G.C.E. (A. L.) Support Seminar - 2015

Physics I

Two hours

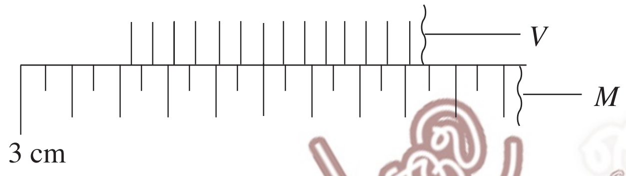
Instructions :
* Answer **all** the questions.
* Select the correct or the most suitable answer.

$(g = 10\,\mathrm{N\,kg^{-1}})$

1. The SI unit, that is used to measure the dose of radiation or the absorption energy per unit mass is,

(1) Bq (2) Gy (3) Sv (4) dB (5) J

2. In a measuring equipment that applies the vernier principle, 49 parts of $\frac{1}{2}$ mm each in the main scale (M) are divided in to 50 parts in the vernier scale (V). The diagram shows how the scales are placed in cause of a measurement made with that instrument. Assuming that there is no zero error in the instrument, the value of that measurement is,

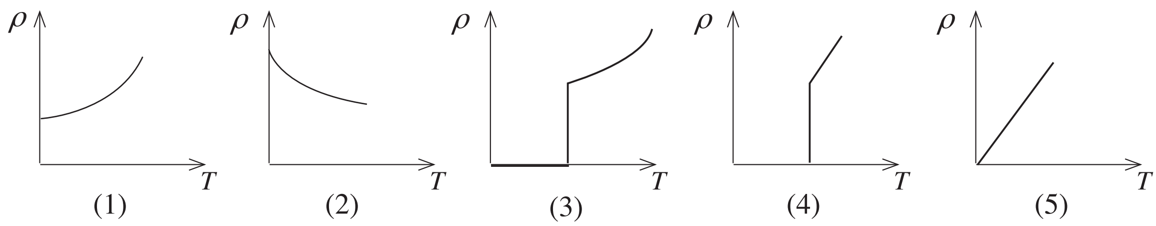


(1) 32.05 mm (2) 32.06 mm (3) 32.60 mm (4) 34.05 mm (5) 34.06 mm

3. Given that the Plank constant is h and the velocity of light is c, the energy E of a photon, of wave length λ is,

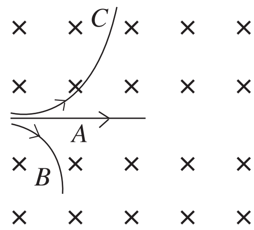
(1) $hc\lambda$ (2) $hc\lambda^2$ (3) $\frac{\lambda c}{h}$ (4) $\frac{\lambda}{hc}$ (5) $\frac{hc}{\lambda}$

4. The graph that shows the variation between absolute temperature (T) and the resistivity (ρ) of a super conductor is,



5. Three paths named A, B and C of three particles which are moving in a magnetic field are shown below. The corresponding particles to these three paths would be.

	A	B	C
(1)	Neutron	Proton	Electron
(2)	Neutron	Electron	γ rays
(3)	Neutron	Electron	Proton
(4)	Electron	Proton	Neutron
(5)	Proton	Electron	Neutron



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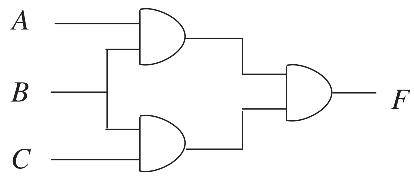
6. The out put F is logic 1 in the following circuit diagram. The inputs for A, B and C would be,

	A	B	C
(1)	0	0	1
(2)	0	1	0
(3)	1	0	0
(4)	1	0	1
(5)	1	1	1



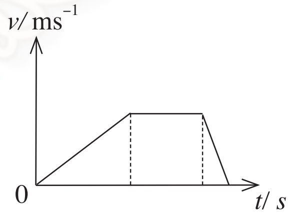
7. If the sound intensity I of a point is increased by 100 times, the intensity level of that point will be increased by,

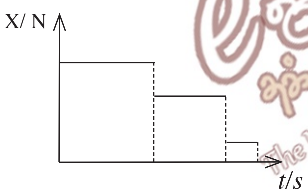
(1) 10 dB (2) 20 dB (3) 10I dB (4) 20I dB (5) 100I dB

8. A 2.5 m long conductor moves perpendicularly to a magnetic field of a magnetic flux density 0.6 T with a velocity of 6 m s^{-1}. The electromotive force, induced in the conductor is,

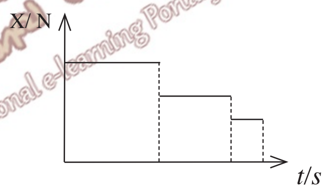
(1) 9.0 V (2) 7.5 V (3) 6.0 V (4) 4.5 V (5) 3.0 V

9. A velocity time graph for an elevator which moves up wards is shown in the figure. A load is on a top loading balance inside the elevator. The best graph that represents the variation of the balance reading (X) with time is,





(1)



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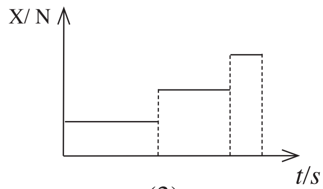

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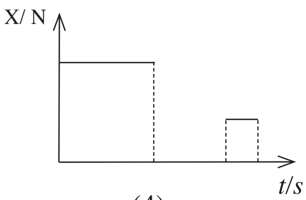

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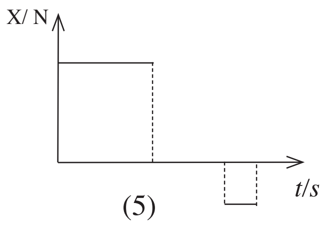
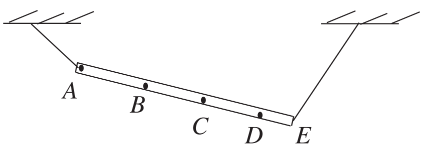


(5)

10. The most probable point, for the centre of gravity of the AE bar shown below is,



(1) A (2) B (3) C (4) D (5) E

11. If a particle with a mass m and a charge q accelerates under a potential difference of V, the De Broglie wave length is,

(1) $\dfrac{h}{\sqrt{2mqV}}$ (2) $\dfrac{h}{2mqV}$ (3) $\dfrac{hV}{\sqrt{2mq}}$ (4) $\dfrac{h}{2\sqrt{mqV}}$ (5) $\dfrac{2h}{\sqrt{mqV}}$

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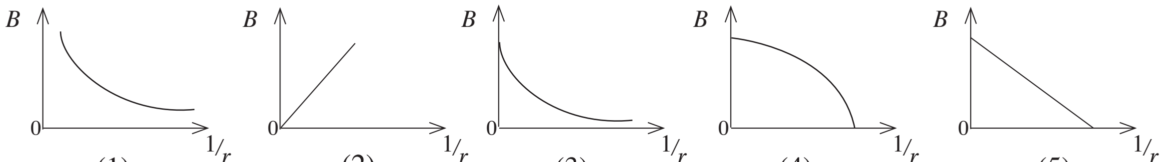
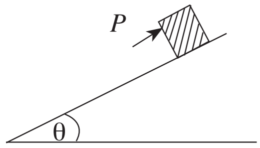
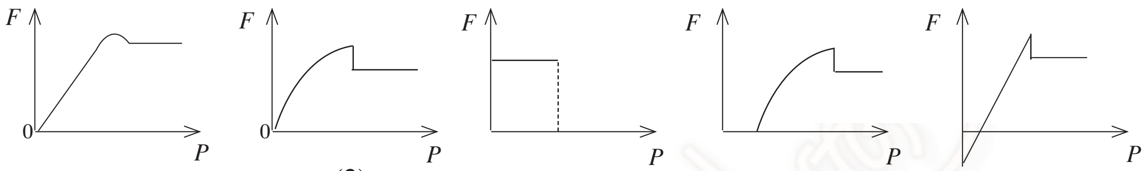
12. A current I flows in an infinitely long conducting wire. If the magnetic flux density of a point at a distance r from the wire is B, the best graph that represents the variation of magnetic flux density (B) with $1/r$ is,



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

13. The best graph that represents the variation of the frictional force (F) with the increasing force P applied parallel to the inclined plane on the object kept on the rough plane is,





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

14. Consider the following statements about the use of thermometers.

A - Mercury in glass thermometer is suitable to obtain the cooling curve of liquid paraffin instead of thermistor.

B - Thermocouple is suitable to measure rapidly changing temperature of a surface instead of mercury in glass thermometer.

C - Thermistor can be used to measure small variations of temperature in a gaseous medium

of the above statements,

(1) Only A is true. (2) Only C is true.
(3) Only A and B are true. (4) Only A and C are true.
(5) Only B and C are true.

15. Density of ice is x g cm^{-3}. Density of water is y g cm^{-3}. The volume difference when mass m grams of ice melts, in cm^3 is,

(1) $\frac{m}{y-x}$ (2) $\frac{m}{y+x}$ (3) $\frac{m(x+y)}{xy}$ (4) $\frac{m(y-x)}{xy}$ (5) $\frac{2m}{x+y}$

16. A sphere of mass 2 kg is moving towards east with a velocity of 4 m s^{-1}. Another sphere of mass 3 kg is moving towards north with a velocity of 6 m s^{-1}. The two spheres collide each other, combine and move together after the collision. The angle between east and the direction of motion is

(1) $\tan^{-1}(4/9)$ (2) $\tan^{-1}(1/2)$ (3) $\tan^{-1}(2/3)$ (4) $\tan^{-1}(6/4)$ (5) $\tan^{-1}(9/4)$

17. Consider the statements about the atmosphere.

A - Relative humidity of dry atmosphere will never be 100%.

B - Absolute humidity decreases whenever relative humidity of atmosphere decreases.

C - Relative humidity becomes 100%, when the absolute humidity of the atmosphere is at its maximum value at any temperature.

of the above statements,

(1) Only B is true. (2) Only C is true.
(3) Only A and B are true. (4) Only A and C are true.
(5) Only B and C are true.

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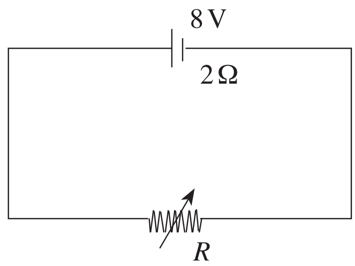
18. α and β particles are emitted by the decay of the radioactive nucleus $^{A}_{Z}X$. If the daughter element created is $^{A-4}_{Z}Y$, the number of α and β particles emitted respectively.

(1) 1, 0 (2) 1, 1 (3) 1, 2 (4) 2, 1 (5) 2, 2

19. An egg is entered into a measuring cylinder containing 400 ml of water carefully. Then the water level was raised up to 470 ml. Now the sea water of relative density 1.2 is added into the measuring cylinder carefully. The egg was risen in the liquid when the liquid level becomes 870 ml. The mass of the egg is,

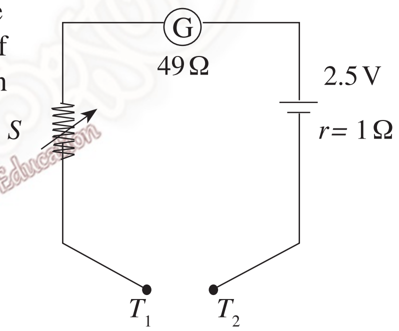
(1) 70 g (2) 76 g (3) 77 g (4) 84 g (5) 100 g

20. Value of the maximum power output across the variable resistor R in the circuit is,



(1) 4 W (2) 8 W (3) 24 W
(4) 32 W (5) 64 W

21. A modified Ohm meter from a galvanometer of internal resistance 49 Ω, is shown in the figure. If the full scale deflection current of the galvanometer is1 mA, the value of variable resistor S when the reading zero on Ohm scale is,



(1) 0 Ω (2) 2000 Ω (3) 2010 Ω
(4) 2450 Ω (5) 2500 Ω

22. Radius of the orbit of Geo statimary satellite of mass m is r. If mass of the earth is M and the radius is R , the total energy of the satellite at the orbit is,

(1) $\frac{-gR^2m}{2(r+R)}$ (2) $\frac{-gR^2m}{2r}$ (3) $\frac{-gR^2m}{(r+R)}$ (4) $-gR^2m$ (5) $-gRm$

23. Metal sodium, work function 2.28 eV, is illuminated by a monochromic light. All the electrons release from sodium is stopped by a potential of 1.51V. The energy of incident photon is,

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

24. What is the phenomenon that **cannot** be explained by Bernoule's principle?

(1) Attraction of a person who is standing closer to the railway track, towards the train travelling fast.
(2) Increasing the velocity of water, when it is moving from a big tube to a small tube.
(3) Removal of light roofing plates, when there is a heavy wind.
(4) Drying off the surrounding springs, when the water moves in tunnels.
(5) Spraying process of a spray pump.

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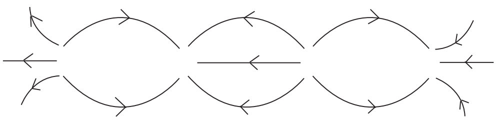
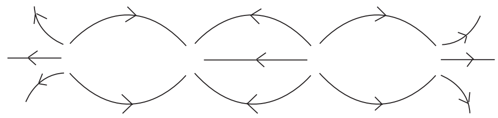
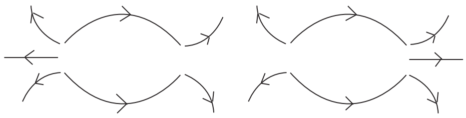
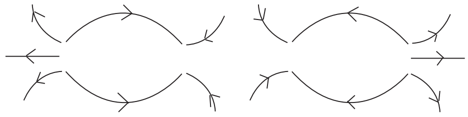
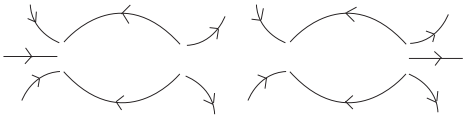
25. Two solenoids are shown in the figure. The must accurate representation of magnetic field lines around two solenoids is,

(1) 

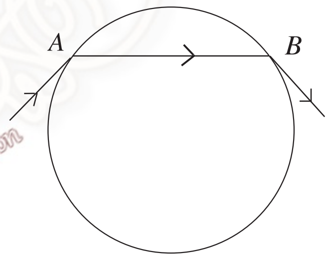
(2) 

(3) 

(4) 

(5) 

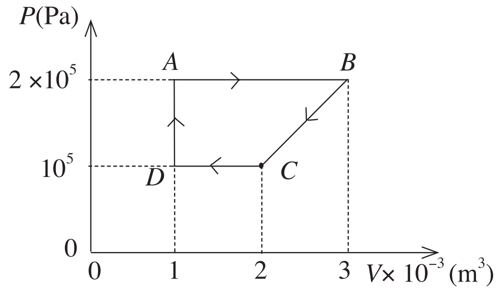
26. Path of a ray of light through a glass sphere is shown in the figure. If the angle sub tended by the arc AB on the centre is 100° and the deviation of the ray is 80°, the refractive index of glass is,



(1) $\dfrac{\sin 50^\circ}{\sin 40^\circ}$ (2) $\dfrac{\sin 70^\circ}{\sin 30^\circ}$ (3) $\dfrac{\sin 80^\circ}{\sin 40^\circ}$

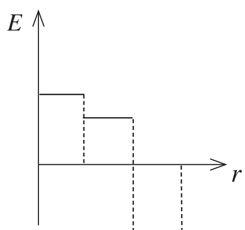
(4) $\dfrac{\sin 75^\circ}{\sin 30^\circ}$ (5) $\dfrac{\sin 90^\circ}{\sin 40^\circ}$

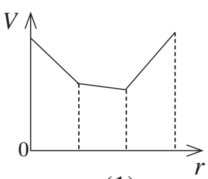
27. The variation of the pressure (P) and the volume (V) of a gas in a cyclic process is shown in the figure. Work done during the process is,



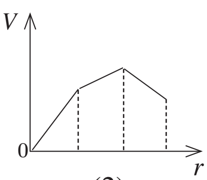
(1) +150 J
(2) −150 J
(3) +300 J
(4) −300 J
(5) +400 J

28. Variation between the electric field intensity (E) and the distance (r) in a certain electric field is shown in the diagram. According corresponding to best graph that represents the variation between the potential (V) and the distance (r) is,





(1)



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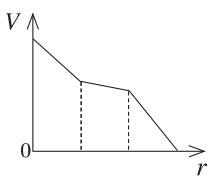

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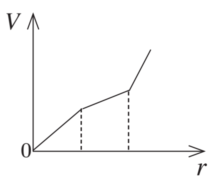

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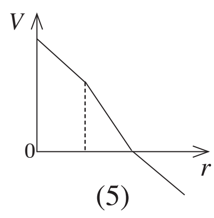

(5)

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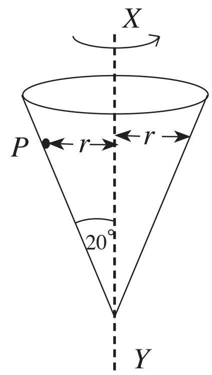
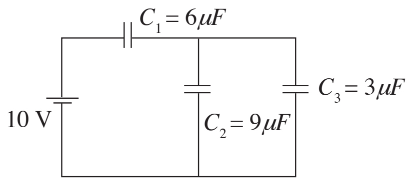
29. According to the figure, a small ball P is kept inside a conical shaped container with a smooth surface is rotated around XY axis. Then the ball P is at rest relative to the surface at the position as shown in the diagram. If the speed of the ball is V them V^2 is given by,



(1) $gr \sin 20^\circ$ (2) $gr \cos 20^\circ$ (3) $gr \tan 20^\circ$

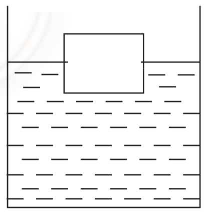
(4) $\dfrac{gr}{\sin 20^\circ}$ (5) $\dfrac{gr}{\tan 20^\circ}$

30. There is no internal resistance of the cell given in the circuit and the electromotive force is 10 V. The charge and the potential difference of capacitor C_1 is,



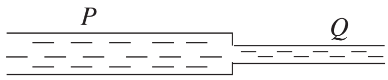
(1) 12.6 μC, 3.67 V (2) 20 μC, 5.33 V
(3) 30 μC, 6.67 V (4) 40 μC, 6.67 V
(5) 90 μC, 7.33 V

31. According to the figure a wooden block with a volume 0.04 m^3 is floating on the water as 75% of the total volume is immersed in the water. The required minimum vertical force in order to immerse the wooden block totally in the water is, (density of water 1000 kg m^{-3})



(1) 10 N (2) 30 N (3) 100 N
(4) 300 N (5) 400 N

32. According to the figure, tubes P and Q with radii $2r$ and r respectively are connected and kept horizontally. A laminar flow of a viscous liquid is allowed to flow in the tubes. The lengths of the tubes are equal. Consider the following statements.

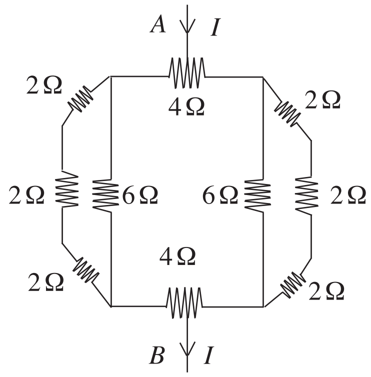


A - The volume flow rates through both tubes are equal.
B - The pressure difference between the two ends of tube P is 16 times that of tube Q.
C - Speed of liquid at Q is twice that of P.

of the above statements,

(1) Only A is true. (2) Only B is true.
(3) Only A and B are true. (4) Only A and C are true.
(5) Only B and C are true.

33. The current entered from the mid point of the top most 4 Ω resistor in the resistor networks exits from the mid point of the bottom most 4 Ω resistor, as shown in the figure. The equivalent resistances between A and B terminals is,



(1) 3.0 Ω
(2) 3.5 Ω
(3) 5.5 Ω
(4) 7.0 Ω
(5) 12.0 Ω

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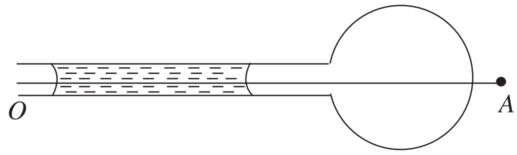
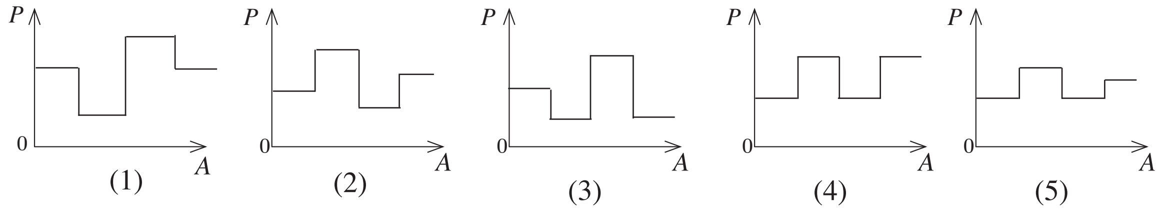
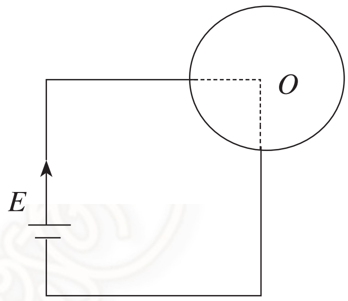
34. According to the figure a soap bubble has been formed at the end of a capillary tube A, and the air is trapped inside the bubble using a water column. What is the best graph that represents the variation of pressure from O to A?





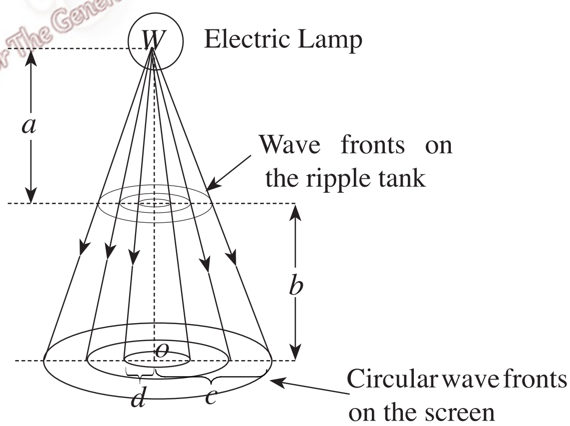
35. A cell of electromotive force E with no internal resistance has been connected to a uniform circular wire of radius a and the resistance R. The cell has connected to the wire in order to divide the circular wire in 1 : 3 ratio. Magnetic flux density at the centre is,



(1) $\dfrac{2\mu_o E}{Ra}$ (2) $\dfrac{3\mu_o E}{2Ra}$ (3) $\dfrac{\mu_o E}{Ra}$

(4) $\dfrac{\mu_o E}{2Ra}$ (5) 0

36. Image of the circular wave front created in a ripple tank is shown in the figure. The distance between the lamp and the ripple tank is a, the distance from the ripple tank to the screen is b, the distance from the centre O to the edge of 3rd illuminated ring is c and the distance from O to the edge of 1st illuminated ring is d. The wave length λ of the wave formed in the ripple tank is,



(1) $\lambda = \dfrac{a(c-d)}{(a+b)}$

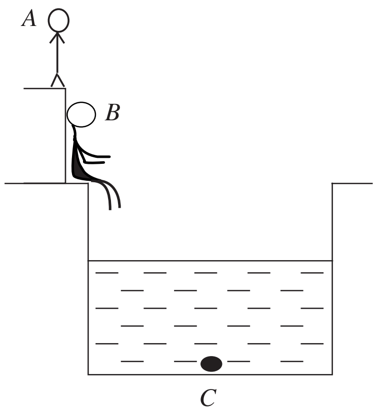
(2) $\lambda = \dfrac{a(c-d)}{2(a+b)}$

(3) $\lambda = \dfrac{2a(c-d)}{(a+b)}$

(4) $\lambda = \dfrac{a(a+b)}{(c-d)}$

(5) $\lambda = \dfrac{a(a+b)}{2(c-d)}$

37. The way that the two persons A and B, who look at a bulb C which is in a tank filled with water, is shown in the figure B is sitting and A is standing on a stage behind B. What is the most correct statement regarding the apparent position of the bulb observed by A and B?

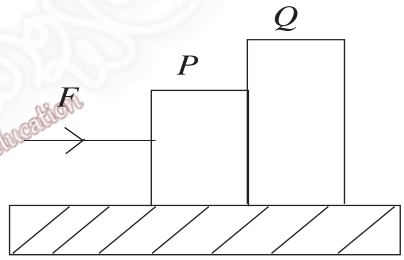


(1) Position of the bulb observed by B is above the position of the bulb observed by A.
(2) Position of the bulb observed by B is below the position of the bulb observed by A.
(3) Apparent position of both A and B are same.
(4) B can observe the bulb but A can not.
(5) A can observe the bulb but B can not.

38. The density of a vacuum which can be produced in the laboratory is 10^{-17} kg m^{-3}. If there are 3×10^{6} molecules in 1 m^{3} and the temperature is 27 °C, the pressure is (Boltzman constant is 1.4×10^{-23} J K^{-1})

(1) 1.26×10^{-18} Pa (2) 1.26×10^{-17} Pa (3) 6.4×10^{-15} Pa
(4) 1.26×10^{-13} Pa (5) 6.4×10^{-13} Pa

39. Two wooden blocks P and Q of different mass are kept in touch and a horizontal force F is applied on P. Mass of Q is greater than the mass of P in the figure. consider the following statements.



horizontal table

A - If the table is smooth, force applied on Q by P is less than $\frac{F}{2}$.

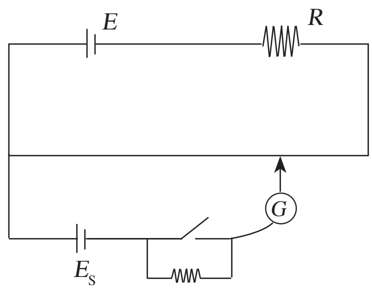
B - If the table is rough, force applied on Q by P is greater than $\frac{F}{2}$.

C - Although the table is rough or smooth, the force on Q by P remains same.

of the above statements,

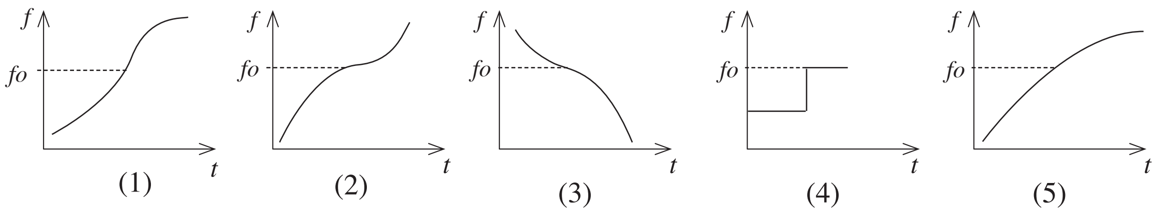
(1) Only A is true. (2) Only B is true.
(3) Only A and B are true. (4) Only A and C are true.
(5) Only B and C are true.

40. To increase the sensitivity of the potentiometer in the figure,



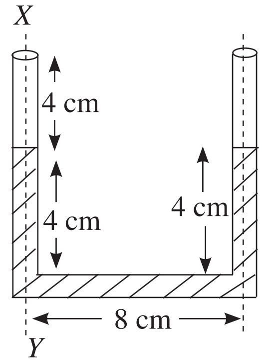
(1) E_s should be increased.
(2) R should be increased.
(3) R should be increased after increasing E_s.
(4) R should be decreased after increasing E.
(5) E should be decreased and R should be increased.

41. A horn emitting a note of frequency f_0 is thrown vertically upwords with a velocity of u, the variation of apparent frequency f with time t as observed by an observer on the ground is,



[See page 9

42. As shown in the figure a vertical u tube is filled with water. The maximum possible angular velocity around XY axis in order to avoid spilling of water from the right arm is, (density of water 1000 kg m^{-3})

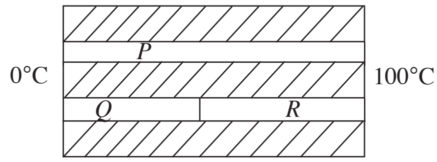


(1) $2\sqrt{2}$ rad s^{-1} (2) $\sqrt{12.5}$ rad s^{-1}

(3) 8 rad s^{-1} (4) $5\sqrt{5}$ rad s^{-1}

(5) 125 rad s^{-1}

43. Bars P, Q and R with equal cross sectional areas are made of materials having the heat conductivities K_1, K_2 and K_3 respectively. Q and R are equal in length and length of P is twice that of Q. $K_1 > K_2 > K_3$. curved surfaces of the bars are insulated (lagged) and the two ends are kept at 0°C and 100°C. Consider the following statements.



A - The rate of heat flow of bars P and Q are same.

B - The temperature at the junction Q - R is greater than the temperature at the midpoint of P.

C - Temperature gradient of R is grater than that of Q

of the above, true statement/ statements is/ are,

(1) Only B (2) Only C

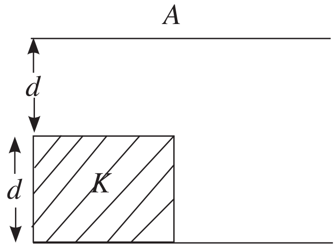
(3) Only A and B (4) Only A and C

(5) Only B and C

44. The ratio between number of turns in a step down transformer is 20 : 1. If this works with a efficiency of 80% the ratio $\dfrac{\text{Current in the primary}}{\text{Current in the secondary}}$ is,

(1) 1/25 (2) 1/20 (3) 1/16 (4) 16 (5) 25

45. Distance between the plates of a parallel plate capacitor is $2d$ and the effective area is A. A block of substance with a dielectric constant K, the thickness d and the area $\frac{A}{2}$ is inserted in between the parallel plates of the capacitor. The equivalent capacitance of the system is,



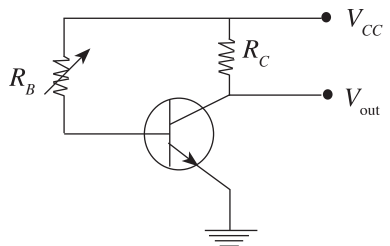
(1) $\dfrac{2K\varepsilon_o A}{(K+1)d}$ (2) $\dfrac{(2K+1)\varepsilon_o A}{2d(K+1)}$

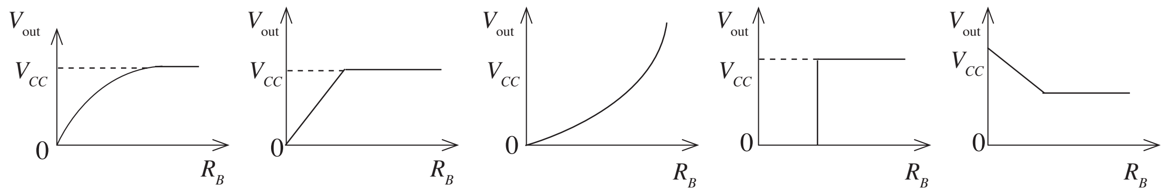
(3) $\dfrac{\varepsilon_o A}{2d(K+1)}$ (4) $\dfrac{\varepsilon_o A\,(2K+1)}{4d(K+1)}$

(5) $\dfrac{2\varepsilon_o A}{2(K+1)d}$

[See page 10

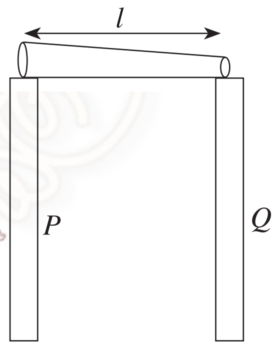
46. The graph that shows the variation of V_{out} with R_B, when the R_B of the circuit in the figure increases from o to a very high value is,





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

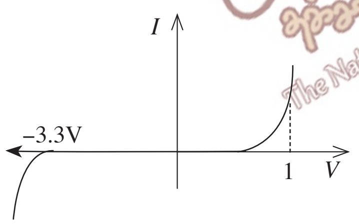
47. A non uniform bar is kept horizontal on the two vertical metal posts P and Q having same dimensions. The Young's modulus of P and Q are y_1 and y_2 respectively. The horizontal distance from P to the centre of gravity of the bar is,

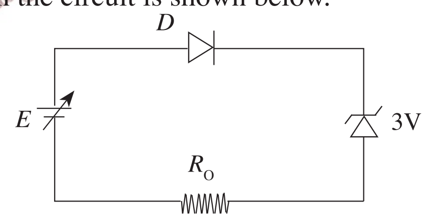


(1) $\dfrac{y_1 l}{y_1 + y_2}$ (2) $\dfrac{y_2 l}{y_1 + y_2}$ (3) $\dfrac{(y_1 - y_2) l}{y_1 + y_2}$

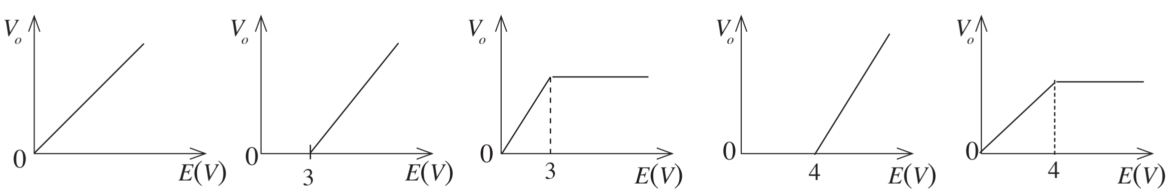
(4) $\dfrac{y_1 y_2 l}{y_1 + y_2}$ (5) $\dfrac{y_1^2\, l}{y_1^2 + y_2^2}$

48. $I - V$ characteristic curve of the diode D in the circuit is shown below.





The best graph represents the variation in potential difference V_0 across the resistor R_0, when the voltage E is increasing is,

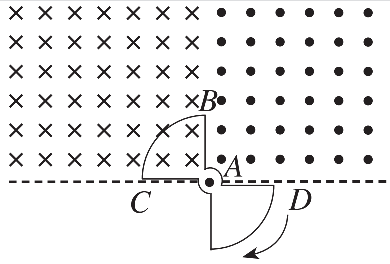


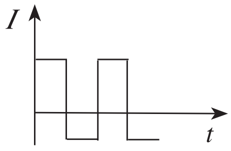
(1) (2) (3) (4) (5)

49. A large number of equal charges, each having charge Q lie on a line at distances of 1 m, 2 m, 4 m, 8 m ... from point P. Electric field intensity at point P would be,

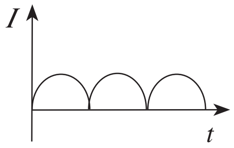
(1) $\dfrac{Q}{2\pi\varepsilon_o}$ (2) $\dfrac{Q}{3\pi\varepsilon_o}$ (3) $\dfrac{Q}{4\pi\varepsilon_o}$ (4) $\dfrac{Q}{8\pi\varepsilon_o}$ (5) $\dfrac{Q}{16\pi\varepsilon_o}$

50. The conducting loop in the figure rotates at a constant angular velocity around its axis A. There are two uniform magnetic fields which are perpendicular to the plane of rotation of the loop according to the figure. Variation in induced current I, with time is well represented by,



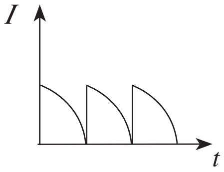


(1)

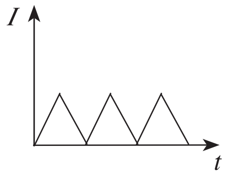


(2)

(3)



(4)



(5)

* * *

G.C.E.(A. L.) Support Seminar - 2015

Physics II | *Three hours*

Instructions :

* **Part A : ** Answer **all** the questions.

* **Part B : ** Answer **only four** questions.

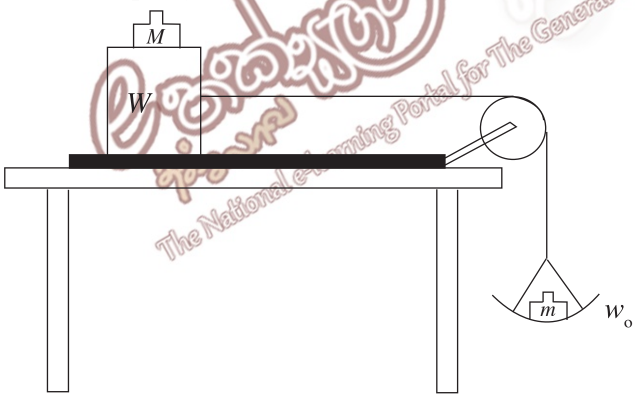
($g = 10$ N kg^{-1})

Part A - Structured Essay

1. You are supposed to determine the static coefficient of friction μ between a wooden plate and a wooden block placed on a table in the laboratory.

(*a*) Write an expression for static coefficient of friction μ in terms of limiting frictional force F, and the normal reaction R.

(*b*) To determine μ a scale pan of mass w_o, a wooden block of mass W, a few extra masses M (0.1 kg, 0.2 kg, 0.3 kg, ...), a smooth and light pulley and a few small masses m including other essential items have been supplied for you. Scale pan and the wooden block are connected by a light inextensible string and the string is passed around the pulley. The experimental setup is given in the figure below.



(i) Mark the forces acting on the wooden block with extra masses and the scale pan in the figure.

(ii) Write an expression for frictional force on the wooden block in terms of m, w_o and the gravitational acceleration (g).

(iii) Write **two** facts that you should take in to the consideration when performing this experiment?

(1)

(2)

(iv) How do you determine the limiting frictional force experimentally?

[See page 2

(v) Obtain the relationship between the independent variable and the dependent variable when you determine the static coefficient of friction μ and write it in the form of $y = mx + c$.

....

....

....

....

(vi) In the above experiment the gradient was 0.4 and the intercept was 0.25 kg of the graph.

(1) Find the value of μ.

....

(2) If w_o is 0.025 kg, find W.

....

....

....

(*c*) μ can be found by inclining the wooden plate on the table after removing the scale pan and the pulley.

(i) What are the two length measurements (l_1, l_2)and the instance which should be obtained to determine μ.

l_1 - .... l_2 - ....

Instance - ....

(ii) Write an expression for μ in terms of l_1 and l_2.

....

2. An experiment is planned to determine specific heat capacity (S) of liquid X using the Newton's Law of Cooling. Specific heat capacity of X is less than that of water (W).

(*a*) (i) Write the **three** factors affecting on the Newton's Law of Cooling.

(1) ....

(2) ....

(3) ....

(ii) Write the conditions under which the Newton's law of cooling is true.

....

....

(*b*) Name **three** measuring equipment that are essential to do this experiment.

(i) ....

(ii) ....

(iii) ....

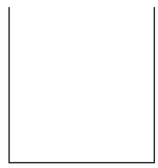
(*c*) (i) Having filled heated water in to a container, a student expects to plot a cooling curve. Another student says that a glass container is **not** suitable for that. Do you agree with this? Give the reasons.

....

....

....

(ii) Mark the level of water that should be filled in the given container.



(iii) Write the reason to fill water up to the level that you mentioned.

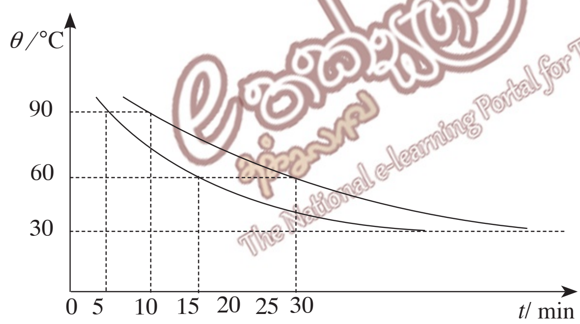
....

....

(iv) Write the reason to fill the heated liquid *X* up to the same level as in (*c*) (ii) for the same container to plot the cooling curve of liquid *X*.

....

(*d*) The two cooing curves obtained here are shown below.



(i) Label the two cooling curves for liquid and water as *X* and *W* respectively in the above figure.

(ii) According to the curves, find the mean rates of cooling of liquid and water from 90 ºC to 60 ºC.

(1) Mean rate of cooling of liquid = ...

....

(2) Mean rate of cooling of water = ...

....

(iii) The heat capacity of the container is 400 J K^{-1}, and the specific heat capacity of water is 4200 J kg^{-1} K^{-1}. The masses of water and liquid are 240 g and 190 g respectively. Find the specific heat capacity (*S*) of the liquid *X*.

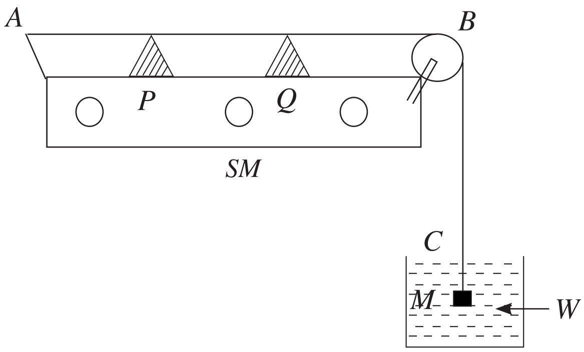
....

....

....

[See page 4

3. A student arranged the following set up to determine the relative density of a metal block of known volume using the sonometer in the laboratory. The sonometer wire is made of the same metal as the metal block is made. The student uses also a set of tuning forks for this experiment.



ABC	=	sonometer wire
P and *Q*	=	bridges
M	=	metal block
W	=	water
SM	=	sonometer box

The length of vibration (l) at the resonance of the fundamental tone of the wire is obtained with a tuning fork of frequency f by the student.

(*a*) (i) At which position the tuning fork should be kept for this purpose? Give the reasons for your answer.

....

....

(ii) At which position on the wire, the paper mounts should be kept to obtain the length l in this experimental process? Mention the reason to keep paper mounts on that place.

....

....

(iii) Explain that how the length l is obtained.

....

....

....

(*b*) (i) If the relative density of the metal is s and volume of the metal block is V, obtain an expression for f in terms of l, V, s, cross sectional area of the wire A and gravitational acceleration g.

....

....

....

....

(ii) Rearrange the expression obtained in (*b*)(i) so as to obtain a graph of a straight line. It should be in the form of $y = mx$ **without** square root terms.

....

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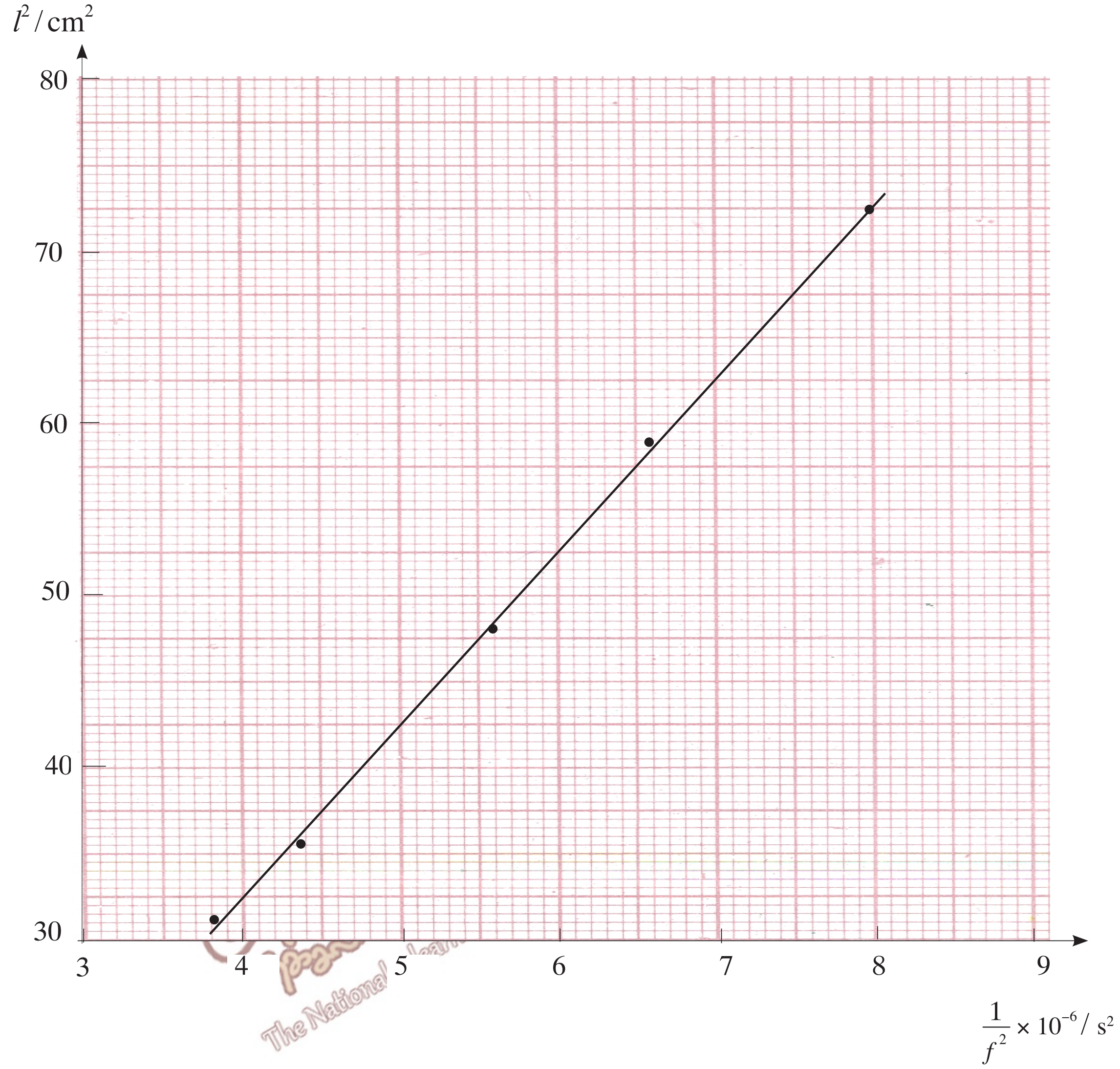
(*c*) The graph plotted by the student using the measurements obtained is shown below.



(i) Find the gradient of the graph.

(ii) If $V = 400$ cm^3, $A = 0.8$ mm^2 find the relative density of the metal.

(*d*) Sound intensity level of the fundamental tone for a given tuning fork is 40 dB. Find the relevant intensity. (Sound intensity for threshold of hearing is 10^{-12} Wm^{-2})

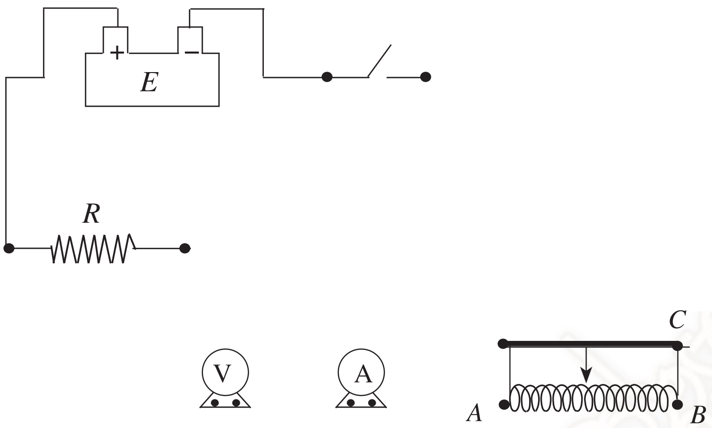
[*See page* 6

4. You are supposed to verify the Ohm's law in the laboratory.

(*a*) Write the relationship among the potential difference V across a resistor, current I and the resistance R.

....

(*b*) The figure shows an incomplete circuit of a setup that uses to verify the Ohm's law with the equipment given.



(i) Connect the equipment voltmeter, ammeter and rheostat to the circuit by drawing the lines and complete the setup. Mark the (+) and (–) terminals of voltmeter and the ammeter.

(ii) How should be the internal resistance of voltmeter and the ammeter relative to R?

Voltmeter : ....

Ammeter : ....

(iii) Indicate the independent variable and the dependent variable to verify the Ohm's law by the graphical method.

Independent variable : ....

Dependent variable : ....

(iv) Why it is **not** suitable to use a resistance box instead of the rheostat for this experiment?

....

....

(v) Why a small current should be sent through constant resistor R in this experiment? Write the reason for that.

....

....

(*c*) (i) The following voltmeter (V) and ammeter (A) readings have been obtained by immersing the resistor R in coconut oil to determine the temperature coefficient of resistance of R. (Consider the voltmeter and the ammeter are perfect.)

Temperature	V **(V)**	I **(A)**
50 °C	4.5	0.05
200 °C	6.0	0.04

....

....

....

....

....

....

(ii) Write **two** properties which should have in a liquid that can be used to determine the temperature coefficient of resistance by this method.

(1) ....

(2) ....

* *

Part B - Essay

(g = 10 N kg^{-1})

* Answer **four** questions only

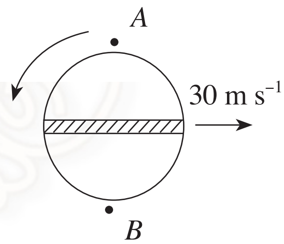
5. (*a*) (i) Write the Bernoulli's principle as an equation. Introduce each term correctly.

(ii) Mention the requirements that should be fulfilled for the validity of Bernoulli's principle.

(*b*) Two styles of balling of a fast bawler are given below.

- Directing the ball straightaway to the batsman without spinning. Then the batsman is tended to protect the wicket
- Directing the spinning ball away from the batsman (out swing) or towards the batsman (in swing). The objective of this balling is to compel the batsman to hit the ball and make him be out.

A bawler throws a ball of mass 150 g with a radius of 3.5 cm towards the wicket with a horizontal velocity of 30 ms^{-1} in still air having the density of 1.3 kgm^{-3} spinning 10 rotations per second about its vertical axis through the centre of the ball. The figure shows the top view of the ball along the spinning axis. (Take π = 3)



(i) What is the direction and the magnitude of the velocity of air relative to the ball?

(ii) What is the tangential velocity of the spinning ball?

(iii) (1) What is the velocity of the layer of air at the point A relative to the ball?

(2) What is the velocity of the layer of air at point B relative to the ball?

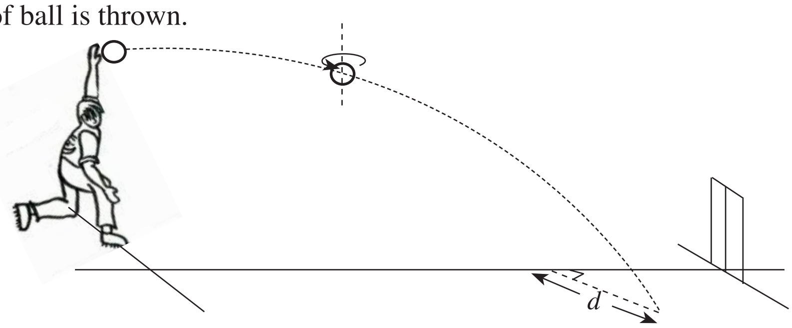
(iv) (1) Find the pressure difference at either sides of the ball at points A and B.

(2) Find the horizontal force on the ball due to above pressure difference.

(3) Draw the change of the path of the ball due to the above force when viewed at the top.

(v) If the ball is released from the hand of the bowler at a height of 1.8 m, from the ground what is the horizontal distance along the direction of ball is thrown, that the ball hits on the ground from the bowler?

(vi) If the ball hits the ground as shown in the figure find the displacement d of the ball, perpendicular to the direction of ball is thrown.



6. The range of vision of a person is 50 cm - 400 cm. The diameter of the eye ball is 2.5 cm.

(*a*) (i) Draw a ray diagram to show the paths of the rays which come from the **near** point of the person to the retina.

(ii) Find the power of the eye lens at the above instance.

(*b*) The above person, who suffers from both farsightedness and nearsightedness hope to wear a pair of spectacles. Such a pair of spectacles is made in a way that the upper part is to view the far and lower part is to view the near. (least distance of the distinct vision of a healthy person is 25 cm)

(i) Find the power of the upper part of the lens.

(ii) Find the power of the lower part of the lens.

[See page 9

(*c*) (i) Draw the ray diagram to show the image of a 2 cm tall object which is 50 cm away from the eye, when the pair of spectacles is not worn.

(ii) Find the angle subtended on eye by the object in radians.

(iii) Find the angle subtended in radians on the retina of a healthy person by the image, when the 2 cm tall object is at 25 cm away from the eye.

(iv) A student says that the person with eye defect sees images by named ege, with lower magnifications compared to a healthy person. Would you agree with this statement? Explain.

(*d*) A healthy person is observing a cell using a compound microscope with the lenses of focal lengths 10 cm and 8 cm. The person with the eye defect says that he cannot see cell properly through microscope with out the spectacles.

(i) Draw a ray diagram to show the way that a healthy person observers the cell when compound increasing in normal adjustment.

(ii) What is the direction that the eyepiece should be moved to see the image of the cell by the person with defect? Find the distance that the eyepiece should be moved?

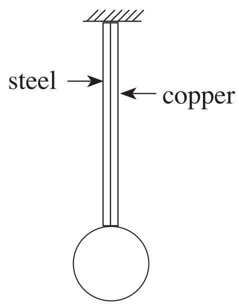
(iii) The angular magnification of a compound microscope at normal adjustment is

$M = \left[\frac{V}{f_o} - 1\right]\left[\frac{D}{f_e} + 1\right]$ .If all the symbols have their usual meanings, find the angular magnification of the compound microscope, relevant to the person with the above defect. The image distance for objective (V) is 24 cm.

7. (*a*) Write an expression for Young Modulus in terms of tensile stress and tensile strain.

(i) A 200 kg sphere is hung by two wires of copper and steel each with 2 m in length as shown in the figure. Find the extension in the compound wire. The diameters of copper and steel wires are 2 mm and 4 mm respectively. (Take $\pi = 3$)

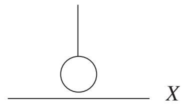
Young modulus of copper $= 1.2 \times 10^{11}$ Nm^{-2}
Young modulus of steel $= 2.0 \times 10^{11}$ Nm^{-2}



(ii) Find the magnitude of the force (F_{cu}) acting in the copper wire.

(iii) Find the magnitude of the force (F_s) acting in the steel wire.

(*b*) Plot the change of extension with immersing height in the compound wire, when it immerse in a liquid as shown in the figure.



(*c*) Find the extension of the wire, when the sphere is immersed completely in theliquid. Radius of the sphere is 20 cm and the density of the liquid is 10^3 kg m^{-3} .

(*d*) (i) When the sphere is immersed in the liquid, if the wire is disconnected suddenly, find the terminal velocity of the sphere. Coefficient of viscosity of water is 0.1 N s m^{-2}.

(ii) Without doing any further calculation, explain why the terminal velocity calculated in above (*d*) (i) is not realistic.

(*e*) Plot the following graphs relevant to the motion of the sphere soon after it is released from the wire.

(i) Momentum Vs time
(ii) Resultant force Vs time
(iii) Displacement Vs time

[See page 10

8. As shown in the figure two parallel square shaped conducting plates with length of a side is 10 cm are kept 2 cm apart. A charge of $-Q$ is given to the upper plate and $+Q$ is given to the lower plate. The electric field intensity between the plates due to the charge is 2×10^{3} N C^{-1}.

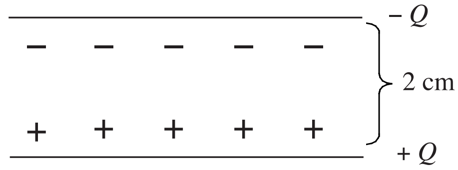


Figure 1

(a)(i) Copy figure 1 in to your answer script and draw the distribution of field lines in the space between plates.

(ii) Find the potential of the upper plate, when the lower plate is earthed.

(iii) Find Q. ($\varepsilon_o = 9 \times 10^{-12}$ F m^{-1})

(b) As shown in figure 2 an electron is projected from the lower (+) plate with a velocity of V_o at an angle of 60° with the lower plate as shown. $V_o = 6 \times 10^{6}$ m s^{-1} and the charge and mass of an electron are 1.6×10^{-19} C and 9×10^{-31} kg respectively.

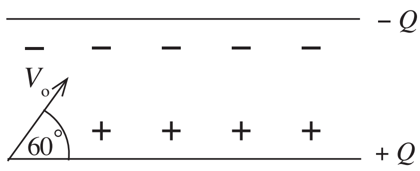


Figure 2

(i) Up to which distance between plates should be increased for not colliding the electron with the upper plate. (Neglect the effect of gravitational field)

(ii) What is the amount of change in capacity due to changing the separation between the plates?

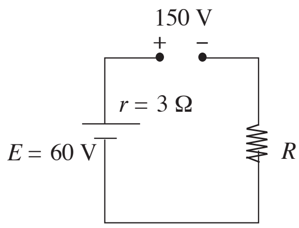
(iii) What is the work done required to increase the separation between the plates?

(iv) Does the potential difference increase due to the change in separation between plates? If so how much is it?

(c) If a conducting sphere is kept in between the conducting plates in (a), draw the distribution of field lines in a diagram.

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

9. (A) (a) A battery with an electromotive force $E = 60$ V and internal resistance $r = 3\ \Omega$ is charged with a 150 V direct current source, suppling 1.5 A current. The circuit diagram for that is shown below.



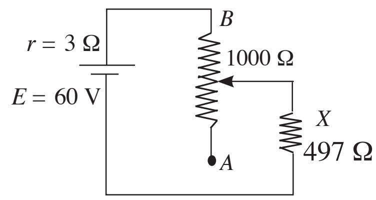
(i) Find R.

(ii) If the battery is charged for 40 hours find the number of kilowatt hours (kW h) spent.

(iii) If one unit of electricity is Rs. 12.50, find the total cost for the electricity used.

(iv) Find the percentage of power dissipated as heat.

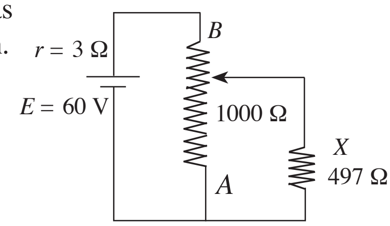
(b) According to the circuit shown, an electric appliance X with a resistance of 497 Ω is connected to the cell charged above.



(i) Find the maximum and minimum currents across X.

(ii) Find the potential differences across X in each instance above.

(c) If the electric appearance X is connected to the circuit as shown below, calculate (i) and (ii) as in above (b) again. Compare the maximum current received in this case with the maximum current received in above (b) (i). Explain your answer.



(*d*) The above battery mentioned in (*a*) is connected to the circuit as in figure 1. In figure 2, two cells *P* and *Q* are connected in parallel instead of the cell in Figure 1. This parallel connection is equivalent to the battery shows in figure 1.

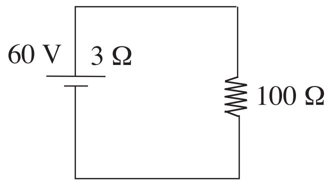


Figure 1

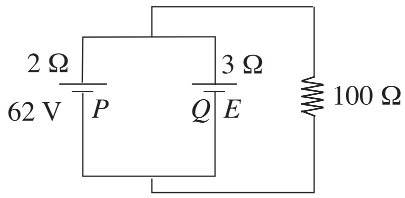
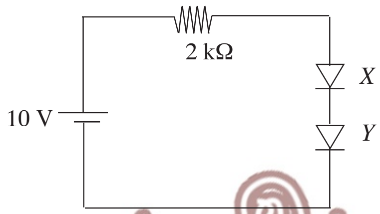


Figure 2

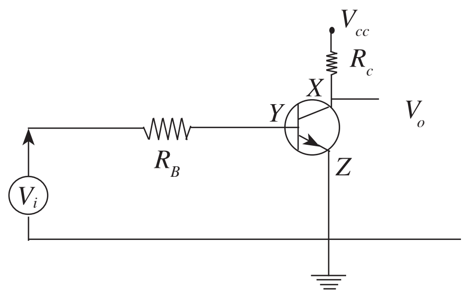
(i) Find the current across 100 Ω resistor.
(ii) Find the electromotive force in cell *Q*.

9. (B) (*a*) Two identical silicon diodes, *X* and *Y*, are connected in series with a cell of 10 V electromotive force as shown in the Figure. Assume that the potential barrier of *Si* diode is 0.7 V.

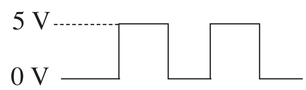


(i) Find the potential difference and the current across 2 kΩ resister.
(ii) If the terminals of diode *Y* are exchanged, what is the current in the circuit?

(*b*) A circuit of a *Si* transistor used in common emitter configuration is shown below.
$V_{BE} = 0.7$ V



(i) Name the terminals *X, Y,* and *Z*
(ii) What are the maximum and minimum values for V_0, if $V_{CC} = 5$ V, $R_B = 300$ kΩ, $\beta = 100$, $R_C = 5$ kΩ, $V_i = 0$ V and $V_i = 5$ V?
(iii) If the variation of V_i for equal time periods is as follows, draw the variation of V_0.
What is the integrated logic gate equivalent to the above circuit?



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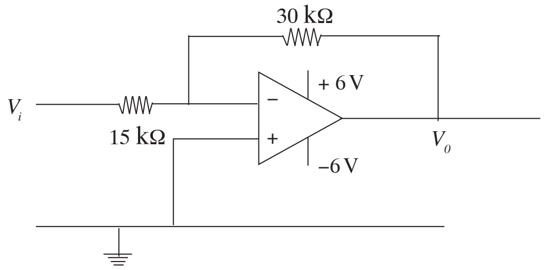
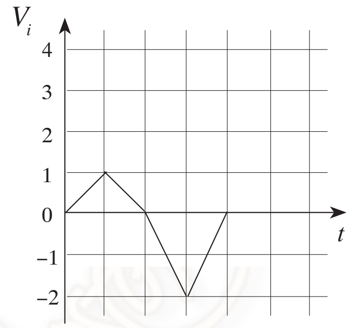
(*c*) Figure shows an operational amplifier circuit with an inverting output.



(i) Find the close-loop gain of the amplifier.

(ii) If input V_i varies as shown draw the variation of output in the same graph by copying it in to your answer script.



(*d*) (i) Write the main difference between the sequential logic circuits and combinational logic circuits

(ii) Draw a circuit diagram for *SR* (Flip-Flop) and give the truth table.

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

10(A) 1 kg of water at 30° C room temperature is kept in a pressure cooker which has 200 $J\,K^{-1}$ heat capacity. Water is heated by a hot plate of 1.5 kW. It takes 200 s for water to reach 80° C. Consider that 80% of the power generated by the hot plate is supplied to the pressure cooker and water. Specific heat capacity of water = 4200 $J\,kg^{-1}\,K^{-1}$

(*a*) (i) Find the total amount of heat absorbed by the cooker and water from supplied heat.

(ii) Find the mean rate of heat loss to the environment from heat supplied, to pressure cooker and water.

(iii) The cooker was remove from the hotplate after reaching to 80° C and allowed to cool. If the mean rate of heat loss at 80° C to 30° C temperature range is equal to the value calculated in above (ii), Find the rate of heat loss at 80° C.

(*b*) The container was opened and allowed the temperature to reach 100° C. Estimate a value for the time period that the water in the container is converted into vapour totally. Assume that the rate of heat loss of the cooker at 100° C is 320 W. Latent heat of vapourization of water = $2.2 \times 10^6\,J\,kg^{-1}$

(*c*) The cooker was closed with a 1 kg of water at 30° C again, the pressure inside cooker is equal to the atmosphere pressure when the lid is closed. Then the cooker was kept on the hot plate and heated until temperature reaches to 105 °C. (Consider the vapoure is not removed from pressure valve)

(i) Calculate the Pressure in the cooker at 105 °C

Saturated vapour Pressure of water at 30 °C	= 54 kPa
Saturated vapour Pressure of water at 105 °C	= 110 kPa
Atmospheric Pressure	= 101 kPa

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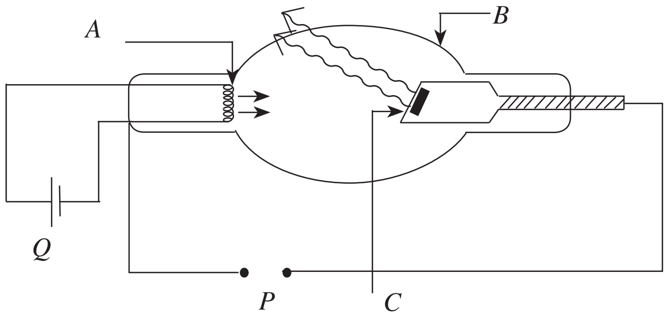
(ii) Why the water remains as a liquid even at a higher temperature like 105 °C?

(iii) Plot the Pressure change P in the Container with water from 30 °C to 105 °C?

(iv) In which instance that it is more advantageous for cooking using a pressure cooker at sea level or on a top of a mountain? Explain your answer.

10. (B) A rough Sketch of a X-ray Producing tube is shown in the figure below.



(*a*) (i) Label A, B and C in the diagram.

(ii) What is the necessity to use a high Voltage supply for P?

(iii) Name a material for C and write the necessity to use that material.

(iv) What is the change has to be done in the set - up to increase the emission of X-ray photons per unit time?

(v) It the wave length λ, of an emmited X-ray photon is 5×10^{-12} m, find the energy of it in eV.
(Plank Constant $h = 6.6 \times 10^{-34}$ J s, Velocity of light $= 3 \times 10^{8}$ m s^{-1},
Charge of an electron $= 1.6 \times 10^{-19}$ C)

(*b*) Photons are emitted in a X-ray tube due to the interaction between matter and electrons. Electrons can be emitted due to the interaction between matter and photons in photo electric effect. Photons with a suitable frequency are allowed to fall on to a metal surface and electrons are released.

(i) Plot the variation of maximum kinetic energy (K_{max}) of emitted electrons, when the frequency (f) of incident photons are changed.

(ii) Mark the threshold frequency (f_0) on the same graph.

(iii) Above photo cell in (*b*) is replaced by a metal Y with a lower work function than the used metal (W) plot the variation of maximum kinetic energy (K_{max}) with frequency (f) on the same graph above and name them.

(*c*) Electrons with a maximum kinetic energy of 1.65×10^{-19} J emitted when a photon with a frequency of 7×10^{14} Hz was incident on to the metal surface.
Calculate,

(i) Work function of the metal (ϕ)

(ii) Stopping Potential (V_s)

(iii) Threshold frequency of the metal (f_0)

* * *