel (ρ = 8000 Kgm^{-3})

7. I. Two metal sphere of radius 5cm each charged to $+1\mu C$ and $+0.25\mu C$ are placed in air.The distance between their centers is x.

(a) Write an expression for the repulsive force between them.

(b) If x= 1m, calculate the magnitude of the repulsive force

$(\frac{1}{4\pi\epsilon} = 9 \times 10^9\ Nm^2c^{-2})$

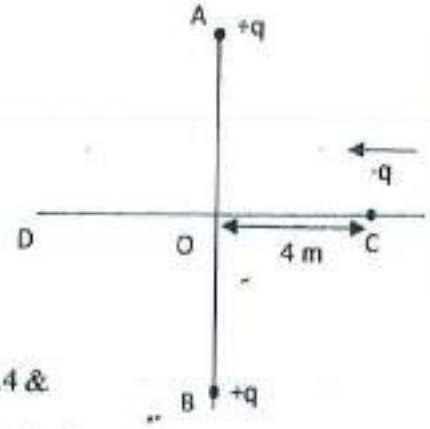
(c) Above equation cannot be applied if x= 12 cm .What is the reason for this.

II. Two spheres are fixed to the ends of an insulating rod and a pebble of charge q is sent through the rod so that it can more along the rod freely shown in the figure.

(a) . The length of the rod is 12cm .Find the distance to the equilibrium position of the pebble from A.

(b) . Is the pebble in stable equilibrium position at this moment? Explain

VI. Two equal charges +q each having $5x10^{-5}$ C are fixed at A and B with separation 6cm as shown in the diagram. A charge –q moves along the line COD due to the effect of charges at A and B.COD is the perpendicular bisector of AB. When the charge is at C ,4m from O its kinetic energy is 4J .



(a) Find the total energy of –q at C.$(\frac{1}{4\pi\epsilon} = 9 \times 10^9\ Nm^2c^{-2})$

(b) Find the distance to the turning point of –q from O($\sqrt{2} = 1.4$ &

(c) . Can the –q pass the point C in its return path. Explain qualitatively.

(d) . Describe the subsequent motion of –q after that.

8. I. Define the surface tension and contact angle

II. Give a molecular explanation for the surface tension effect

III. A liquid drops are formed slowly at the tip of a thin wall glass capillary tube held vertically and leaks out of it as shown in the diagram. Radius of the tip is r and the surface tension is σ.

(a) Write an expression for the maximum weight of the drop W that the tube can hold

(b) Number of drops fell from the tube is counted and its mass is measured. It is found that a certain percentage of the maximum weight of the drop is left on the tip. The weight of the falling drop is W'. The f is defined as the ratio W'/ W and it depends on the factor $\frac{r}{V^{\frac{1}{3}}}$; where r is the radius of the tip and the v is the volume of a falling drop. If this factor is known the corresponding f can be found from the table given.

$r/v^{1/3}$	f
0.00	(1.000)
0.30	0.7256
0.35	0.7011
0.40	0.6828
0.45	0.6669
0.50	0.6515
0.55	0.6362
0.60	0.6250
0.65	0.6171

For certain experiment radius of the tip is measured to be 0.5 mm and the volume of 100 drops is measured to be 100 mm^3. The density of the liquid is 800 kg m^{-3}.

(1) Find the corresponding f value

(2) Find the surface tension of the liquid

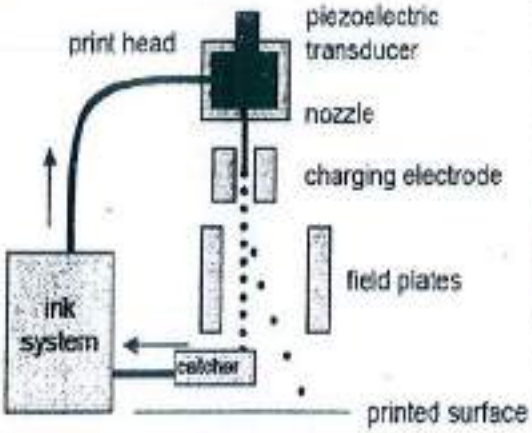
(c) Considering the thickness of the wall, draw the shape of the liquid meniscus at the tip of the tube if

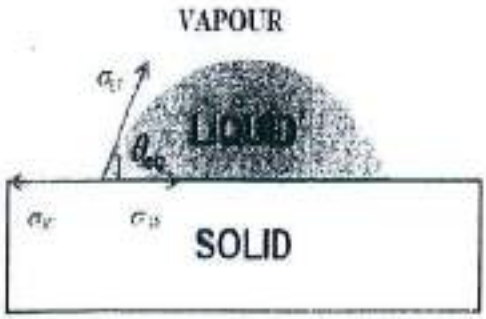
(1) the liquid wets glass

(2) the liquid does not wet the glass

IV. A substantial number of experimental, numerical and theoretical studies have been conducted to identify the important parameters influencing the wetting process and the final outcome of drop impact, for practical applications such as coating, painting and ink jet printing. In the inkjet printing process, a stream of drops is formed from a continuously flowing jet of ink that is driven from a nozzle. Then they impact with a paper, spread and wet the paper in a short time. The extent to which a drop wets the surface is described by its equilibrium contact angle. The liquid drop takes the shape which minimizes the free energyof the system that is, minimizing the surface area of the drop. For a plane, homogeneous surface, the minimization yields,

$\cos\theta = \frac{\sigma_{sv} - \sigma_{sl}}{\sigma_{lv}}$;





σ_{sv}-Surface tension for solid vapour(40 Nm^{-1})

σ_{sl}-Surface tension for solid liquid (25 Nm^{-1})

σ_{lv}-Surface tension for liquidvapour(35 Nm^{-1})

(a) Find the equilibrium contact angle of the drop

(b) Draw the shape of the drop if the contact angle $\theta \approx 0°$(complete wetting), $\theta \approx 90°$(partially wetting)and $\theta \approx 180°$(non-wetting)

(c) In the wetting stage the contact diameter D increases slowly with time t given by the equation

$$D = k\, t^{n}$$

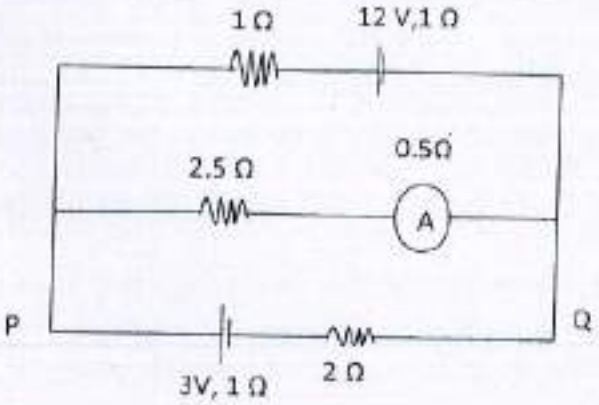
Where, the coefficient k depends on the surface tension and the viscosity. For the ink its value is 0.001 and the value of n is 0.2.Equillibrium contact diameter of the drop is 100 μm.

(1) What are the factors which determines equilibrium time and the equilibrium contact diameter

(2) Find the time to come to equilibrium after hitting the paper

9. **Answer only part (A) or (B)**

(A). The diagram shows a properly connected electrical circuit.



I. What is the reading of the ameter?

II. Find the power generation of the 2.5 Ω resistor.

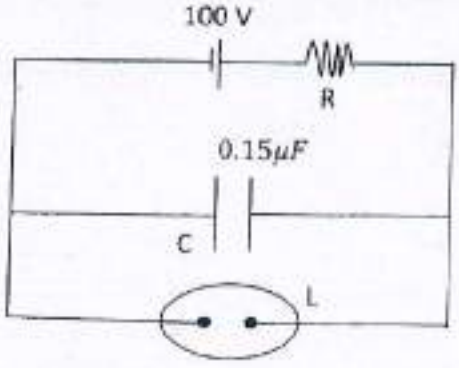
III. Find the terminal potential of each cell.

IV. What is potential at P if Q is grounded?

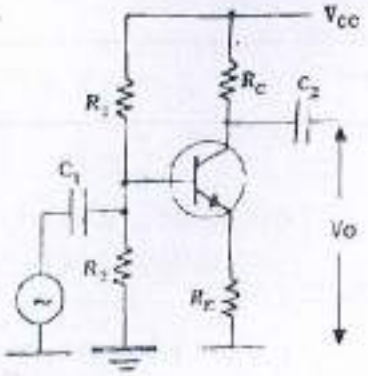
V. If a capacitor of capacitance 10 μF is connected across P and Q, Find its minimum charge.

VI. If the 12 V cell is disconnected ,find the minimum charge of the capacitor.

VII. The diagram shows a flash light used in construction site at night. The light a capacitor and a cell of negligible internal resistance are connected as shown in the circuit .The current flows through the light when the voltage across it excess the break down voltage V_L .Then the capacitor is completely discharged. Find the maximum charge of the capacitor.



B . I. Shown here is n-p-n silicon transistor used as an amplifier in its common emitter configuration.(potential barrier for p-n junction of Si is 0.7 V)



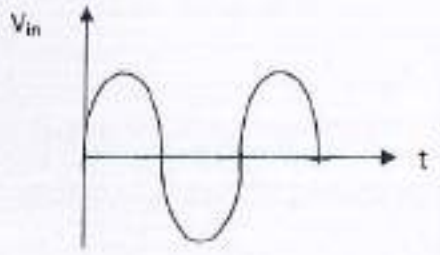
(a) (1) Sketch the input – output characteristic curve for this transistor and mark the corresponding states . in your graph.

(2) At which state of the transistor would you obtain a signal amplification without any distortion ? Explain.

(3) How would you obtain this condition practically?

(b) What are the functions of the condensers C_1 and C_2 connected in the circuit?

(c) AC voltage signal shown here is input to the above transistor. Sketch the corresponding variations of



(1) Output voltage (V_0) with time (t)
(2) Collector current (I_c) with time (t) in two separate coordinate planes.

(d) Following values correspond to the transistor amplifier circuit shown above.

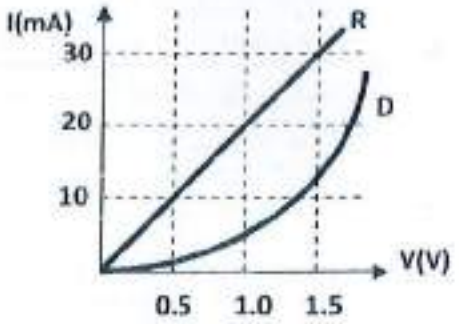
V_{cc}= 10 V , R_1 = 8 kΩ , R_2 = 2 kΩ, R_c= 4 kΩ ,R_E = 1 kΩ ,

Root mean square value of the input voltage is 0.5 mV

Dc current gain of the transistor is 150 and AC voltage gain of the transistor is 100. Calculate the following regarding the above circuit.

(1) Base potential
(2) Emitter potential
(3) Emitter current
(4) Collector potential
(5) Potential drop across collector and emitter
(6) Peak value of the output voltage

II. Shown here is the I-V (current –voltage) characteristic of an ohmic conductor (R) and Germanium diode(D).



(a) If R and D are connected in series and sent 10 mA current through the circuit what is the corresponding terminal potential difference?

(b) Now R and D are connected in series across a cell of e.m.f 2.25V and zero internal resistance. What current (approximately) will flow through the cell ?

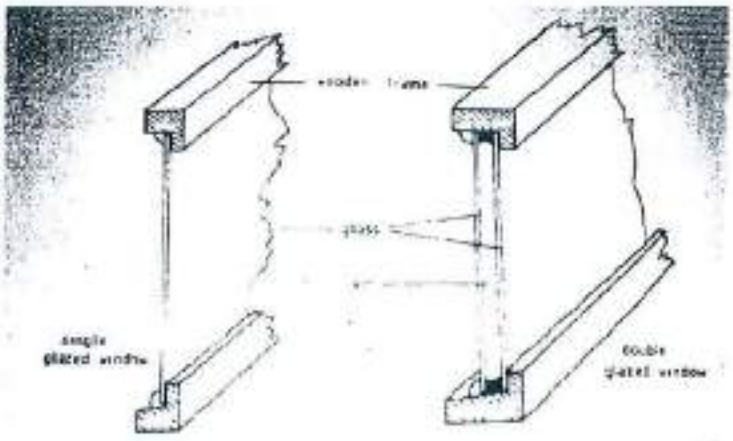
(c) If the reverse voltage of a diode is gradually increased , there is a significant observation at a certain voltage. What is it?

(d) State the type of diode which functions , based on the phenomenon you mentioned in (iii) above. State one application of this type of diodes.

10 . Answer only part (A) or (B)

A. I. Write down 3 methods of transferring heat from high temperature to low temperature

II. Diagram shows two ways to make a window of a house



One is a single glass window and the other is a double glass window with air in between two glasses.

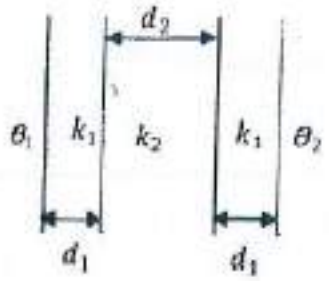
(a) Through which window is the rate of heat transfer maximum? Explain.

III. Effective area of the window X is 1 m^2 and its thickness is 8 mm. The temperature differences across the window is 4 K. The thermal conductivity of glass is 0.8 $Wm^{-1}k^{-1}$ Calculate the rate of heat flow through the window.

IV. (a) Consider the searls experiment to find the thermal conductivity of a metal bar in a school lab. In that experiment two thermometers are placed in two small holes made on the bar with some separation .Holes are filled with mercury .What is the purpose of having mercury in holes @

(b) Water is circulated through copper tubes rapped round the bar at one end. The rate of flow of water through the tube is 1.5 gs^{-1} and the temperature of the water rises from 30^0 to 45^0. Specific heat capacity of water is 4200 $Jkg^{-1}K^{-1}$ .Calculate the rate of flow of heat through the bar.

V. (a) The diagram shows a wall having three layers .The thicknesses of layers and their thermal conductivities are shown in the diagram.



The temperature at the two sides are θ_1 and θ_2 Obtain an expression for the rate of heat flow through the wall in term of θ_1" θ_2" k_1" k_2"d_1" d_2.

(b) A room is made of bricks .Inner and outer sides are plastered by cement mixture. The roof and the door are made of wood and the window is made of glass. The thickness of the plaster on each side is 4 cm and the thickness of the brick is 10 cm. The effective area of the walls is 9 m^2 .The inside temperature is maintained at 20^0 C by using an air conditioner and outside temperature at 35^0 C .Calculate the rate of heat flow through the walls. Thermal conductivities of the cement mixture and the bricks are 0.4 $Wm^{-1}k^{-1}$ and 0.5 $Wm^{-1}k^{-1}$.

(c) Sketch the temperature variation across the wall with the distance.

VI. Cross section of a solar panel and its essential parts is shows in the diagram.

Water is circulated through tube by using an electric motor. Write down the reason for following questions.

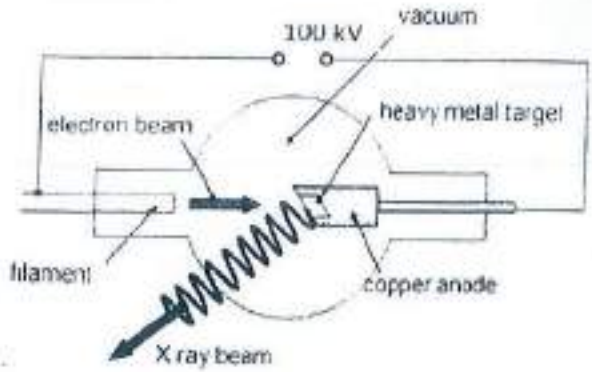
(a) the bottom is plate blacken
(b) the use of mineral fiber
(c) the energy taken by the panel increased by the glass plate

B. I. X-rays production tube is shown in the diagram

(a) Explain how the x rays are produced from this set up

(b) Why is the chamber evacuated?

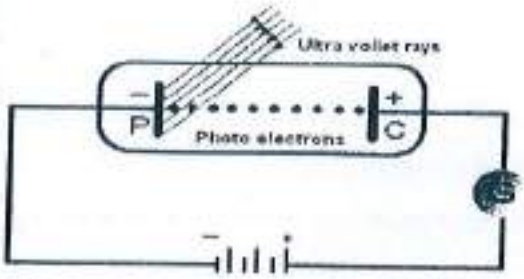
(c) Only 1% of the kinetic energy of the electron hitting the target metal is converted to the X-rays. Calculate the wave length of the X-rays emitted
Charge of an electron is 1.6×10^{-19}C
Plank constant (h) is 6.63×10^{-34}Js



II. These emitted x-rays are used in a photocell to study the photoelectric effect

(a) When the cathode is exposed is to x-rays, the ammeter shows a reading. Explain how this can happen

(b) Work function of the potassium cathode used is 4 eV. Find the kinetic energy of the most energetic electrons emitted from the cathode

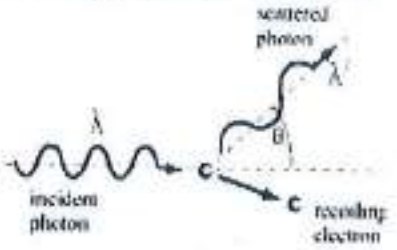


III. Quantum of radiation has a linear momentum given by

$p=\frac{h}{\lambda}$ h- plank constant

λ-wave length of the radiation

Thus when a photon interacts with matter, energy and momentum are transferred as if there were a collision between the photon and matter.

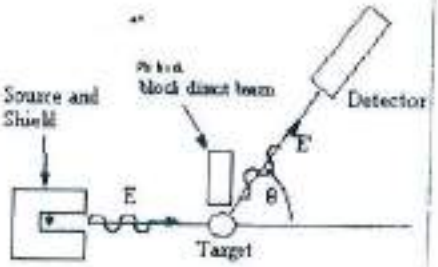


(a) Supposea single photon is associated with interaction of x-ray beam and a stationary electron. In general, the direction of travel of the x-ray will change (scattering), and the electron will recoil, which means that the electron has obtained some kinetic energy and the momentum. Wave length of the incident photon and a scattered photon are 0.2 nm and 0.21 nm. The direction of the scattered X-ray (θ) is 45°.

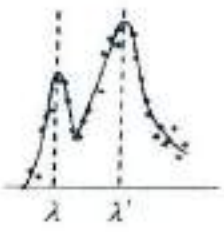
(1) Find the kinetic energy gained by the electron in eV

(2) Find the direction of momentum of the recoil electron with the horizontal

(b) X-ray beam is directed to into target made of carbon as shown in the figure. Some photons interact with loosely bounded electrons in the target and some with electrons tightly bound to the nucleus (literally entire carbon atom).



X-rays interacts with entire atom transfer negligible energy and momentum. The intensity of the scattered x-ray in a certain direction with the wave length is shown in the graph. Explain the reason for the two peaks



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Final Term Test - 2017 June

Year 13

Question No	Answer
01	3
02	2
03	1
04	4
05	5
06	3
07	4
08	4
09	2
10	3
11	2
12	3
13	2
14	4
15	2
16	2
17	5
18	4
19	5
20	~~2~~ (3) 5
21	~~3~~ all
22	1
23	1
24	~~1~~ 2
25	2 3?

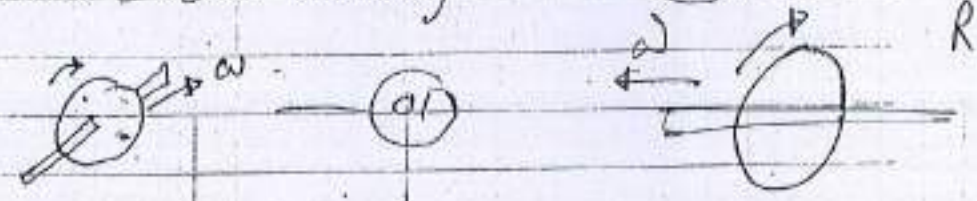
Question No	Answer
26	4
27	4 all
28	2
29	2
30	3
31	5
32	2
33	4
34	5
35	2 English 5 - sinhala
36	1
37	3
38	2
39	3
40	1
41	2
42	1
43	1
44	1
45	4
46	2
47	4
48	~~1~~ 3 4? ✓
49	3 all
50	5

(1) නිවැරදි -

Date No

(a) සෑම මන එකතනක ලෙස දිගා 2 කට වැඩි ලොකුය නාඩා තාදී ඩ්‍රැක්ඩ්‍රිය් සිදුකාරී කාලය තාය තුබුල ඇතුලතය කිරීම (01)

(b) පිල්ල හාලෙ ඒකාකාර තොත දිගය දිගා (ඇදිය යුතුය) ඒය මන තැබුවේ කියාවලිය වෙනී. (මුලතය තොවේ.) — (01)

(c) 

— (01)

Right hand corkscrew rule.

(d) A හා B දිගාව ඉඩ — d
d දුරය යන කාලය — t. } — (01)

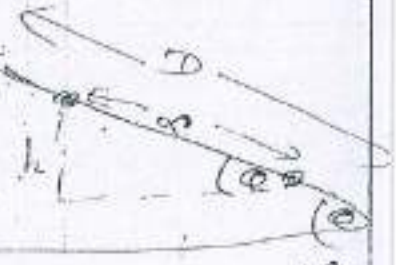
(e) $d = \left(\frac{V+0}{2}\right) t$ — OR $\beta = \left(\frac{V+0}{2}\right) \alpha$ — (01)

$\frac{2d}{t} = V$ OR $\frac{2\beta}{\alpha} = V$

(f) 

$\frac{D}{H_1} = \frac{d}{h} = \sin\theta$

$d h = \frac{d H_1}{D}$ — (01)



$\sin\theta = \frac{h}{\alpha} = \frac{H_1 - H_2}{D}$

From Principle of conservation of mechanical energy

(g) $mgh = \frac{1}{2} I\omega^2 + \frac{1}{2} mv^2$ — (01)

$= \frac{1}{2} I \frac{v^2}{R^2} + \frac{1}{2} mv^2$ — (01)

$I = \frac{mR^2 (gh - \frac{1}{2}v^2)}{\frac{1}{2}v^2}$.

(h) h ඇති V — (01)
h වැඩිවේ
V වැඩිවේ. } — (01)

(2) (i) P - දුරේක්ෂය
Q - ඒකාන්තරකය
R - ත්‍රිස්‍රා මේසය } (1½) —— (01)

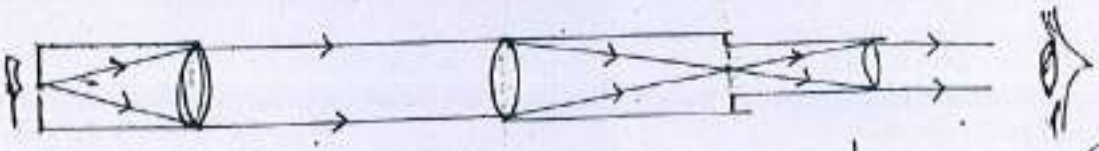
telescope
collimator
prism table.

(ii) O - ඇස ළඟින් සහ දුරේක්ෂය පුරාණය කිරීමට හා අවශ්‍ය තරමට ඇසෙහි ස්ථානය වෙනස් කරයි
F - කඳ සහ ලොක් පුළු ඉතාම සුළු ප්‍රමාණ වලින් දුරේක්ෂය දළයෙන් කිරීමට භාවිතා කරයි. Fine adjustment screw } (1)

(iii).

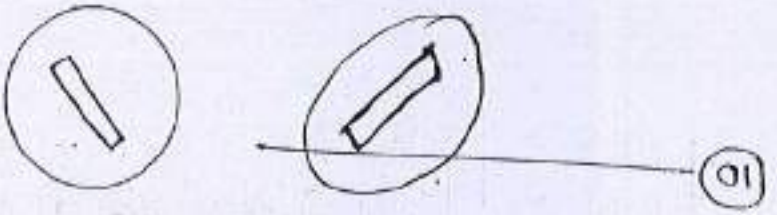
—— (01)

(iv)



(01)

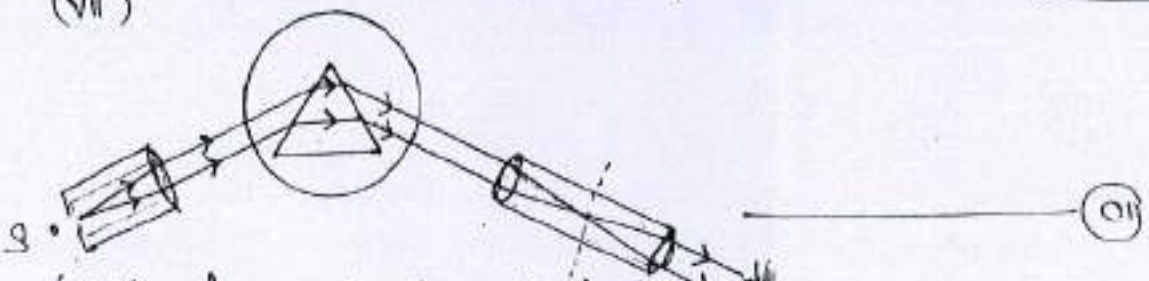
(v)



(01)

(vi) • ඒකාන්තරකයේ නිකල්ලත් ආලෝකය ත්‍රිස්‍රයෙ පාතය තරංගය හා සමාන්තර වීමය එහ ත්‍රිස්‍රයය එහ ත්‍රිස්‍රයය තබන්න.
• ත්‍රිස්‍රය තුළින් වර්ණාවලිය හා දිගු දිගුවර ප්‍රතිබිම්බය ස්ථාවරවන් මනාව පෙනෙනා ඇස ලොක් දුරේක්ෂය සූදානම් කරන්න.
• දැන් ත්‍රිස්‍රය ඉවතට පෙනෙන්න සූදානම් කරන්න දිගු දිගුවර ප්‍රතිබිම්බය දුරේක්ෂය තුළින් නිරීක්ෂණය කරන්න.
• ඉන්ඩ අවශ්‍යතාවයි විවිධතාවය සංගණනය පරාසයේ ප්‍රතිඵලවල දිගහැර ගන්න කරන්න. ඒවා අතර අවශ්‍යතා ඇත්තේ.

(vii) (01)



(01)

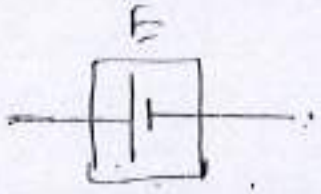
(viii) $\delta_{min} = (360^\circ - 339^\circ 16') + 05^\circ 44'$
$= 39^\circ 26'$ (01)

(ix) අවම අපගමන කෝණය. ඒවා වර්ණ වලට වෙනස් වේ. —— (01)

(x) දිගහැර ස්ථාවර කරන ලද ස්ථාවරණ ඇසක් භාවිතා කරමින් අවම අපගමන කෝණය මනින්න. —— (01)

adjust the eye piece to focus the cross wires.

(04)

I 

— (01)

II K, සහ K'. — (01)

III. ස්විචය යතුර AB ඇමිණිය යුතු ආකාරය හා ගැල්වනෝමීටරයේ ඍණාංකය ඉහළට ඇවෑමේ දිශාව — (01)

IV. ගැල්වනෝ මීටරය මූලික අයුරින් ධාරාවක් ගලා යන වලක්වා ගැනීම — (01)

V. a) $\frac{2}{100} \times 40 = 0.8\,A$ — (01)

b) $0.85 - 0.8 = 0.05\,A$ — (01)

VI 1) පරිපථයේ ගලන ධාරාව වෙනස් කිරීම.

2) E කෝෂයේ ඇබකම / E කෝෂය වෙනුවෙලා වෙන — (01)

VII $\frac{6}{R+1} = 0.8$ — (01)

$R_1 + 1 = \frac{60}{8}$

$R = \frac{52}{8} = 6.5\,\Omega$ — (01)

VIII $\frac{2}{100} \times 25 = 0.5\,A$ $\quad \frac{2}{100} \times 80 = 1.6\,A$

0.5 සහ 1.6 A අගයන් — (01)

(i) A – අභිකාරක ජීවය
B – ආශ්‍රිත (ගුළු)
C – මෙන්ටිය
D – ඔත් ද ස්ථරය (දුවය)
E – සුරතල් ස්ථරය
F – කැල්සීමීෂ්‍යය (කැල්සියම්)
සියල්ලම නිවැරදි නම් (01)

(ii) කැල්සි මීෂ්‍යයේ ආශ්‍රිත වර්ගීකරණය
" " ආශ්‍රිතයේ සම්භවය (ආශ්‍රිත නිශ්චිතකරණය)
දුවය හා ප්‍රතිශ්‍රය අතර උත්තාල ගෝත්‍රය (ඉහළ උත්තාලය) } (01)

(iii) ඝනත්ව සවිකාවේ (ආවෘතයේ ඝනත්ව සවිකාව)
ඔලෙක්ත්‍රොනික තුලාව (තෝදනු තුලාව, සිව් දඬු තුලාව) } (01)

(iv) ඛනිජයේ ආශ්‍රයේ උත්තාලය සෑම තැනකම ඒකාකාරී නොවේ.
(:. ඛනිජය ප්‍රතිශ්‍රාවක නිසා) :. ආශ්‍රයෙන් සිදුවන ආඝ ගතිය සෑම තැනකම ඒකාකාර නොවේ. (01)

හෝ

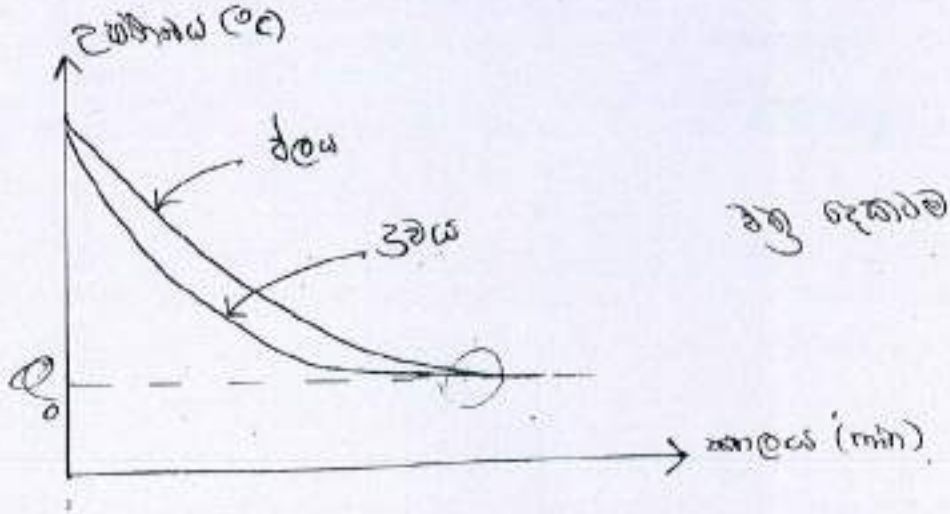
ඒදුර වල සහනාගෙනයේ වූහ නිසා දුවය මූල උත්තාලය ආශ්‍රිත ආශ්‍රයේ උත්තාලය පෙළඹ ගත නොහැක.

(v) වල වර්ගීකරණ හා දුවී වර්ගීකරණ සඳහන් කිරීම. (01)
ගෙතුව - තාරය ගති සහ සෑම ආශ්‍රීය වර්ගීකරණය සඳහන් කිරීම සඳහා (01)

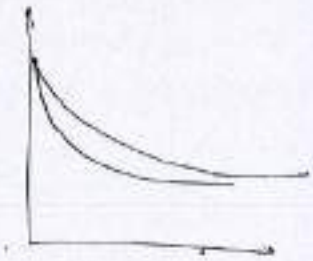
හෝ

සිංසිලත ගත්ති සඳහන් කර ගැනීමට.

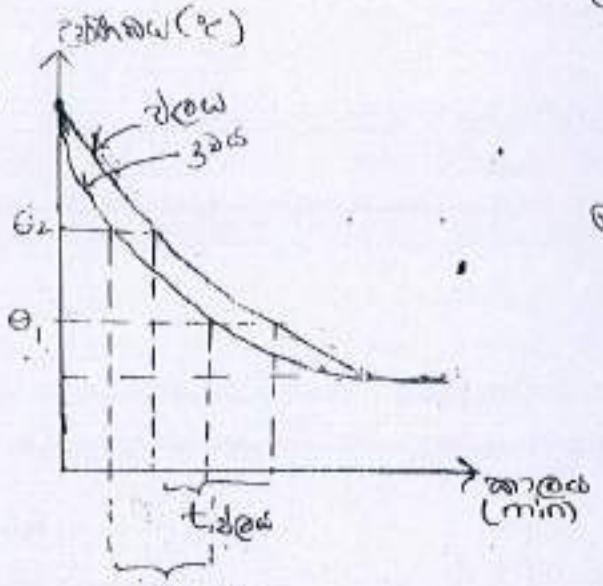
(vi)

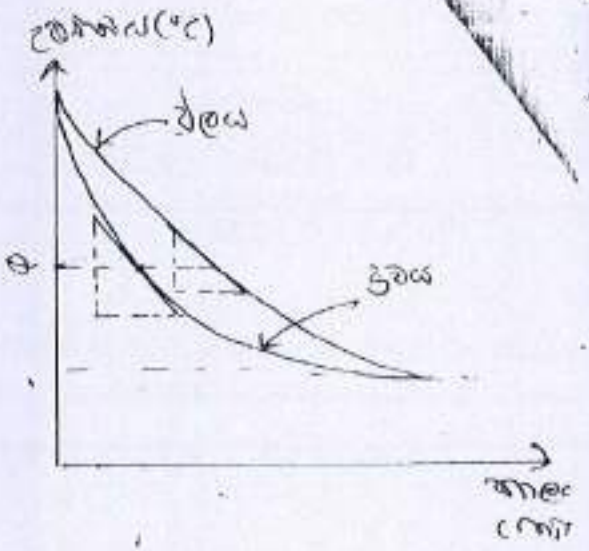


නමු දෙකාම (01)



(vii)





(01)

(viii) $(ms + m_d s_d)\left(\frac{\Delta\theta}{\Delta t}\right)_{වර්ලය} = (ms + m_3 s_3)\left(\frac{\Delta\theta}{\Delta t}\right)_{ද්‍රවය} = cA(\theta - \theta_0)$

$$\frac{ms + m_d s_d}{16} = \frac{ms + m_3 s_3}{5}$$ (01)

$$\frac{50.4 + (1000 \times 100 \times 10^{-6} \times 4200)}{16} = \frac{50.4 + (800 \times 100 \times 10^{-6} \times s_3)}{5}$$

$$(50.4 \times 5) - (50.4 \times 16) + (5 \times 420) = 16 \times 8 \times 10^{-2} s_3$$

$$252 - 806.4 + 2100 = 128 \times 10^{-2} s_3$$

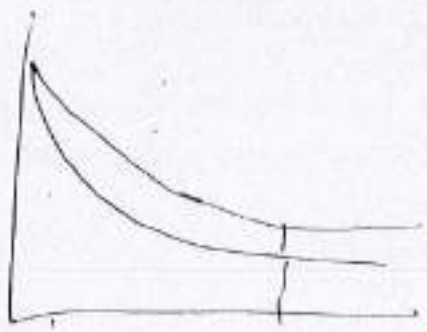
$$s_3 = \frac{1545.6 \times 100}{128}$$

$$s_3 = 1207.5 \text{ J kg}^{-1} \text{ K}^{-1}$$ (01)

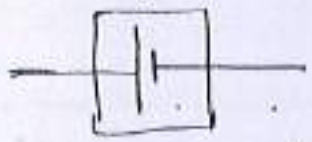
$$\Longleftarrow$$

$$1205 \text{ J kg}^{-1} \text{ K}^{-1}$$

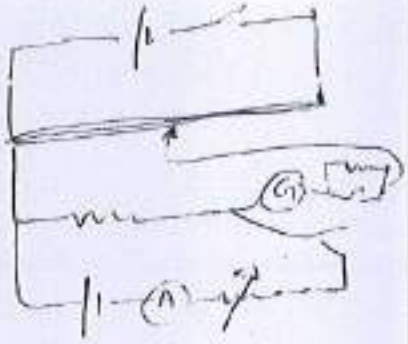
10



04)

I 

— (01)



II K, m K. — (01)

III එම්පරය යොදා AB කම්බිය මත තබන්න සහ තනි ලුප්වෙන්වීමේ කාර්යක්ෂම පැහැදිලි කිරීම. — (01)

IV ලුප්වෙන් වීමේදී මූලික අඩංගු කාබන් ගලා යන වලක්වා ගැනීම — (01)

$I = \frac{V}{R}$ $R = kl$

V a) $\frac{2V}{100cm} \times 40cm =$ 0.8 A — (01)

b) 0.85 − 0.8 = 0.05 A — (01)

VI 1) අඩුවෙන් ගලන කාබන් වැඩි කිරීම.

2) E කොශයේ ආයුෂය / E කොශය වැඩි කාලයක් පවතින්නා කිරීමට For the cell to last longer. (01)

VII $\frac{6V}{R+1} = 0.8A$ — (01)

$R_1 + 1 = \frac{60}{8}$

$R = \frac{52}{8} = 6.5\ \Omega$ — (01)

VIII $\frac{2}{100} \times 25$ $\frac{2}{100} \times 80$

$= 0.5A$ $= 1.6A$

0.5 සිට 1.6 A දක්වා — (01)

(5) I ඒකක පරිමාවක ගලන තරලයක ගම්‍යතාව $= \frac{1}{2}\rho V^2 + \frac{1}{2}\rho u^2$ —— (01)

II ප්‍රාන්තවල ප්‍රවාහ වේගයන් සමාන වීම —— (01)

III සාපේක්ෂ ප්‍රවේගය ශූන්‍ය වීම —— (01)

සර්ව සමීකරණය —— (01)

IV ප්‍රාන්ත දෙක තිරස් වීම හෝ ඒවායේ උන්නතාංශ වෙනස නොසලකා හරින බව සඳහන් කිරීම —— (01)

V (a) ප්‍රවේගය $= V$ —— (01)

(b) $100A \times V_K = A \times V$

$V_K = \frac{10}{100} V$ —— (01)

(c) $P_0 + 0 = P_0 - (h_1 + h_2)\rho g + \frac{1}{2}\rho V^2$ (ප්‍රමාණය) —— (01)

$V = \sqrt{2g(h_1 + h_2)}$ —— (01)

(d) $V = \sqrt{2 \times 10 \times 0.8}$

$= 4 \text{ ms}^{-1}$ —— (01)

(e) බිලෝ සංඛ්‍ය ක්‍රියා පරිමාව $= 1.2 \times 0.4 \times \frac{4}{100}$ ප්‍රමාණය —— (01)

$= 1.90 \times 10^{-2} \text{ m}^3\text{s}^{-1}$

(f) බිලෝ සාමාන්‍ය ගුණ ක්‍රියා පරිමාව $= 1.92 \times 10^{-2} \times \frac{2}{3}$ —— (01)

$= 1.28 \times 10^{-2} \text{ m}^3\text{s}^{-1}$ —— (01)

VI $\frac{F}{A_1} = \frac{1}{2}\rho\left[V^2 - V_1^2\right]$ —— (01)

$F = \frac{1}{2}\rho A_1\left[V^2 - \left(\frac{A_2 V}{A_1}\right)^2\right]$

$F = \frac{1}{2}\rho A_1 V^2\left[1 - \frac{A_2^2}{A_1^2}\right]$

$V = \frac{8}{\sqrt{5}} = 3.6 \text{ ms}^{-1}$ —— (01)

(6) සලකුණ

(a) (i) සමවාරතාව = f විස්තාරය = A — (01)

(ii) $180^\circ = \pi$ — (01)

(iii) $v = fL$ — (01)

iv. චිනාව වේගයෙන් ගුහාවේ බිත්තියට ළඟා වන විට පරාවර්තනය වේ. (01)
පරාවර්තනය වීමෙන් ඒකාබද්ධ තරංග ඇති වේ.
ඉදින් $v = fL$ යොදා දිගෙන් පරාවර්තනය වන තරංගයේ වේගය. — (01)

~~(b) (i) $f = \frac{1}{2l}\sqrt{\frac{mg}{\mu}}$~~

(b) (i) $f = \frac{1}{2l}\sqrt{\frac{T}{m}}$

f - සංඛ්‍යාතය
l - නාරුවේ දිග — (01)
T - නාරුවේ ආතතිය
m - නාරුවේ ඒකක දිගක ස්කන්ධය

(ii) $120 = \frac{1}{2\times1.2}\sqrt{\frac{Mg}{1.6\times10^{-3}}}$ — (01)

$Mg = \frac{36\times144\times1.6\times10^{-3}}{10}$

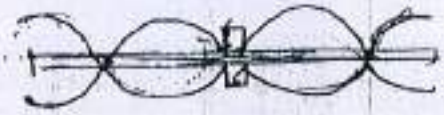
$= 8294.4\times10^{-4} = 0.82944$

$= 0.829$ kg. — (01)

(iii) $f = \frac{n}{2l}\sqrt{\frac{T}{m}}$

$120 = \frac{n}{2\times1.2}\sqrt{\frac{10}{1.6\times10^{-3}}}$ — (01)

$n = 3.6$ — (01)

(c) (i)  —(01)

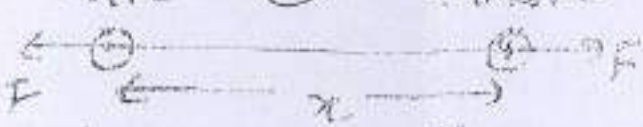
$$f = \frac{3}{2L}\sqrt{\frac{E}{d}} \quad \text{—(01)}$$

$$\frac{250}{7500} = \frac{3}{2\times 1}\sqrt{\frac{E}{8000}} \quad \text{—(01)}$$

$$E = 625\times 10^{4}\times 4\times 8000$$

$$= 2\times 10^{11}\ Nm^{-2} \quad \text{—(01)}$$

(a) (i)

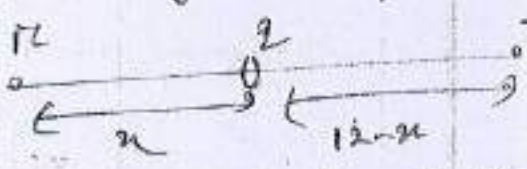


$F = \frac{1}{4\pi\varepsilon_0} \times \frac{1 \times 0.25 \times 10^{-12}}{x^2}$ —— (1)

(ii) $F = 9\times10^9 \times \frac{0.25\times10^{-12}}{1} = 2.25\times10^{-3}$ N —— (1)

(iii) ඉහත කිරීමෙදී ලබාගත් සම්බන්ධතාවය ඇසුරින් ආරෝපණ අතර දුරින් වෙනස් වීමේදී බලය වෙනස් වන ආකාරය විමසා බැලීම සඳහා x හි විවිධ අගයන් සඳහා F හි අගයන් ගණනය කිරීම, ප්‍රස්තාරය ඇඳීම සඳහා අක්ෂ නම් කිරීම, ප්‍රස්තාරයේ හරස්කඩ ලක්ෂ්‍ය ලකුණු කිරීම, ප්‍රස්තාරය නිවැරදිව ඇඳීම සඳහා ලකුණු ලබා ගැනීම —— (1)

(b) (i)



q ආරෝපිත අංශුව මත බල සමාන හා ප්‍රතිවිරුද්ධ දිශාවලට ක්‍රියා කරයි.

$\frac{1}{4\pi\varepsilon_0}\frac{q}{x^2} = \frac{1\times0.25\times q}{4\pi\varepsilon_0(12-x)^2}$ —— (1)

$\frac{1}{x} = \frac{0.5}{12-x}$

$12 = 1.5x$

$x = 8$ cm —— (1)

—— (1)

(ii) ස්ථායී සමතුලිතතාවය

සමතුලිත තත්ත්වයෙන් q අංශුව ඒකාකාරයෙන් ඉවතට විස්ථාපනය කළ විට එය ආපසු සමතුලිත තත්ත්වයට පැමිණීමට නැඹුරු වේ. —— (1)

(11)

(ii) ...

$$\text{বি.শ.} = \frac{1}{4\pi\varepsilon_0} \times \frac{q_1 q_2}{r} \times 2 \quad \text{(i)}$$

$$= \frac{9\times10^9 \times 25\times10^{-10}}{5} \times 2$$

$$= -9\ \text{J} \quad \text{(ii)}$$

$$\text{মোট বি.শ.} = 4 - 9 = -5\ \text{J} \quad \text{(iii)}$$

(iii) ধ্রুবকণাটিকে অসীম দূরত্ব থেকে নিয়ে আসতে যে পরিমাণ কাজ করতে হবে তাই বিভব শক্তি।

$$\text{বি.শ.} = \text{কাজ} \quad \text{(iv)}$$

এক্ষেত্রে যেহেতু, C তে মোট বি.শ. = বিভব শক্তির পরিবর্তন

$$-5 = -\frac{1}{4\pi\varepsilon_0} \times \frac{q^2}{a} \times 2$$

$$-5 = -\frac{9\times10^9 \times 25\times10^{-10}}{a} \times 2 \quad \text{(v)}$$

$$a = 9\ \text{m} \quad \text{(vi)}$$

$$OP = \sqrt{9^2 - 5^2} = 6\sqrt{2} = 8.4\ \text{m} \quad \text{(vii)}$$

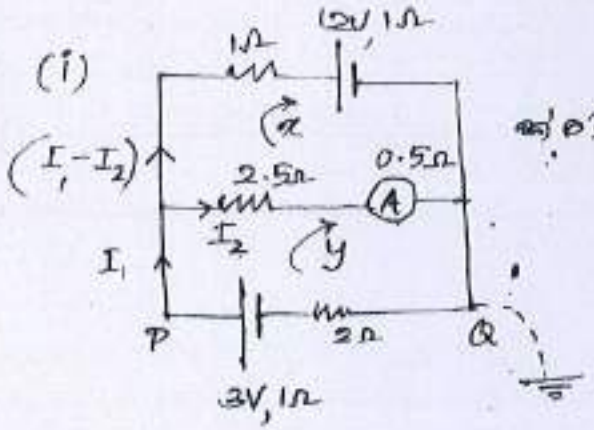
(iii) C বিন্দুতে মুক্তিবেগ যদি 4J হয় তা হলে কী পরিমাণ বেগ দিয়ে ধ্রুবকণা -q, C থেকে অসীম দূরত্বে নিয়ে যাওয়া যাবে।

(iv) O বিন্দু থেকে O এর সমান দূরত্বে O বিন্দুতে আরেকটি ধ্রুবকণা রাখলে তার বিভব শক্তি কত হবে।

যে বি.শ. = 45J হবে; (i) থেকে $= 45 - 9 = 36\ \text{J}$ (iv)

(c) থেকে $-36 = -\frac{9\times10^9}{r} \times 25\times10^{-10} \times 2$ (v)

(A) (i)



ചിത്രത്തിൽ ചിഹ്നങ്ങൾ രേഖപ്പെടുത്തുന്നതിന് ..... (01)

$\circlearrowright x$ $\quad -12 = (I_1 - I_2) \times 2 - I_2 \times 3$ ..... (01)

$-12 = 2I_1 - 5I_2$ —— ①

$\circlearrowright y$ $\quad 3 = I_1 \times 3 + I_2 \times 3$ ..... (01)

$1 = I_1 + I_2$ —— ②

① − 2×②;

$-14 = -7I_2$

$I_2 = 2A$ ..... (01)

(ii) $P = I^2R$ ..... (01)

$P = 2^2 \times 2.5 = 10W$ ..... (01)

(iii) 12V → $V_1 = E + Ir$

$V_1 = 12 + (-3) \times 1$

$= 9V$ ..... (01)

3V → $V_2 = E - Ir$

$= 3 - (-1) \times 1$

$= 4V$ ..... (01)

(iv) $V_{PQ} = V_P - V_Q$ ..... (01)

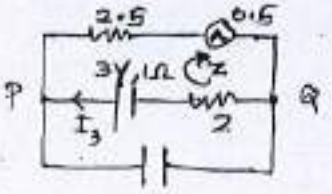
$2 \times 3 = V_P - 0$

$V_P = 6V$ ..... (01)

(v) $Q = CV$ ..... (01)

$Q = 10 \times 6 = 60\mu C$ ..... (01)

(vi)



$\circlearrowright z$ $\quad 3 = I_3 \times 6$

$I_3 = 0.5A$

$V_{PQ} = 3 - 0.5 \times 3 = 1.5V$ ..... (01)

$Q' = 10 \times 1.5 = 15\mu C$ ..... (01)

(vii) $Q = eV$

$Q = 0.15 \times 70 = 10.5\mu C$ ..... (01)

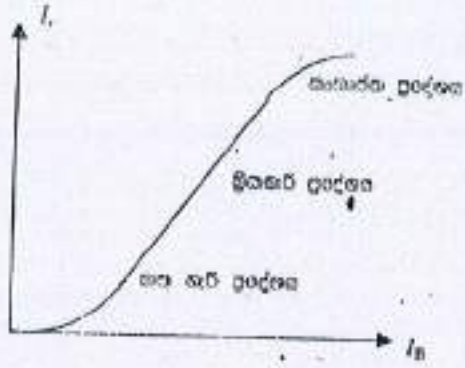
15

ICS - June - 2017 - Gr. 13 (PR)

Essay 9 (B) - Marking scheme

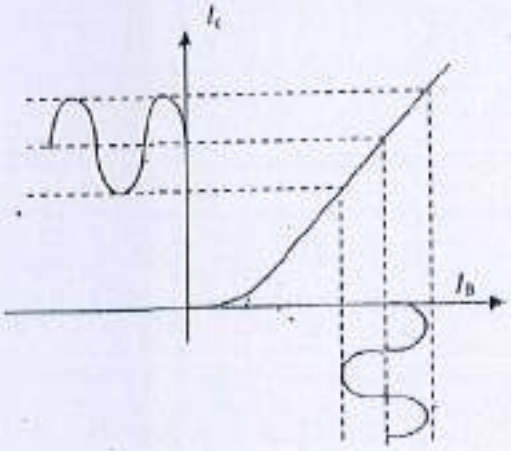
4, 10, 20
24, 35
50

A) i) a)



හැඩය සහ ප්‍රදේශ නම් කිරීම (01)

b)

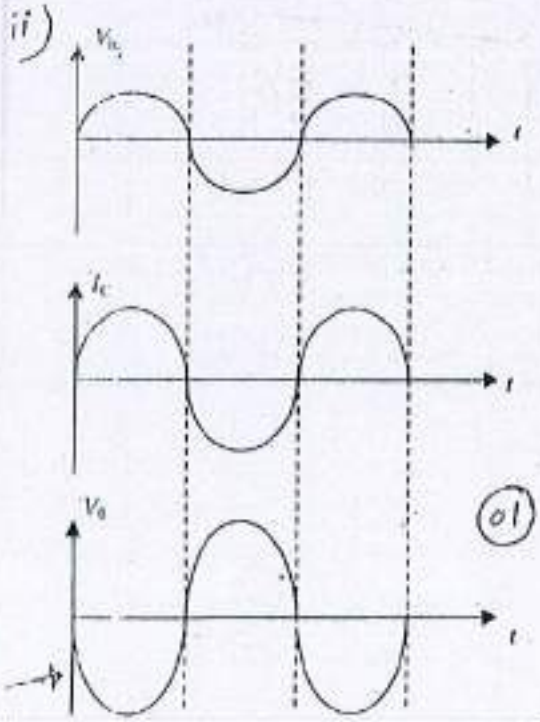


ඉහත ප්‍රස්තාරයට අනුව ක්‍රියාකාරී / රේඛීය ප්‍රදේශය තුළ ප්‍රදාන බාරුව පවත්වාගෙන් විට විකෘතියකින් තොර බාරු වර්ධනයක් ලබා ගත හැක. එහෙත් සංතෘප්ත හෝ සංතෘප්ත ප්‍රදේශ තුළ ප්‍රදාන බාරුව පවත්වාගත් විට ප්‍රතිදාන බාරුවේ එක් සහ ධනාත්මක නිම්නවලින්වල පුඩුම් ප්‍රතිදාන තෙරපුම්වල විකෘති වේ. — (01)

c)

නැඹුරු කිරීම ත්‍රාන්සිස්ටරය ලෙස ලබා ගන්නේ ප්‍රතිඝාවර්ත වෝල්ටීයතා ප්‍රතිචාරය සමඟ ත්‍රාන්සිස්ටරය ලෙස ක්‍රියාත්මක කිරීමෙනි. (01)

ii)



(01)

වර්ධනය සහ කලා ප්‍රතිචාරය සලකන්න.

ii) $C_1 \rightarrow I_B$ සරල ධාරාවෙන් කොටසක් ප්‍රදාන වෝල්ටීයතා ප්‍රතිචාරය දෙසට යාවිදු වීම සලකයි.

$C_2 \rightarrow I_c$ සරල ධාරාවෙන් කොටසක් ප්‍රතිදාන අතුරය හරහා ඉවතට ගැලීම වලක්වාලයි. දෙකම නිවැරදි නම් (01)

iv) a) $V_B - 0 = \left(\frac{R_2}{R_1 + R_2}\right) V_{cc}$

$= \frac{2}{(8+2)} \times 10 = \underline{2\,V}$ — (01)

ට්‍රාන්සිස්ටරයේ පාදම ධාරාව ඉතා කුඩා නිසා පාදමේ විභවය R_1 හා R_2 ප්‍රතිරෝධක හරහා බෙදීමෙන් විභව භාජකයේ ඔධාරයේ විභවය ලබා ගත හැක.

b) $V_{BE} = 0.7V$ (Si)

$V_B - V_E = V_{BE}$

$2 - V_E = 0.7$

$V_E = 1.3\,V$ — (01)

c) $I_E = \frac{V_E - 0}{R_E} = \frac{1.3}{1 \times 10^{-3}}$

$I_E = 1.3 \times 10^{-3}\,A$ — (01)

d) සෑදුම කාරාව ඉහා තුඩා තුවින් සාපෘභාව කාරාව, විභෝවක කාරාවට ඉහා ආසන්න ලේ. ඒ අනුව $I_C = 1.3 \times 10^{-3}\,A$

$I_C R_C + V_{CE} + I_E R_E = V_{CC}$

$(1.3 \times 10^{-3}) \times 4 \times 10^3 + V_C - V_E + 1.3 \times 10^{-3} \times 1 \times 10^3 = 10$

$V_C = 4.8\,V$ — (01)

e) $V_{CE} = V_C - V_E = 4.8 - 1.3 = 3.5\,V$ — (01)

f) $V_{out} / V_{in} = 100$ ඉහිදාන වෝල්ටීයතා ලාභය

$V_{out} = 100 \times 0.5 = 50\,mV$

$V_p = \sqrt{2}\, V_{rms} = 50\sqrt{2}$

$= 70.7\,mV$ — (01)

(B) i) පුස්තාරයම අනුව 10mA කාරාවක් ගලන විට ඉහිරෝධයේ අග්‍ර අතර 0.5V විභව අන්තරයක් ද දියෝඩය හරහා 1.25 V විභව අන්තරයක් ද පවතී. $0.5 + 1.25 = 1.75\,V$ (01)

ii) 15 mA (01) මෙහිදී ඉහිරෝධය හා දියෝඩය තුළින් සමාන කාරා ගලයි. පුස්තාරය අනුව කාරාව 15 mA වන විට ඉහිරෝධයේ අග්‍ර අතර දැල වෙනසෙන් 0.75 V ද දියෝඩයේ අග්‍ර අතර දැල වෙනසෙන් 1.5 V ද වන විභව අන්තර පවතී. එවිට $0.75\,V + 1.5\,V = 2.25\,V$

iii) p-n සන්ධිය බිඳ වැටී විශාල කාරාවක් දියෝඩය තුළින් ගලා යාම — සෙනර් බිඳ වැටීම. (01)

iv) සෙනර් දියෝඩ — වෝල්ටීයතා ස්ථායිකාරක ලෙස භාවිතා කිරීම.

දියෝඩ වර්ගය සහ භාවිතය දෙකම නිවැරදි නම් (01)

(15)

10 (A)

(i) සන්නයනය හා විකිරණය (01) (for both)

(ii) සිදුරු හා වාතය ඇතුළත 380 (C) තාප සන්නායකතාව [illegible] (k) හි තාප හානිය අවම වේ. (01)

(iii) $\frac{Q}{t} = KA\frac{\Delta\theta}{\Delta l}$ (01)

$= \frac{0.8 \times 1 \times 4}{8 \times 10^{-3}}$

$\therefore \frac{Q}{t} = 400\,W$ (01) with units

(iv) (a) [illegible] තාප [illegible] [illegible] තාප [illegible] [illegible] [illegible] [illegible] [illegible] (01)

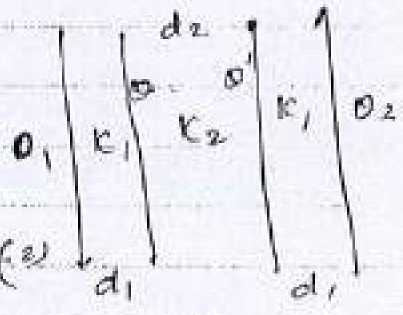
(b) $\frac{Q}{t} = \frac{mc\theta}{t}$ (01)

$= 1.5 \times 10^{-3} \times 4200 \times 15$

$= 94.5\ J s^{-1}$ (01) 94.5 W – English

$1.5 \times 10^{-3}\,kg$

(v) (a) පළමු තාප්ප හරහා



$Q = \frac{K_1 A(\theta_1 - \theta)}{d_1}$ —(1)

දෙවන තාප්ප හරහා; $Q = \frac{K_2 A(\theta - \theta')}{d_2}$ —(2)

තෙවන තාප්ප හරහා; $Q = \frac{K_1 A(\theta' - \theta_2)}{d_1}$ —(3)

(1) න්; $\theta_1 - \theta = \frac{Q d_1}{A K_1}$ —(4)

(1), (2), (3) සම්බන්ධ වලට (01)

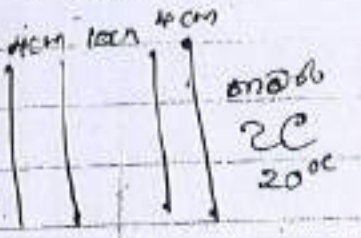
(2) න්; $\theta - \theta' = \frac{Q d_2}{A K_2}$ —(5)

(3) න; $\theta' - \theta_2 = \frac{Q d_1}{A K_1}$ —(6) (1b)

(4) + (5) + (6) න; $\theta_1 - \theta_2 = Q\left[\frac{d_1}{AK_1} + \frac{d_2}{AK_2} + \frac{d_1}{AK_1}\right]$

$$Q = \frac{(\theta_1 - \theta_2) A}{\frac{2d_1}{K_1} + \frac{d_2}{K_2}} \quad (01)$$

(b) $Q = \frac{(\theta_1 - \theta_2) A}{\frac{2d_1}{K_1} + \frac{d_2}{K_2}}$

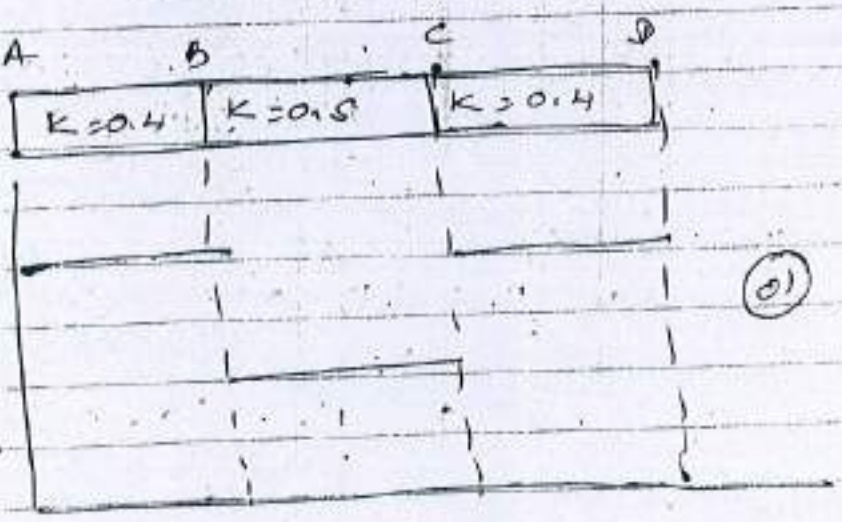


$= \frac{9 \times (35 - 20)}{\frac{2 \times 4 \times 10^{-2}}{0.4} + \frac{10 \times 10^{-2}}{0.5}}$ (01) අනුකූලව

$= \frac{9 \times 15}{2 \times 10^{-1} + 2 \times 10^{-1}}$

$= 337.5 \ J.s^{-1}$ (01)

(c)



(01)

(vi) (a) සෙ සැමු තාප්පවලල වල වැඩිවන් අගළාය (01)
භූවරණයකය කේ ඇරුණ දුරින් දුරින් ඉතාලය කළ අවශ්‍ය.

(b) කෙටු දුර්වල තාප සන්නායකතා සහ
නල කිරීම ලුණාගන්න තාපය අඩාන නොවේ. (01)

(c) තව පළුවිය කිරීම් විසේකාරය කර ඇති
සුළඟ තරංග වල තරංග ආයාමය වැඩ සඳහා (01)
විශේෂව තරුණ විසෙරීම නොවේ

10. B

a(i) Thermionic electron emitted from the filament are accelerated by the potential difference between the electrodes. Then the electrons gain very high kinetic energy. These fast moving electrons collide with the target metal and rapidly decelerates in it. As a result the kinetic energy is lost. The part of this lost kinetic energy is converted to x-rays. (01)

(ii) Then no kinetic energy is lost of electrons due to collisions with gas molecules on its way to the target. (01) (01)

(iii) $\frac{hc}{\lambda} = Ve \times \frac{1}{100}$

$\lambda = \frac{hc \times 100}{Ve} = \frac{6.63 \times 10^{-34} \times 3 \times 10^{8} \times 100}{10^{5} \times 1.6 \times 10^{-19}}$ (01) (01)

$\lambda = 12.4 \times 10^{-10}\ m$

(b). (i) When X-ray photons hit the chatted metal (cathode metal) they pull out electrons from the metal. These electrons are attracted to the anode due to the potential difference applied across the electrodes. Then there is a electron flow in the circuit. (01)

(ii) Energy of the x-ray photon (01)

$E = hf = Ve \times \frac{1}{100}$ (01)

$= \frac{10^{5} \times 1.6 \times 10^{-19}}{100 \times 1.6 \times 10^{-19}} = 1000\ eV.$

(c). (i) Incident ray, $E = \frac{hc}{\lambda} = \frac{6.63 \times 10^{-34} \times 3 \times 10^{8}}{0.2 \times 10^{-9} \times 1.6 \times 10^{-19}}$ (01)

$E_1 = 6215\ eV.$

(ii) scattered ray, $E = \frac{hc}{\lambda'} = \frac{6.63 \times 10^{-34} \times 3 \times 10^{8}}{0.21 \times 10^{-9} \times 1.6 \times 10^{-19}}$ (01)

$E_2 = 5920\ eV.$

Energy lost of the photon

$\Delta E = 6215 - 5920$

$= 295\ eV$

Energy gained by the electron (01)

$= -295\ eV.$

(2) → $\frac{h}{\lambda} = \frac{h}{\lambda'} \cos\theta + P_1$ ——— (01)

$P_1 = h\left(\frac{1}{\lambda} - \frac{1}{\sqrt{2}\lambda'}\right) = \frac{h(\sqrt{2}\lambda' - \lambda)}{\sqrt{2}\lambda\lambda'}$

↑ $0 = \frac{h}{\lambda'}\sin\theta - P_2$ ——— (01)

$P_2 = \frac{h}{\sqrt{2}\lambda'}$

$\tan\theta = \frac{P_2}{P_1} = \frac{\lambda}{\sqrt{2}\lambda' - \lambda}$ ——— (01)

$= \frac{0.2}{(1.41 \times 0.21 - 0.2)} = \frac{0.2}{0.1} = 2$

$\theta = .$ ——— (01)

15

+2

b) i) some photons interacting with loosely bounded electrons. Therefore there is a significant energy lost in scattered photons. Some interact with tightly bounded electrons. Then the scattered photons have negligible energy loss — (01)

ii) λ - wavelength of the scattered photons interact with the tightly bounded electrons.

λ' - Wavelength of scattered photons interact with loosely bounded electrons. — (01)

(08)

a) Force acting perpendicular to a unit imaginary line on one side along the surface. ——— (01)

Angle between the tangent to the surface at the point of contact and the wall measured through the liquid. ——— (01)

b) Particals below the surface are attracted by it neighbours in all directions. Therefore no resultant acts on them. On the other hand particals on the surface are attracted by the neighbours below the surface only. Therefore there is a resultant force downward on particals on the surface. ——— (01)

c)(i) $W = 2\pi r\sigma$ ——— (01)

(ii) (1) $\frac{r}{V^{1/3}} = \frac{0.5\times10^{-3}}{(1\times10^{-9})^{1/3}} = 0.5$ ——— (01)

$\therefore f = 0.6515$ ——— (01)

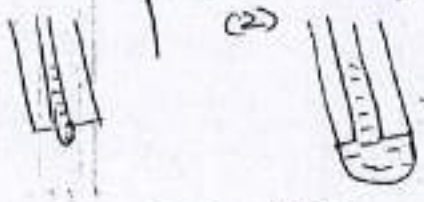
(2) $W' = 2\pi r\sigma f$ ——— (01)

$1\times10^{-9}\times8000\times10 = 2\pi\times0.5\times10^{-3}\sigma\times0.6515$ ——— (01)

$\sigma = \frac{8\times10^{-3}}{2\pi\times0.5\times0.6515} = 3.9\times10^{-3}$ Nm. ——— (01)

——— (01)

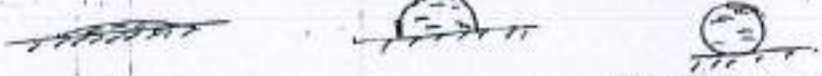
(iii) (1) (2) ——— (01)



d) (i) $\cos\theta = \frac{\sigma_{sv}-\sigma_{sl}}{\sigma_{lv}} = \frac{40-25}{35} = 0.4286$

$\theta = 64^\circ 37'$ ——— (01)

(ii) $\theta = 0$ $\theta = 90$ $\theta = 180$ ——— (01)



(iii) (1) surface tension, co-efficient of viscosity ——— (01)

(2) $D = kt^n$ $t = 10^{-5}$ s

$100\times10^{-6} = 10^{-3}\times t^{0.2}$ $= 10\,\mu s$ ——— (01)

$10^{-1} = t^{0.2}$

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