மொறட்டுவை பல்கலைக்கழக பொறியியற் பீட தமிழ் மாணவர்கள்
நடாத்தும் க.பொ.த உயர்தர மாணவர்களுக்கான 7வது
முன்னோடிப் பரீட்சை - 2016

கல்விப் பொதுத் தராதரப் பத்திர(உயர் தர) முன்னோடிப் பரீட்சை - 2016
General Certificate of Education (Adv.Level) Pilot Examination - 2016

பௌதிகவியல் I
Physics I

01 E I

இரண்டு மணித்தியாலம்
Two hours

Important :

- This paper contains **50** questions in **12** pages.
- Answer **all** questions.
- Write **your index number** in the space provided in the answer sheet.
- Choose the **correct** or **most appropriate** answer from the answers numbered **(1) , (2) , (3) , (4) , (5)** for each question from **1** to **50** and put a cross **(X)** according to the **instructions given in the answer sheet.**

Use of calculator is prohibited.

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

1. The dimension of rate of change of momentum is.

(1) MLT^{-1} (2) $ML^{-1}T^{-1}$ (3) MLT^{-2} (4) $ML^{2}T^{-2}$ (5) $ML^{-2}T^{-3}$

2. A micrometer screw guage is used to measure the diameter of a copper rod. The reading of this instrument when measuring the diameter is shown in the figure 1. The rod is removed and the jaws of this instrument are made to coincide and the reading is taken as shown in the figure 2.

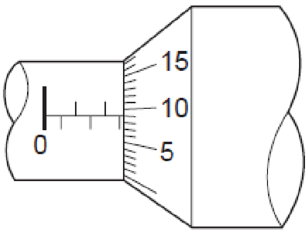


Figure -1

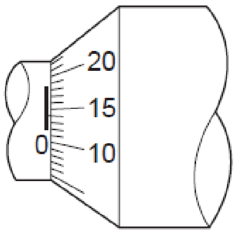


Figure -2

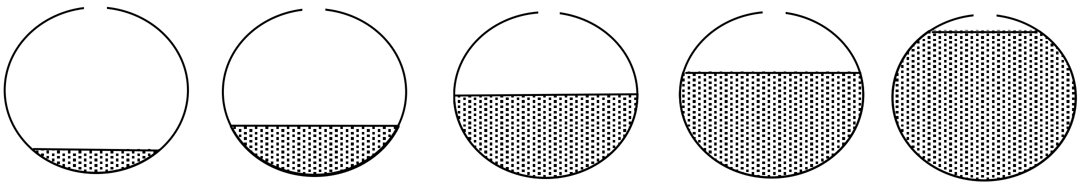
The diameter of the rod is

(1) 1.90mm (2) 2.45mm (3) 2.59mm (4) 2.73mm (5) 5.90mm

3. The noise level at a work site is $90dB$. It is instructed to reduce the noise level to a comfortable noise level as $70dB$. By how much, the intensity should be reduced?

(1) 1000 Wm^{-2} (2) 100 Wm^{-2} (3) 10 Wm^{-2} (4) 99×10^{-5} Wm^{-2} (5) 9×10^{-5} Wm^{-2}

4. Which of the following correctly shows the shape of a liquid making a contact angle of 60^0 with a spherical glass vessel?



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

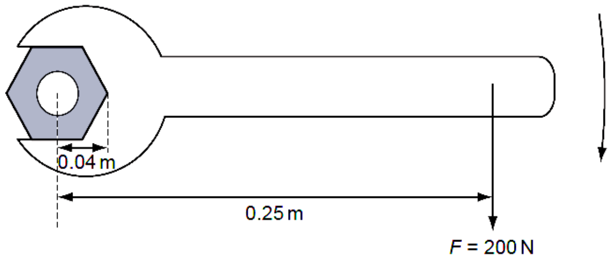
[See page two

5. A force **F** is applied on an object moving freely. At a particular moment the velocity of the object is **V** and its acceleration is **a**. The quantities that should be in the same direction.
(1) **a** and **V** (2) **a** and **F** (3) **V** and **F** (4) all **V, F, a**
(5) None of the above should be in a same direction.

6. A ceiling fan performs 36 rotations until it reduces its angular velocity to 50% of its initial. The number of further rotations it would perform until it comes to rest (its angular deceleration is uniform)
(1) 48 (2) 36 (3) 24 (4) 18 (5) 12

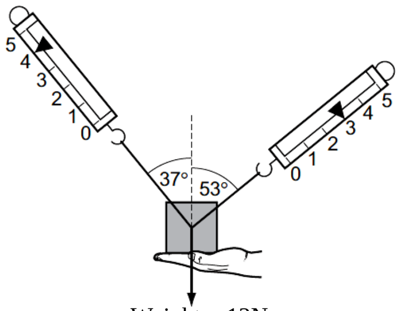
7. The kinetic energy of a vehicle of mass 1000kg is 4.5×10^5J. It is made to come to rest by applying a constant opposing force of 6000N. The distance travelled by the vehicle until it stops is
(1) 37m (2) 75m (3) 150m (4) 300m (5) 750m

8. The figure shows a nut is being tightened by a spanner.



A force F is applied perpendicular to the spanner at a distance of 0.25m from the center of the nut. A force of 200N is applied at the moment the nut is tightening fully. The resistive torque in the anticlockwise direction which prevents the further tightening of the nut is
(1) 8Nm (2) 42Nm (3) 50Nm (4) 1250Nm (5) 5000N

9. The figure shows a mass of 1.2kg which is being born by a hand and two Newton balances.



Using the readings of the newton balances and the angular measurements, find the initial vertical acceleration of the mass when the man takes out his hand suddenly
(1) $0.60ms^{-2}$ (2) $2.36ms^{-2}$ (3) $5.83ms^{-2}$ (4) $6.00ms^{-2}$ (5) $7.00ms^{-2}$

10. An ice block of mass M is kept under the atmospheric pressure at 0^0C. It is heated by a heater of power P for a time t. If the latent heat of fusion of ice is L, the mass of the remaining block of ice after time t is
(1) $M - \frac{Pt}{L}$ (2) $M + Pt + L$ (3) $\frac{Pt}{L}$ (4) $\frac{M}{Pt}$ (5) $M - \frac{PL}{t}$

11. A surgery is done to a patient affected by cataract. An artificial lens of fixed focal length is placed instead of the eye lens of the patient in order to cure long-sightedness. If the depth of the retina is 2cm, the focal length of the artificial lens is
(1) 2 cm (2) 2.5 cm (3) 4 cm (4) 25cm (5) 50 cm

[*See page three*

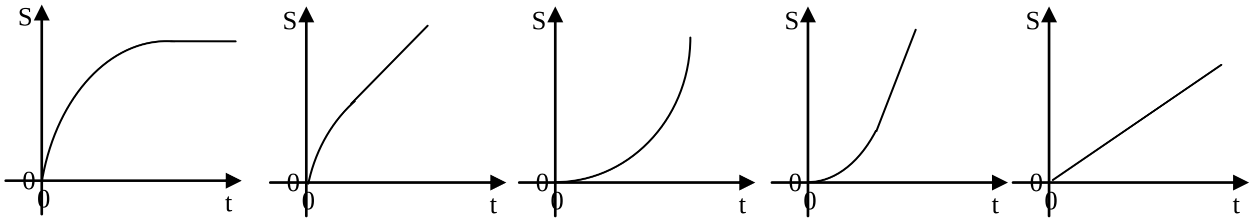
12. When a water tap is closed, the manometer fixed to a water pipe reads 3.5×10^5 Nm^{-2}. The manometer reading when the water tap opened is 3×10^5 Nm^{-2}. The velocity of water through the pipe is

(1) $1ms^{-1}$ (2) $10ms^{-1}$ (3) $100ms^{-1}$ (4) $0.1ms^{-1}$ (5) $1000ms^{-1}$

13. A stationary sound source emits a sound of frequency 600Hz from a place where the speed of sound in air is $300ms^{-1}$. The frequency of the tone heard by an observer moving away from the sound source with the speed of $30ms^{-1}$ is

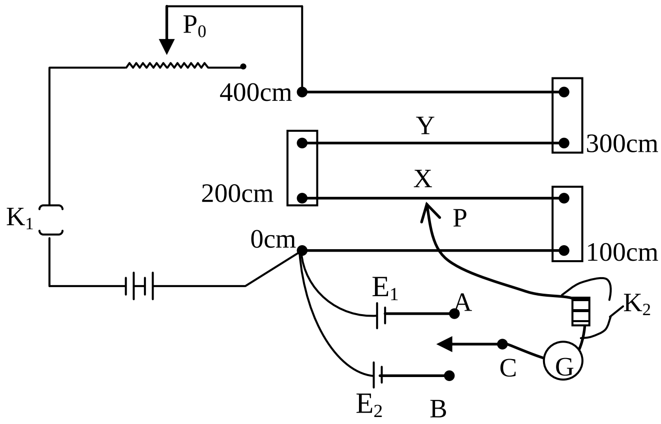
(1) 600Hz (2) 605Hz (3) 660Hz (4) 720Hz (5) 540Hz

14. A tennis ball falls freely from the top of a tall building. The graph which correctly shows the variation of the distance *S* travelled by the ball with time *t* is.



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

15. The galvanometer G shows a zero deflection when the sliding key P touches the points X and Y on the potentiometer wire when the switch C is connected to A and B respectively for a particular position of P_o on the resistor. The ratio of the electromotive forces E_1/E_2 is (X and Y are the midpoints of the particular wires)



(1) 1:2 (2) 2:3 (3) 3:5
(4) 5:6 (5) 1:1

16. A train supplies coal to a power station. The functional measurements of the power station are shown in the table given below.

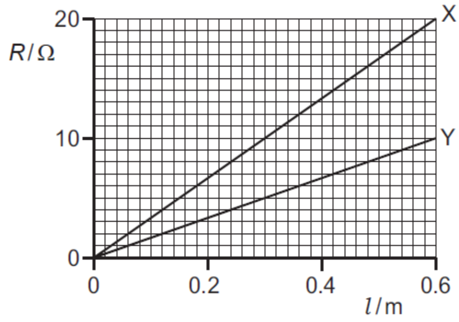
	Symbol	Unit
The output of the power station	P	W
The number of trains per day	N	
The mass of the coal in a train	M	kg
The energy generated from 1kg coal	E	J
The functioning time per day.	t	s

The efficiency of the power station is given by

(1) $\frac{Pt}{NME}$ (2) $\frac{PNt}{ME}$ (3) $\frac{NME}{Pt}$ (4) $\frac{NM}{PEt}$ (5) $\frac{ME}{PNt}$

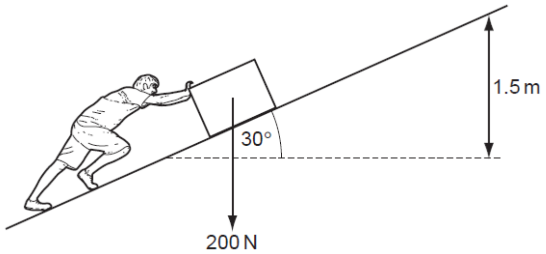
[*See page four*

17. The graph shows the variation of the resistance R with length l for the two rods X and Y made by using the same substance. The relationship that can be obtained from the graph is,



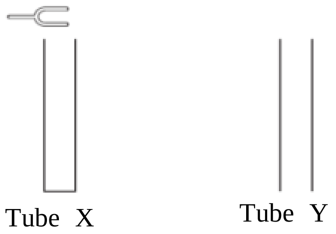
(1) The cross sectional area of X = 2 x cross sectional area of Y
(2) The resistivity of X = 2 x the resistivity of Y
(3) The conductivity of X = 2 x the conductivity of Y
(4) When equal lengths of X and Y are connected to a battery in series, the power dissipated in X = 2 x the power dissipated in Y
(5) When equal lengths of X and Y are connected to a battery in parallel, the current through X = 2 x the current through Y

18. A box of weight 200N is pushed along an inclined path with a uniform speed to a height of 1.5m. The inclined path makes 30^0 with the ground.The frictional force acting on the box when it moves is 150N. The work done by the man is



(1)150J (2) 300J (3) 450J (4) 475J (5) 750J

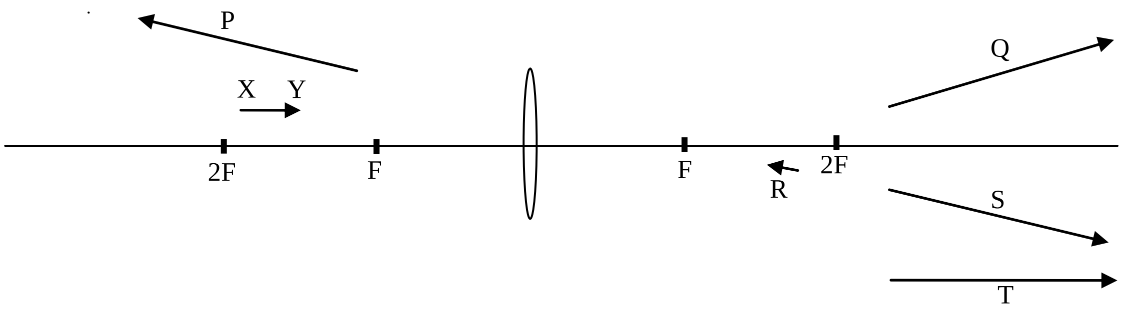
19. The figure shows two similar tubes X and Y. The lower end of the tube X is closed and both ends of the tube Y are opened. When a tuning fork is kept above the tube X, it resonates with the air column at the frequency *f*. The tube X does not resonate with any frequencies which are lesser than *f*. The frequency of the tuning fork which resonates with the tube Y when it is kept above the tube is



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

20. In which of the following instances, a charge of *1C* passes a point in an electric circuit,
(1) The charge passing in 1s when 1*V* potential difference is applied across a resistance of 10Ω.
(2) When 1*A* current passes across a potential difference of 1*V*.
(3) When the power of 1*W* is used for 1*s*
(4) When 5*mA* current passes in 200*s*.
(5) When 10 *A* current passes in 10*s*

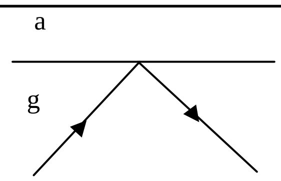
21. A point object is moving parallel to the principle axis of a converging lens from X to Y as shown in the figure. The correct path for the movement of the image formed by the lens is

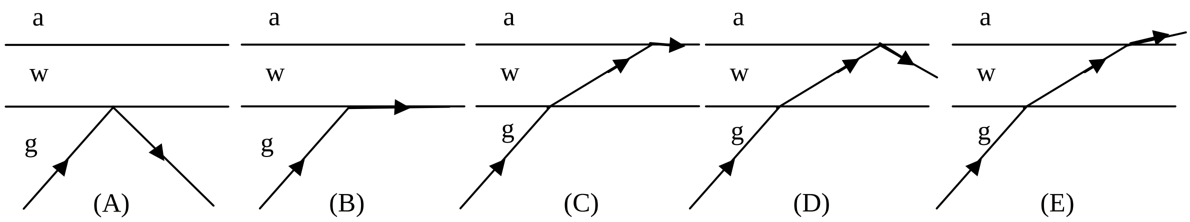


(1) P (2) Q (3) R (4) S (5) T

[*See page five*

22. The figure shows the total internal reflection of a monochromatic light ray on a horizontal glass air interface. Some amount of water is poured on the horizontal glass surface. The possible path/s of the light ray is/are



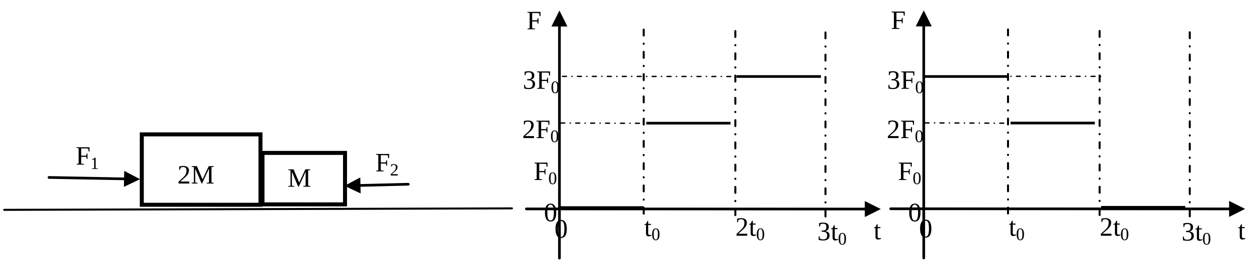


(1) (A) only (2) (B) only (3) (A),(C) only (4) (B),(E) only (5) (A),(B),(D) only

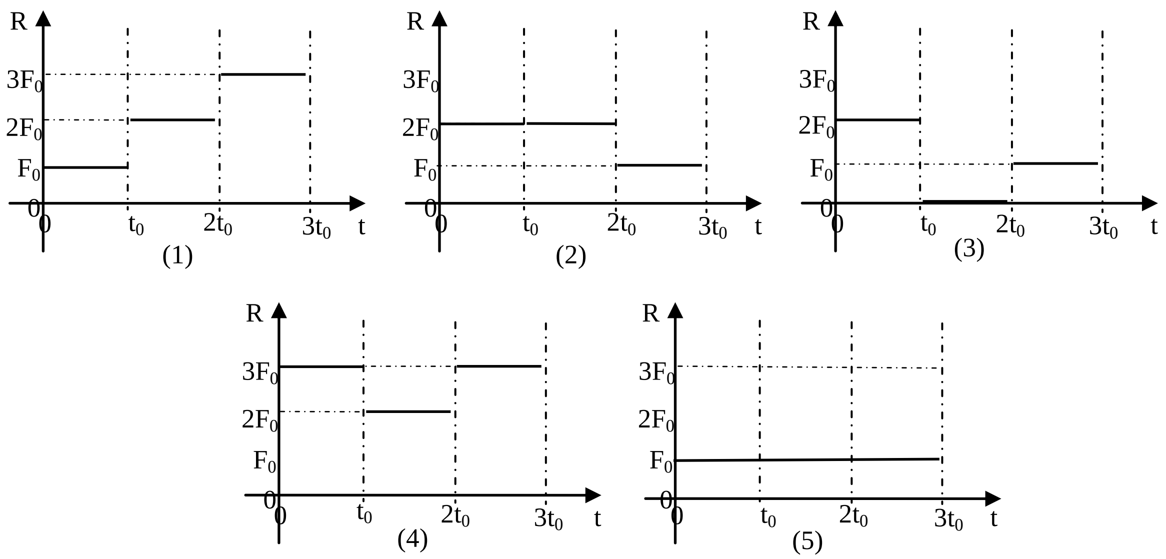
23. The mass of object *A* is twice the mass of the object *B.* The specific heat capacity of A is three times that of B. ΔQ heat is supplied for the object B to experience a temperature change of ΔT . The amount of heat that has to be supplied to A to experience the same amount of temperature change is

(1) $\frac{\Delta Q}{2}$ (2) $\frac{2}{3}\Delta Q$ (3) ΔQ (4) $\frac{3}{2}\Delta Q$ (5) $6\Delta Q$

24.



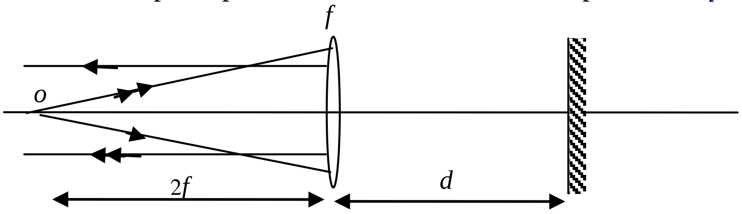
Two blocks of masses $2M$ and M are placed by touching each other on a smooth horizontal floor and the horizontal forces F_1 and F_2 are applied on them respectively. The following graphs show the variation of the magnitude of the forces with time. The graph which correctly shows the variation of the reaction force between the two masses with time is



25. The ratio between the energy of a photon having the wavelength λ and the kinetic energy of an electron having the de Broglie wavelength λ is, (*h* –Plank's constant, *c* – Speed of light in space, *m* – mass of an electron)

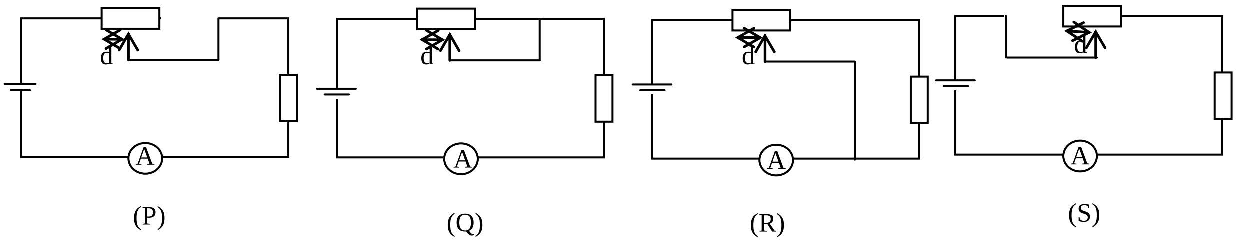
(1) $\frac{m\lambda c}{h}$ (2) $\frac{h}{m\lambda c}$ (3) $\frac{2m\lambda c}{h}$ (4) $\frac{2h}{m\lambda c}$ (5) 1

26. A lens of focal length f and a plane mirror are kept as shown in the figure. A point object O is kept at a distance of $2f$ from the lens. If the rays emerging from the object are incident on the lens and again emitted from the lens parallel to the principal axis, the correct relationship between f and d is



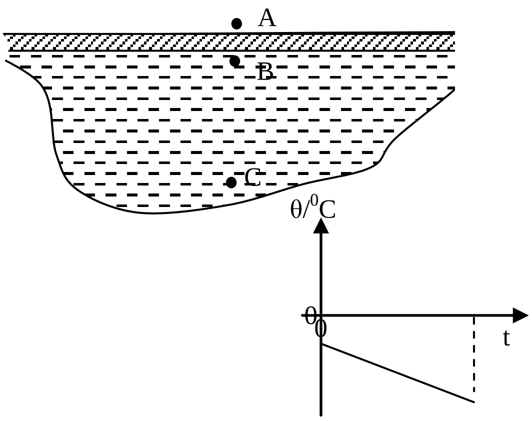
(1) $d = f$ (2) $d = 2f$ (3) $d = 3f$ (4) $2d = 3f$ (5) $3d = 2f$

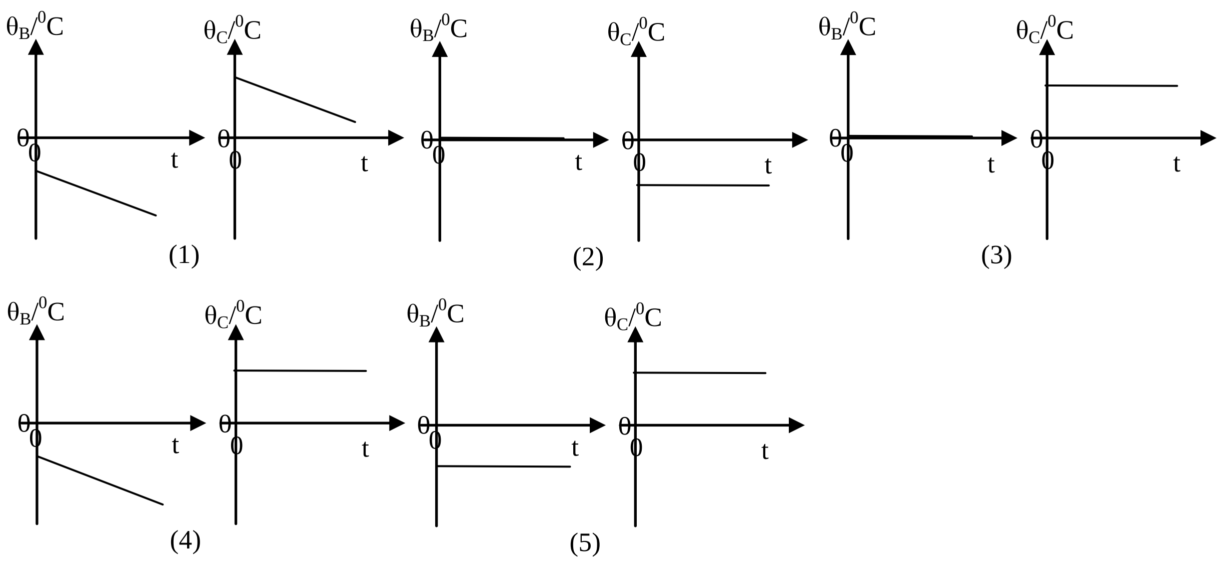
27. Four electric circuits are made by using identical cells having the same electromotive force, ideal ammeters, resistors and connecting wires with no resistance. The circuits which have the same ammeter reading with the distance (d) moved by the sliding key over the resistor are



(1) (P),(Q) (2) (Q),(R) (3) (P),(S)
(4) (P),(Q),(S) (5) Different readings are obtained from each circuit.

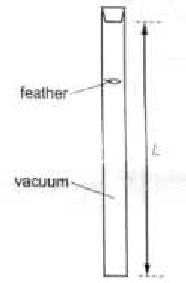
28. The figure shows an ice layer which is formed over the water in a pond in a cold country. The point A is in the air just above the ice layer and the point B is the point of contact of water and the ice layer and the point C is at the bottom of water. The graph shows the variation of temperature (θ) with time (t) for a period of one month. The correct pairs of graphs showing the change of the temperature at the points B and C with time.





[See page seven

29. The figure shows a laboratory experiment in which a feather falls from rest into a vertical vacuum tube of length L. The time taken by the feather to reach the bottom of the tube is T. At the time 0.50T, the distance fallen by the feather from the upper end of the tube is



(1) 0.13L (2) 0.25L (3)0.38L
(4) 0.50L (5) 0.75L

30.

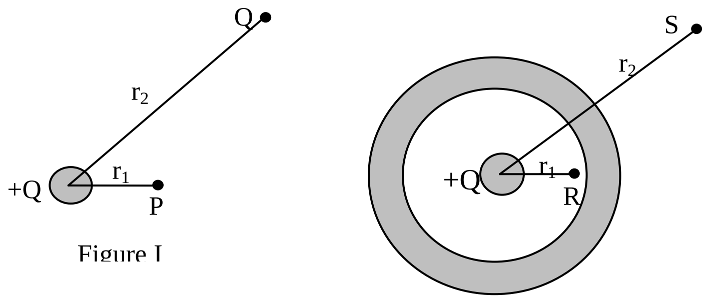


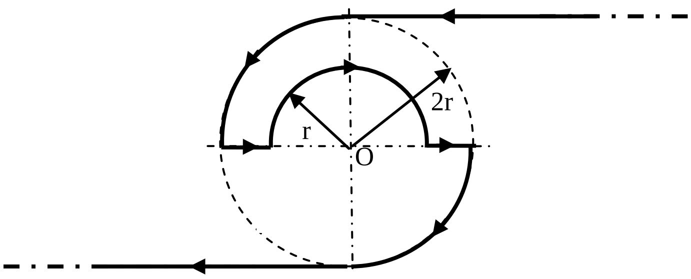
Figure I

Figure II

The figure I shows an isolated solid conducting sphere charged with +Q charge. Figure II shows an isolated system having the above same conducting sphere of charge +Q and a concentric uncharged solid spherical shell. The points (P,Q) and (R,S) are at the distance of r_1 and r_2 from the centre in the figures I and II respectively. The correct relationship between the electric field intensities (E_pE_q,E_R,E_s) and the electric potentials (V_p,V_q,V_R,V_s) is

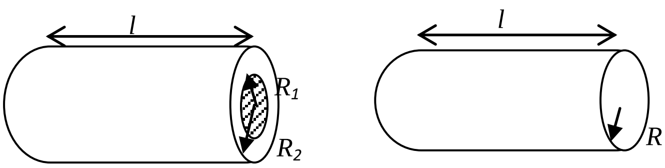
(1) $E_P = E_R$ $E_Q = E_S$, $V_p = V_R$, $V_Q = V_S$
(2) $E_P = E_R$ $E_Q > E_S$, $V_p = V_R$, $V_Q = V_S$
(3) $E_P < E_R$ $E_Q = E_S$, $V_p < V_R$, $V_Q = V_S$
(4) $E_P = E_R$ $E_Q = E_S$, $V_p > V_R$, $V_Q = V_S$
(5) $E_P = E_R$ $E_Q < E_S$, $V_p = V_R$, $V_Q < V_S$

31. A piece of wire is bent into a shape as shown in the figure and a current I is sent in the direction shown. The magnitude of the magnetic flux density at the center O of these curves due to the current is



(1) $\frac{\mu o I}{8r}$ (2) $\frac{\mu o I}{4r}$ (3) $\frac{3\mu o I}{8r}$ (4) $\frac{\mu o I}{4r}\left\{\frac{1}{2}+\frac{1}{\pi}\right\}$ (5) $\frac{\mu o I}{4\pi r}$

32.

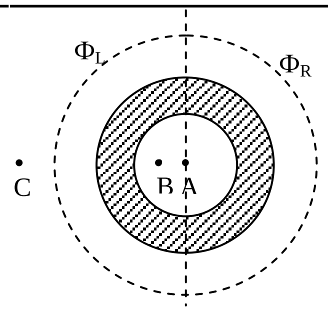


A solid cylindrical substance of length l, radius R_1 and thermal conductivity K_1 is covered by a substance of outer radius R_2 and thermal conductivity K_2. If a solid cylindrical rod of length l and radius R is equivalent to the above combined cylinder then the thermal conductivity of the cylindrical rod is

(1) $\frac{K_1+K_2}{2}$ (2) $\frac{K_1R_1^2+K_2\left(R_2^2-R_1^2\right)}{R^2}$ (3) $\frac{K_1R_1^2+K_2R_2^2}{R^2}$ (4) $\frac{K_1K_2(R_1^2+R_2^2)}{R_2}$ (5) $\frac{K_1K_2(R_1^2-R_2^2)}{(K_1K_2)R^2}$

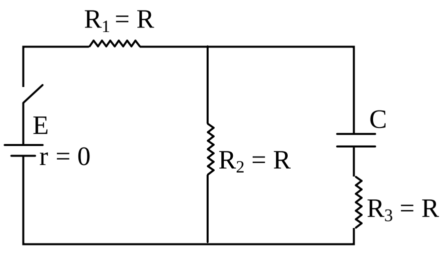
[*See page eight*

33. A Gaussian surface which is drawn concentrically around an isolated uncharged solid spherical shell of centre A is shown by the dotted lines. The electric fluxes through the left and right hemispherical divisions are Φ_L, Φ_R respectively. The correct relationship between them in the following conditions is.



	When the point charge Q is at A	When the point charge Q is at B	When the point charge Q is at C
(1)	$\Phi_L = \Phi_R > 0$	$\Phi_L = \Phi_R > 0$	$\Phi_L = \Phi_R = 0$
(2)	$\Phi_L = \Phi_R > 0$	$\Phi_L < \Phi_R > 0$	$\Phi_L > \Phi_R > 0$
(3)	$\Phi_L = \Phi_R = 0$	$\Phi_L > \Phi_R > 0$	$\Phi_L = \Phi_R = 0$
(4)	$\Phi_L = \Phi_R > 0$	$\Phi_L < \Phi_R < 0$	$\Phi_L > \Phi_R > 0$
(5)	$\Phi_L = \Phi_R > 0$	$\Phi_L = \Phi_R > 0$	$\Phi_L > \Phi_R > 0$

34. Which of the following statement/s is/are correct regarding the given circuit,



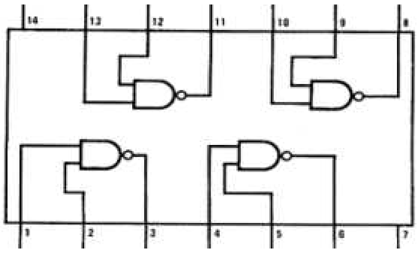
A. When the switch is turned on, the current through the cell is $\dfrac{E}{2R}$

B. At the state when the switch is closed, when the resistance R_1 increases, the charge saved in the capacitor decreases.

C. When the switch is closed and when R_3 increases, the charge saved in the capacitor decreases.

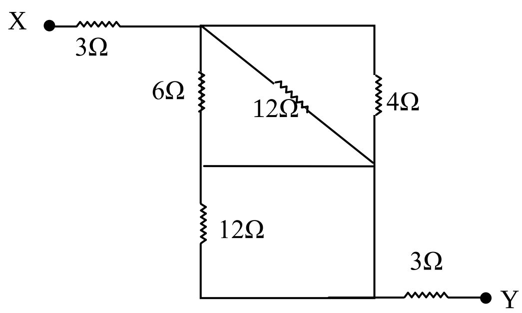
(1) (A) only (2) (B) only (3) (A),(B) only (4) (B),(C) only (5) All (A),(B),(C)

35. The figure shows an integrated circuit containing NAND gates and the power source required for their functioning. The required number of input legs, output legs and the number of connection legs required to obtain an AND gate is correctly given by



	Input	Connections	Output
(1)	1,4	2,5	6
(2)	1,2	3,4,5	6
(3)	1,2	3,4	6
(4)	13,10	12,11,9	8
(5)	1,2	3,10	8

36. The equivalent resistance between X and Y in the given network of resistors is

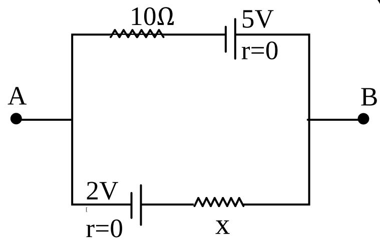


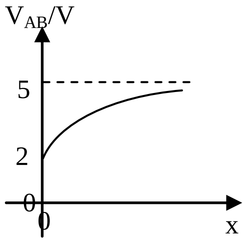
(1) 2Ω (2) 5Ω (3) 6Ω

(4) 7Ω (5) 8Ω

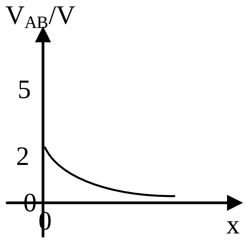
[See page nine

37. The cells 5V and 2V have constant electromotive force and their internal resistances are negligible. The graph which correctly shows the variation of the potential difference V_{AB} between A and B with the variable resistance x is

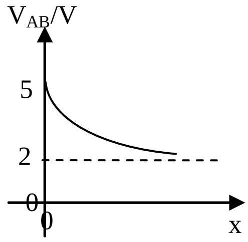




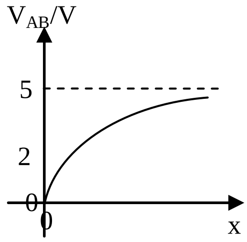
(1)



(2)



(3)



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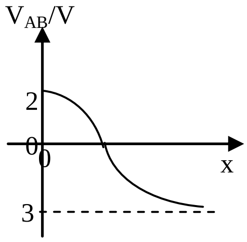

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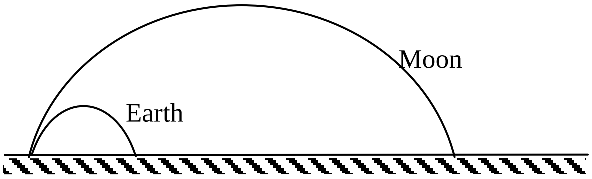
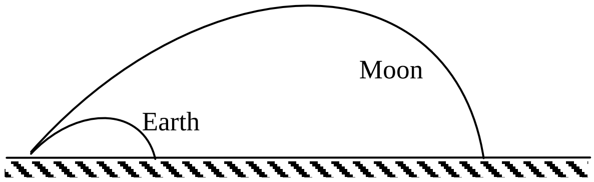
38. A golf ball hits the earth and the moon with same force in the same direction. The shape of the path of the golf ball is



(1)



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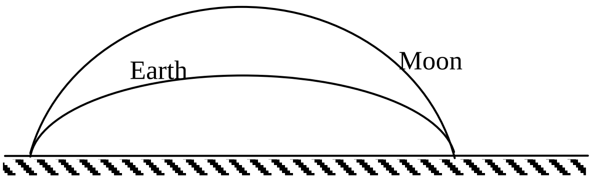

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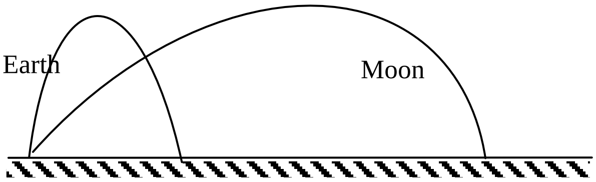

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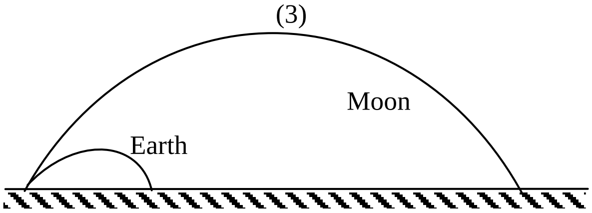
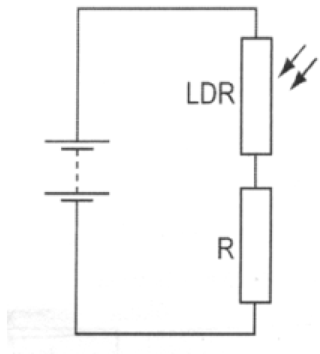


(5)

39. A Light dependent resistor (LDR) is connected to a circuit with a resistor R and an electric cell. When the light does not fall on LDR, the resistance of it is equal to R. When the intensity of light falling on LDR increases, the correct statement is



(1)The current in R decreases.

(2)The current in LDR decreases.

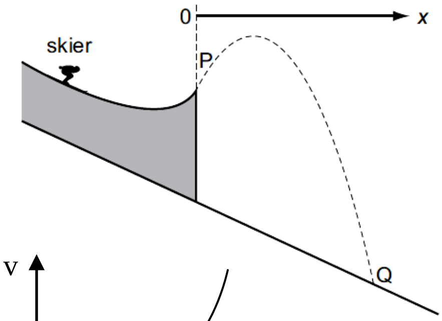
(3)The power generated by the cell decreases.

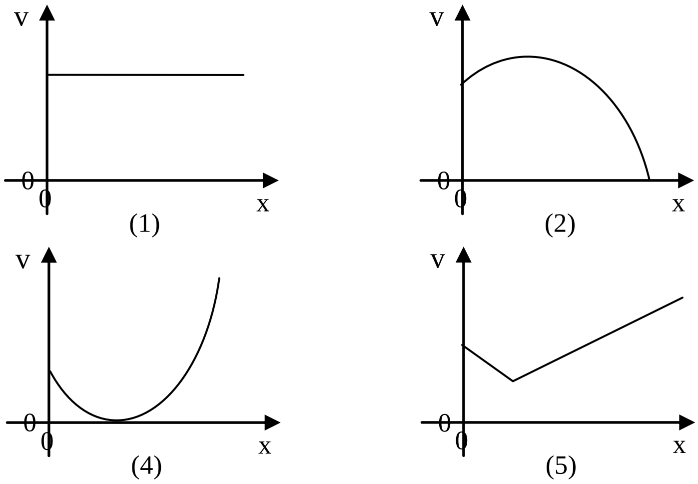
(4)The potential difference across R decreases.

(5)The potential difference across LDR decreases.

[*See page ten*

40. The path of a competitor in a ski-jumping competition is shown by the dotted lines. The graph which correctly depicts the change of the speed of the competitor (V) with the horizontal distance(x) in the path from the initial point P to the point Q where he lands is. (Neglect the air resistance)

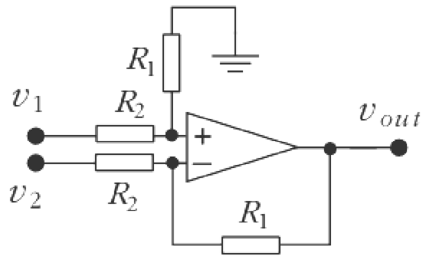




41. An electric smoking device is introduced to reduce the ill effects caused for smokers. There is a saving cell is used inside this. The smoking process is done by vaporizing a liquid with the help of a heating coil found inside the device. The special characteristics that should be possessed by this liquid for the long term use after charging this cell.

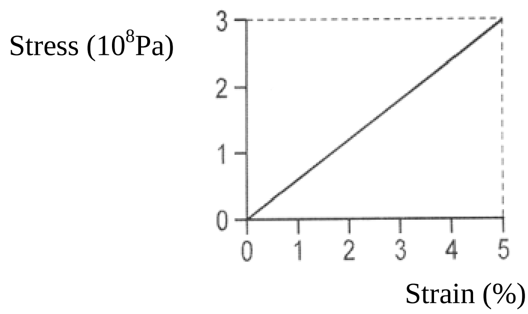
	Specific heat capacity	Latent heat of vaporization	Boiling point
(1)	High	High	High
(2)	Low	Low	Low
(3)	High	High	Low
(4)	Low	High	High
(5)	Low	Low	High

42. V_1 and V_2 are 3V and 1V and R_1, R_2 are 2kΩ, 1kΩ respectively in the operational amplifier circuit shown in the figure. The output voltage(V_{out}) is



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

43. The stress and strain on the metal rods in an experiment are denoted in the graph where the stress axis is in the unit of 10^8Pa and the strain axis is denoted in percentage (%). The Young's modulus of the substance of the rod.



(1) 6.0×10^7Pa (2) 7.5×10^8Pa
(3) 1.5×10^9Pa (4) 6.0×10^9Pa
(5) 6.0×10^{10}Pa

[See page eleven

44. When the mass and radius of the earth reduces by 1%,,

(1) The escape velocity reduces

(2) The escape velocity increases

(3) The acceleration due to gravity decreases

(4) The acceleration due to gravity increases.

(5) The acceleration due to gravity does not change

45. A system of ideal gases is compressed from a particular pressure and volume to another volume. The incorrect statement regarding this compression is

(1) When the volume is halved, the absolute temperature is also halved at a constant pressure.

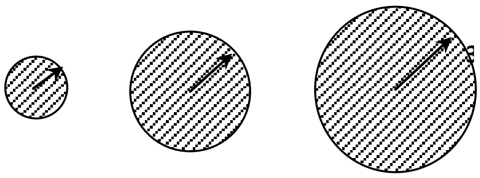
(2) When the volume is halved, the pressure doubles at the isothermal process.

(3) When the gas is compressed in the isothermal process, the work done on the gas is equal to the heat energy released from the system.

(4) When the gas is compressed in adiabatic process, the work done on the gas is equal to the increase in the internal energy.

(5) More work has to be done on the gas in the adiabatic process than that in the isothermal process when the volume of the gas is compressed to half of its initial value.

46.



The masses of the solid spheres of radius R,2R and 3R are equal. When the sphere of radius 3R is dropped inside a liquid, it is fully immersed and in the equilibrium state. When the spheres of radius R and 2R are allowed to move inside the liquid, the sphere of radius R reaches the terminal velocity V_{0}, What is the terminal velocity attained by the sphere of radius 2R?

(1) $\frac{8V_0}{52}$ (2) $\frac{5V_0}{8}$ (3) $\frac{19V_0}{26}$ (4) $\frac{19V_0}{52}$ (5) $\frac{9V_0}{17}$

47. An opened glass vessel which was kept inside the room X is taken into the room Y after it is closed air tight. Consider the following statements,

(A) If the water vapour condenses on the surface of the vessel instantly, the temperature of the room Y is greater than the temperature of the room X.

(B) If water vapour condenses on the inner surface of the vessel after some time, the temperature of room Y is less than the temperature of the room X.

(C) If water vapour condenses on the inner surface of the vessel after some time, the relative humidity of the room Y is less than the relative humidity of room X,

Of the above statements,

(1) Only (A) is correct

(2) Only (A),(B) are correct

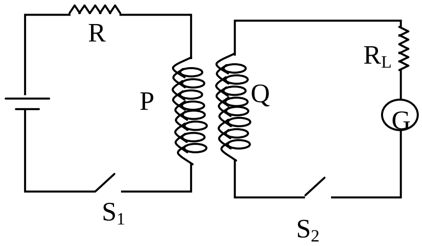
(3) Only (B),(C) are correct

(4) Only (A),(C) are correct

(5) All (A),(B),(C) are correct

[*See page twelve*

48. Consider the following statements made about the deflection of the galvanometer G.



(A) If S_1 is closed when S_2 is closed, a deflection occurs and again comes to zero.

(B) If S_2 is opened when S_1,S_2 are closed, a deflection occurs and again comes to zero.

(C) The maximum deflection of the galvanometer which occurred in the above two processes are equal.

The correct statement/s is/are,

(1) (A) only (2) (B) only (3) (A),(B) only

(4) All (A),(B),(C) (5)None of (A),(B),(C)

49. The following four figures show a cylindrical vesssel of thin wall and a block which floats on steady water. The incorrect relationship between h_1,h_2,h_3,h_4,h_5,h_6 is, (the figures are not drawn to scale)

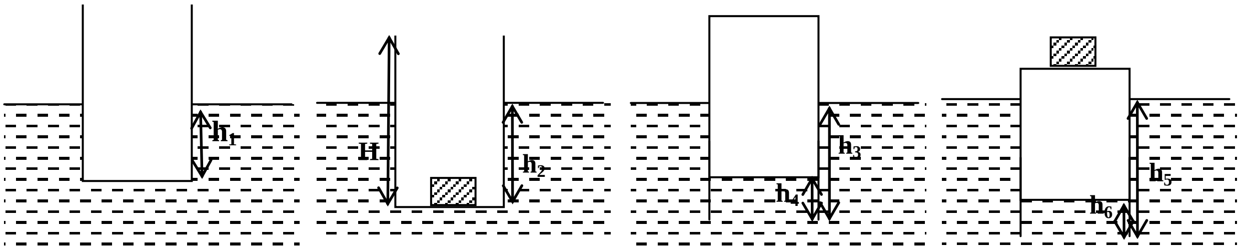
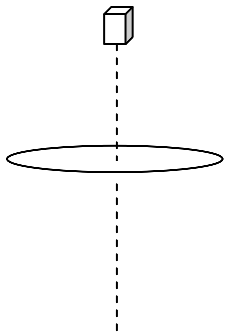
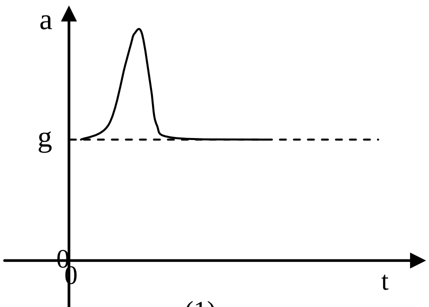


Figure I Figure II Figure III Figure IV

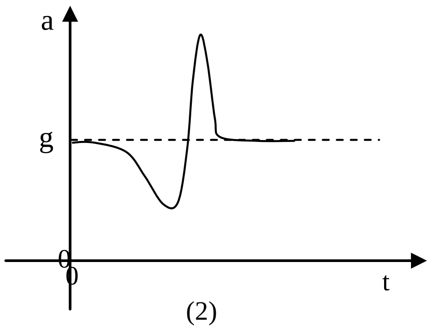
(1) h_3-h_4 =h_1 (2) h_6-h_4 = h_2-h_1 (3) h_5- h_6 =h_2 (4) H-h_1> H-h_2 (5) H-h_1 = H –(h_3-h_4)

50. A bar magnet is dropped freely along the axis of a fixed rigid circular conductor which is in a horizontal plane. The graph which correctly shows the variation of acceleration (a) with time (t) in the subsequent motion is.





(1)



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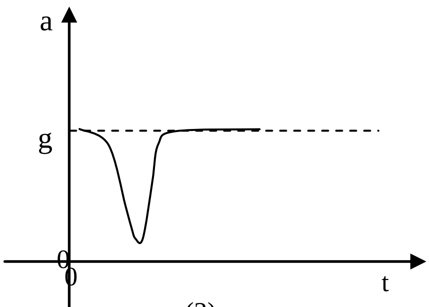

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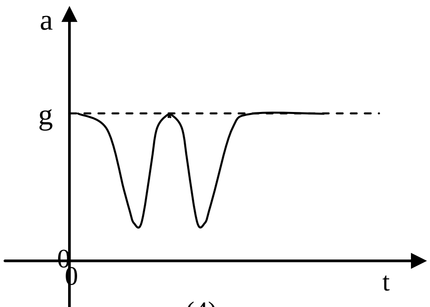

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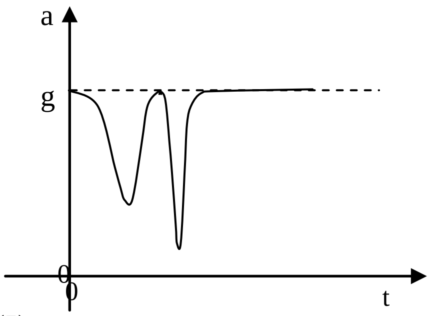

(5)

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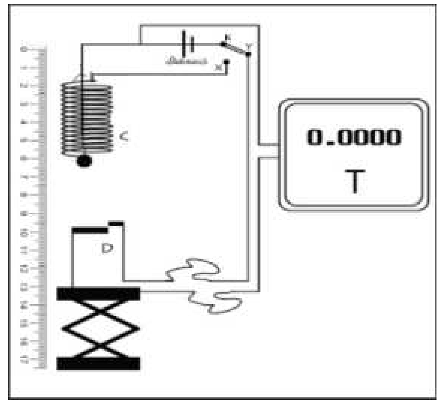
Part A - Structured Essay

Answer all the questions on this paper itself.

Each questions carries 60 marks.

01. A student designed a new method to find the gravitational acceleration g using an electrical method as shown in the figure. Here the electric coil C which is used to make a temporary magnet is attached to the digital clock T. The student further explained that, when the switch is opened T starts to work and stops when the switch D is closed.



a. What is the reason for the selection of the steel ball by the student?

……

……

b. Give an advantage regarding your selection in part (a) for the above experiment.

……

……

c. Briefly give the steps of this experiment.

……

……

d. Write down the readings recorded by the student and state how they can be obtained.

……

……

e. What is the change which you could do to get many readings?

……

……

f.

i) Write down the equation to find the gravitational acceleration g from your readings.

……

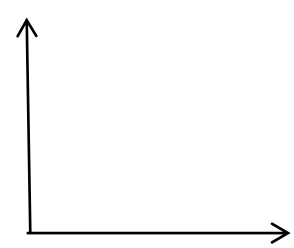
……

ii) Give the independent variable and the dependent variable.

……

……

g. Draw the expected straight line graph in the given axes and state how g can be found. (Clearly label the axes.)



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h. Find the gravitational acceleration if the gradient of the graph is 0.2016

....

....

i. If the expected value for g in this experiment is 10m/s, find the percentage error in this experiment

....

....

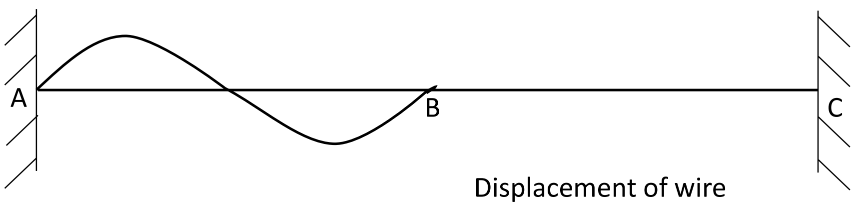
02. The experiment to find the speed of sound in air by using the resonance method is given below.

a. Why sonometer wire is connected to sound box? Explain.

....

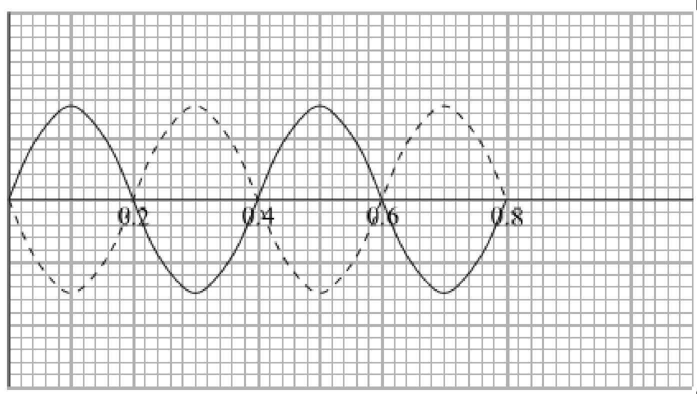
....

b. Density of a sonometer wire AB is 4 times the density of sonometer wire BC, other dimensions are same. The figure shows the propagation of a wave through AB, draw the continuation of the wave in wire BC



Displacement of wire

c. The figure below shows the formation of wave in a sonometer wire of effective length 0.8m.



Displacement along wire

1) Explain how the above wave is formed?

....

....

....

2) Find the wavelength of the above wave using the diagram.

....

3) Find the resonance frequency interms of length (l), mass per unit length (m) and the tension (Mg).

....

4) If M = 4 kg, m = 0.025 kgm^{-1} find the resonance frequency.

....

....

....

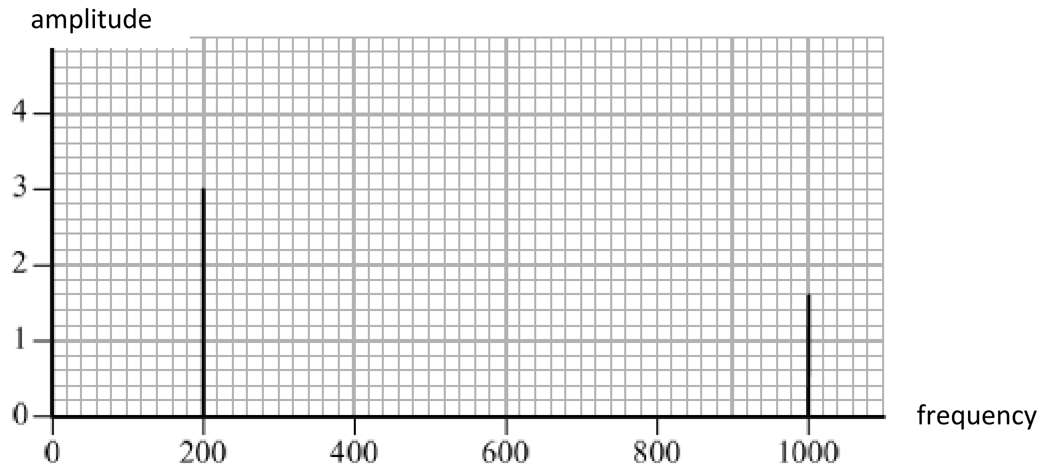
5) State two difference between the waves formed in sonometer and tuning fork.

....

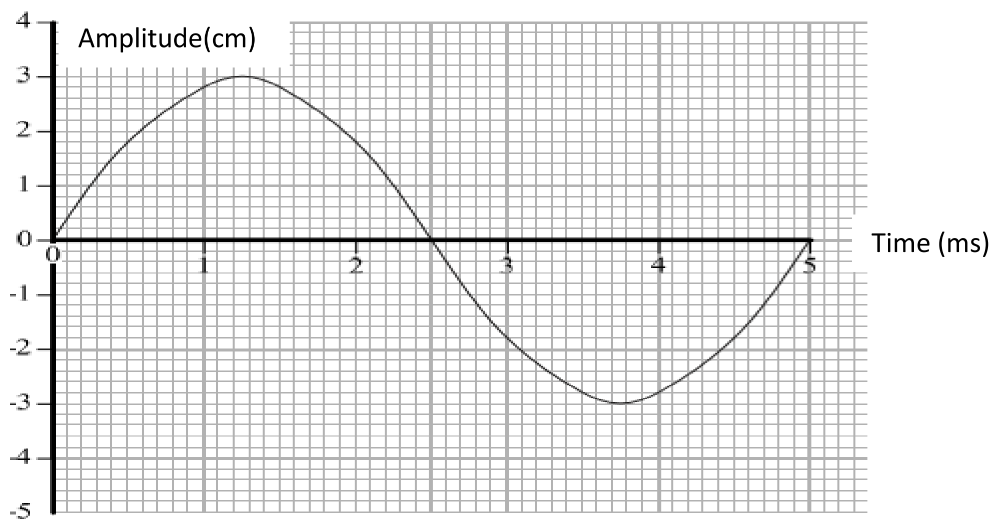
....

....

d. The wave that is obtained by vibrating sonometer is tested using cathode ray tube. The frequency spectrum of that wave, frequency plotted against amplitude is given below.



The graph below shows a wave of frequency 200Hz. Draw a wave with frequency 1000Hz on the same graph.



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03. Nowadays many experiments in Physics are made quickly and accurately by using computers. And this is also welcomed by many students. A heat sensor is connected to a computer by using an interface unit during the validation of Newton's cooling law and when obtaining the specific heat capacity of a liquid from Newton's cooling curve.

The 2 setups were arranged at the same time as shown above. Water was used in one of the setups while oil in the other. Both were heated and allowed to cool simultaneously. Both results were sent to a computer and the variation of the temperature with time was obtained in the screen of the computer.

a. i.State Newton's law of cooling.

………

………

ii.What are the conditions for it to be valid?

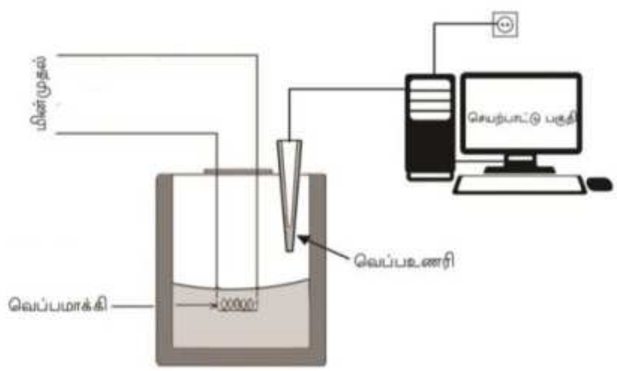
………

………

iii.Why is it important to take equal volumes of water and oil?

………

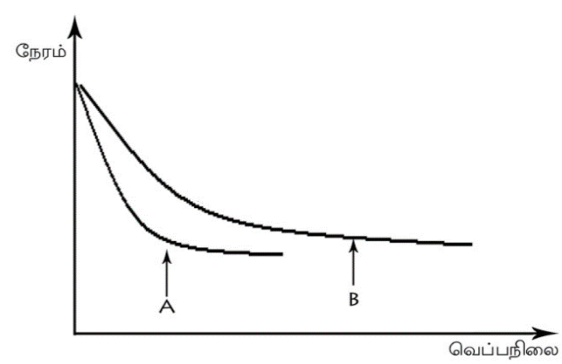
………



b. Identify the liquids which are used to obtain the above curves.

A: ……………………………………………………………………

B: ……………………………………………………………………



c. I. What are the two important equipment which are not used when a heat sensor, interface unit and a computer are used in place of them?

1. ……………………………………………………………………………

2. ……………………………………………………………………………

II. State the difficulties faced by a student when using the equipment stated in (b) I. above.

………

………

d. I. Consider the heat capacity of the calorimeter used in this experiment is negligible. It is given that the specific heat capacities of water and oil are S_w and So and their masses are M_w and M_o respectively. If

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water and oil took the times t_1 and t_2 to cool from the temperature Q_1 to Q_2, write down an expression relating them.

....

....

II. Calculate S_o, if M_w=30g,M_o=40g ,Q_1=69°C ,Q_2=29°C,t_1=50 min,t_2=25 min and S_w=4200$Jkg^{-1}K^{-1}$

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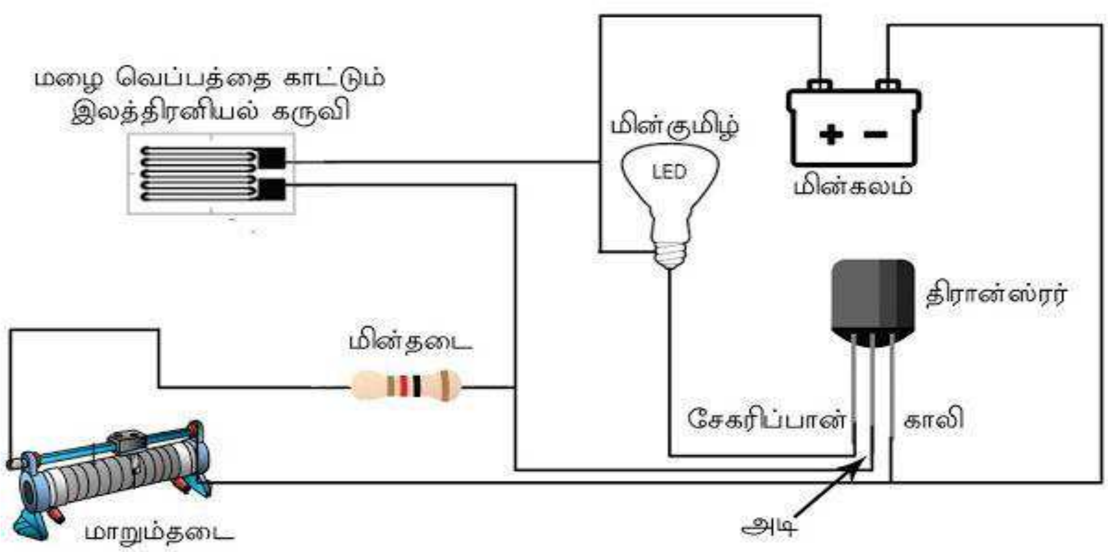
....

04. The diagram shows the circuit diagram of the electronic instruments in an electronic device used to show the temperature of the rain water.



a. Draw a circuit diagram by using the circuit symbols for the instruments A to E in the box given below.

b. i.How would you identify the transistor terminals?

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....

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ii.What is the transistor configuration used here?

....

....

iii.What are the advantages of this setup?

....

....

(iv)Give the state of the transistor when V_{CC}=o Volt, V_{CE}=6 Volt V_{CE}=3 Volt

....

....

c. If the light c glows when it rains, explain briefly how the device works.

....

....

d. If the variable resistor is corrected to Rh=0, what is the base current I_b?
Find also the collector current Ic and emitter voltage $V_{CE.}$

I_b=.................................. I_c=.................................. V_{CE}=.................................

e. A student suggested that if the transistor system is removed and E, C, Rh and S are connected in series the same function can be obtained.

i.State the truth in his statement.

ii.State 2 disadvantages which could occur in part e)i. and prove that connecting that transistor is only suitable for this circuit.

1) ....

2) ....

f. A simple electric circuit is formed connecting a dry cell, a bulb and a switch in a series. The switch opened state 0 and the switch closed state 1 during the wind is shown in the tables (a) and (b).

Switch A	Bulb
Opened state	Doesn't glow
Closed state	glows

I. Complete the table for the circuit containing A, B by taking the above table as a model.

Input A	Output Z
0	0
1	1

II. Write the name of the logical gate for this table and draw the circuit diagram in the box given below.

மொறட்டுவை பல்கலைக்கழக பொறியியற் பீட தமிழ் மாணவர்கள் நடாத்தும் க.பொ.த உயர்தர மாணவர்களுக்கான 7வது முன்னோடிப் பரீட்சை - 2016

கல்விப் பொதுத் தராதரப் பத்திர(உயர் தர) முன்னோடிப் பரீட்சை - 2016

General Certificate of Education (Adv.Level) Pilot Examination - 2016

பௌதிகவியல் II
Physics II

01	E	II

PART B - Essay

*Answer **four** questions only*

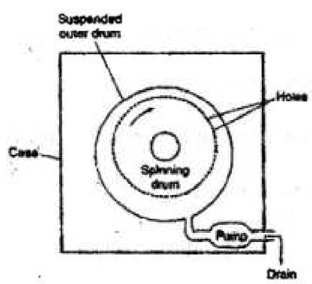
($g = 10\ N\ kg^{-1}$)

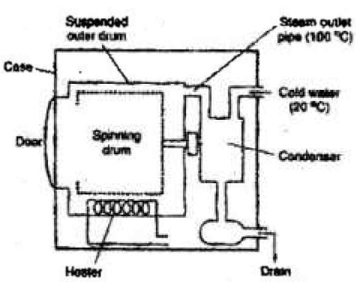
5. (a) (i) Explain what is meant by the moment of inertia of a body.

(ii) Why is there no unique value for the moment of inertia of a given body?

(iii) A rigid body rotates about an axis with an angular velocity ω. If the relevant moment of inertia of the body is I, show that its rotational kinetic energy is $\frac{1}{2}I\omega^2$.

(b) This is about aspects of operation of an automatic washing machine. The question is concerned with the spinning and drying parts of the process.





(i) It takes 5.0 s to accelerate a loaded drum from rest to a speed of 13 rev s^{-1}. The moment of inertia of the loaded drum including the water is 0.90 kgm^2. Assuming that the moment of inertia of the loaded drum remains constant. Calculate,

1. The mean angular acceleration.
2. The mean accelerating torque.
3. The final rotational energy.
4. The final angular momentum.

(ii) In fact the torque exerted by the motor on the drum starts at a high value and decreases to a lower constant value. Explain why this constant torque does not lead the drum accelerating indefinitely.

(iii) After spinning , the machine tumble-dries the washing using a 2.0 kW heater and a pump to remove the condensed vapour. An average load loss of 1.5 kg of water occured in the process.

The specific latent heat of vapourization of water at 100 °C is 2.3 MJ kg^{-1}.

1. Calculate the maximum rate at which water can be vapourized at 100 °C.
2. Neglecting the time taken to reach 100°C, estimate the minimum time required to dry the washing.

[see page ten

6. When two thin lenses are separated by a distance, it is not equivalent to a single thin lens. In fact, such a combination can only be equivalent to a thick lens which has a more complicated theory. In a special case when the object is placed at infinity the combination may be replaced by a single thin lens. Consider a ray passing through a lens of focal length f.

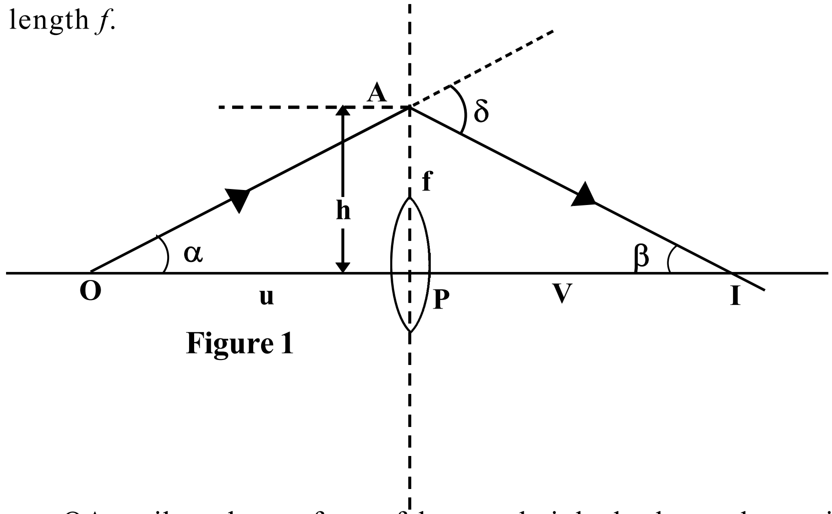


Figure 1

The incident ray OA strikes the surface of lens at height h above the optical centre. When compared with PO and PI, h is small. The angles α, β are also small. ($\alpha \approx \tan\alpha$, $\beta \approx \tan\beta$). Now consider figure 2. The two thin lenses are placed coaxially at a separation d. The incident ray AB and the emergent ray CD intersect at E. The perpendicular from E to the pricipal axis falls at P. The equivalent lens should be placed at this position P. A ray AE, parallel to the pricipal axis will go through the equivalent lens and emerges along ECD. The angle of deviation is δ. The focal length of the equivalent lens is F = PD

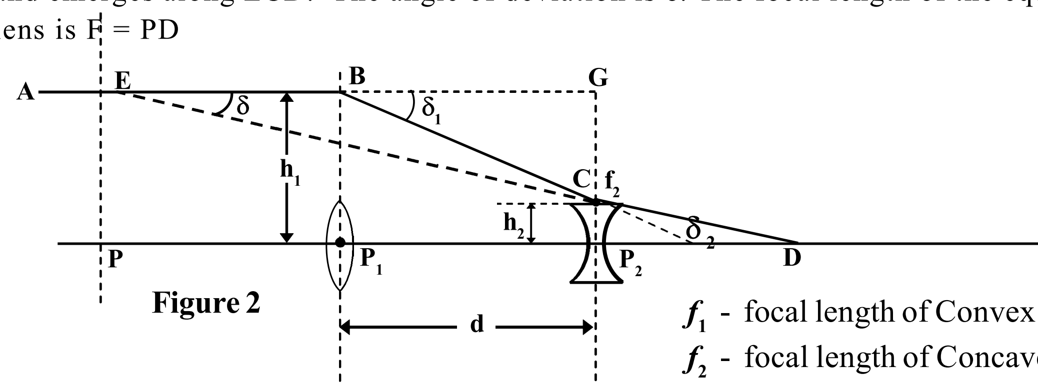


Figure 2

f_1 - focal length of Convex lens
f_2 - focal length of Concave lens

(a) Use the diagram in figure 1 to obtain the expression $\delta = \dfrac{h}{f}$

(b) (i) Derive expression for d in terms of d_1 and d_2

(ii) By using the results obtaind in (a) and (b)(i), show that $\dfrac{h_1}{F} = \dfrac{h_1}{f_1} + \dfrac{h_2}{f_2}$

(iii) Show that $h_2 = h_1 - \dfrac{dh_1}{f_1}$

(iv) Use the results obtained in (b)(ii) and (b)(iii). Show that if the equivalent focal length is F then $\dfrac{1}{F} = \dfrac{1}{f_1} - \dfrac{1}{f_2} + \dfrac{d}{f_1 f_2}$

(v) Find the minimum and the maximum focal lenghts of the combination for the following situations.

1. $f_1 = 10.0$ cm, $f_2 = 15.0$ cm and $d = 0$ cm.
2. $f_1 = 10.0$ cm, $f_2 = 15.0$ cm and $d = 5$ cm

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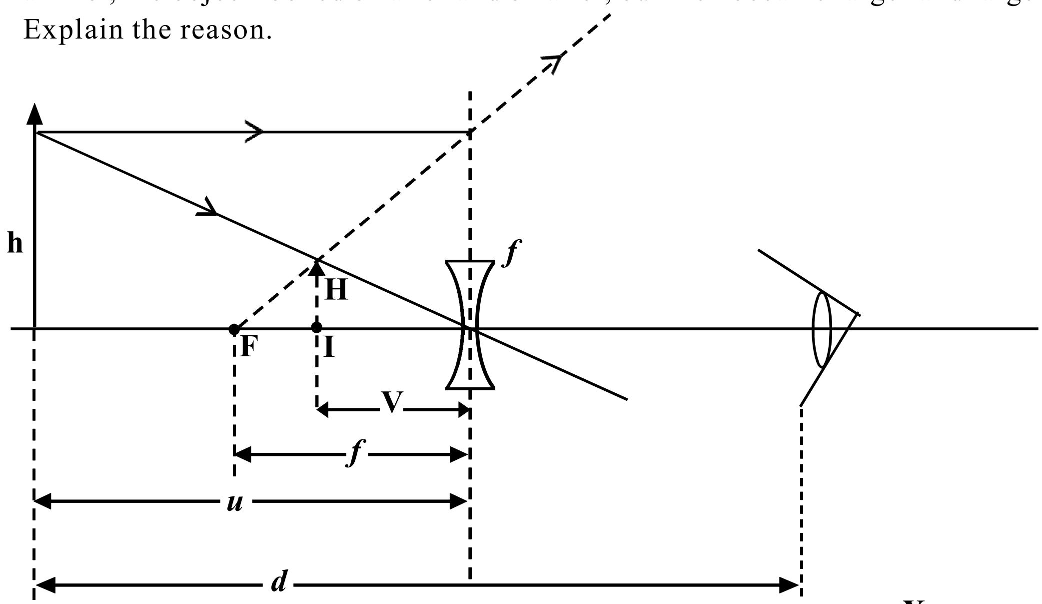
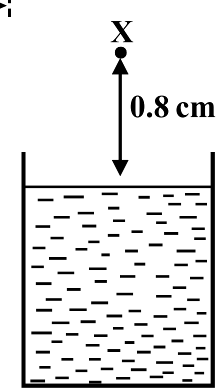
(c) Concave lenses have several uses. One of it is the zoom lens arrangement in cameras. It consists of a convex lens and a concave lens. Use the results you obtained in (b)(v) to justify the purpose of the zoom lens?

(d) (i) Another use of concave lens is the correction of short sightedness. A short sighted man can clearly see objects up to a distance of 1.5 m. Calculate the power of the lens necessary for the remedy of this defect.

(ii) The short sighted man takes off his glasses and observes a fixed object through them, while moving the glasses away from his eyes. He is surprised to see that at first, the object looked smaller and smaller, but then became larger and larger. Explain the reason.



7. A small metal ball is dropped into a cylindrical vessel containing a stationary viscous liquid. The ball is dropped from a point X which is at a height of 0.8 cm from the liquid surface.



(i) Find the time taken for the ball to hit the liquid surface.

(ii) Find the speed of the ball when it hits the liquid surface.

(iii) Find the terminal speed of the ball in the liquid. Use the following data.

Density of the liquid is 1000 kg m^{-3}.

Density of the metal is 10000 kg m^{-3}

Co-efficient of viscosity of the liquid is 5×10^{-2} Nm^{-2} s^{-1}

Radius of the metal ball is1mm.

(iv) If the ball (in question (ii) travels in the liquid very quickly and without any energy loss), draw the v-t graph of the ball.

(v) Suppose the ball reached its terminal speed before entering the liquid surface, draw the velocity - time graph of the ball from its starting point until it reaches the bottom.

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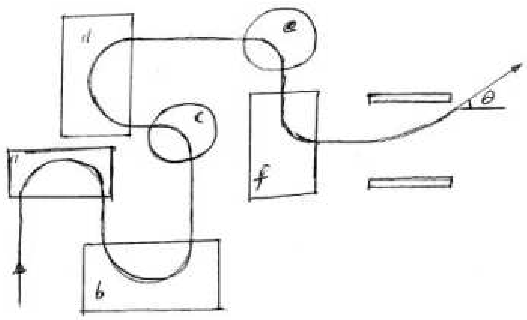
8.



The above figure shows the path of a particle through six regions of uniform magnetic field where the path is either a half-circle or a quarter - circle. Upon leaving the last region, the particle travels between two charged parallel plates and deflected towards the plate of higher potential.

(i) Identify the direction of magnetic field in each six regions.

(ii) State whether the particle has positive charge or negative elecric charge?

(iii) Draw the direction of electric field intensity in the parallel plate capacitor.

(iv) Assume that all the regions have a uniform and same value of magnetic flux density B.The radius, mass, charge and the velocity of the charged particle are R, m, q and V respectively. Derive an expression for velocity V in terms of B, q, R and m.

(v) Calculate the time taken for the above particle to travel inside the magnetic field. (Neglect the gravitational effect. Neglect the loss of kinetic energy when it travels in the free space.)
$M = 9 \times 10^{-31}$ kg, $\pi = 3$, $q = 1.6 \times 10^{-19}$ C, $B = 2.7$ Tesla.

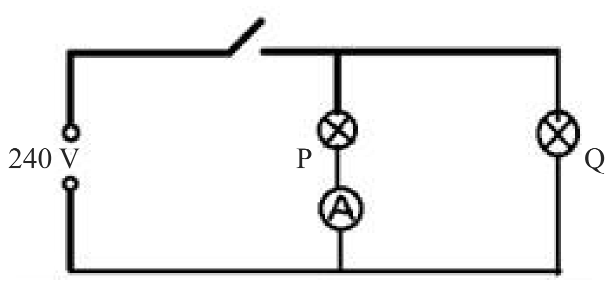
(vi) Calculate the velocity of the charged particle when it is entering the electricfield?

(vii) Deduce the velocity of the charged particle due to the electric field when it is leaving from the electric field.(assume $\theta = 45°$)

(viii) Calculate the kinetic energy of the charged particle when it is leaving from the electric field?

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

A. In a circuit which is at room temperature, a bulb P made from tungsten coil and a bulb Q made from an alloy are connected in parallel. A 240V constant power source is connected to this circuit.(Room temperature=30^{O}C)



(a) (i) What happens to the resistance of a bulb when it is connected to this circuit and continuously supplied with electricity?

(ii) When the switch is opened the current I_1 through bulb P is measured as 6A.Calculate the resistance R_1 of bulb P.

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(iii) The above ammeter was connected in series with the bulb Q and its reading I_2 was found to be 4A.Calculate the resistance R_2 of the bulb Q.

(b) After a short time interval, the ammeter was connected to the bulb P without opening the switch and the reading was I_3=2A.The temperature of the bulb P was then found to be 3000^{O}C.

(i) Calculate the value of the resistance of the bulb P.

(ii) Calculate the coefficient of resistance of the tungsten coil in bulb P.

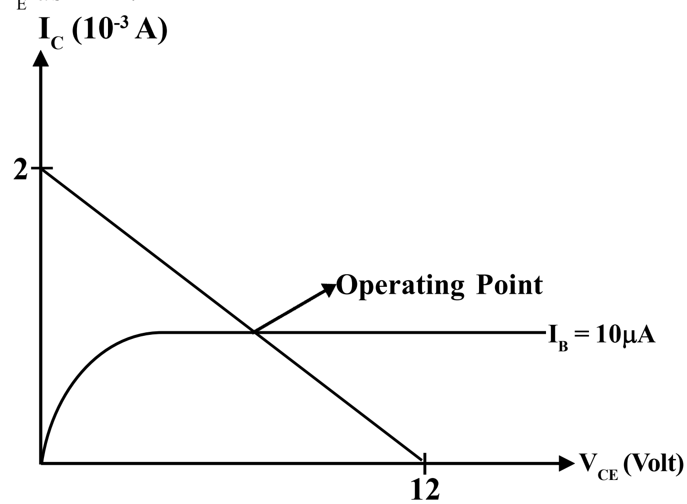
(iii) At the same temperature the ammeter was connected in series with bulb P and the ammeter reading I_4 was found to be 1A.Calculate the resistance of the bulb Q.

(iv) Calculate the coefficient of resistance of the alloy which is used to make the coil of the bulb Q.

(c) Draw the variation of the electric current and the potential difference with time for the bulb P from the time the switch was closed.

(d) The two bulbs P and Q glow with the same brightness at the above mentioned temperature. By using calculations, explain which bulb is more economical to use.

B. A student has decided to design a common emitter amplifier for small-signals.The circuit he used for this purpose is shown in the diagram given below. He should select the mid-point of the load-line as the operating point. He wishes to keep the value of R_E as 1kΩ.



(i) Find the value of the potential at the emitter (use $I_E = I_C$)

(ii) Calculate the following.

(a) The value of R_B.

(b) The value of V_{out}.

(c) The value of R_C.

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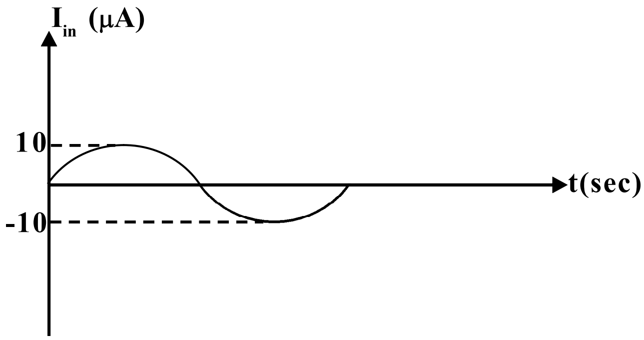
(iii) Now an A.C signal is applied to the input. Due to it, an input current (A.C) flows through base, as shown in figure (3).

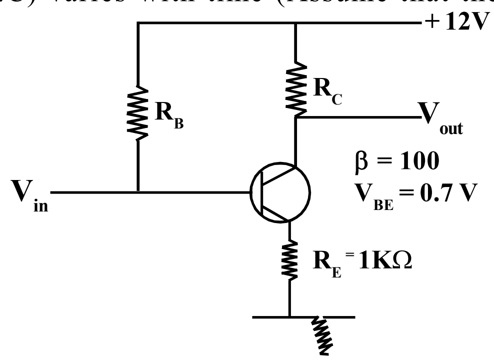


(a) Draw how base current (A.C + D.C) varies with time after A.C signal is applied.

(b) Calculate the minimum and the maximum values of V_{out}. ($\beta = 100$)

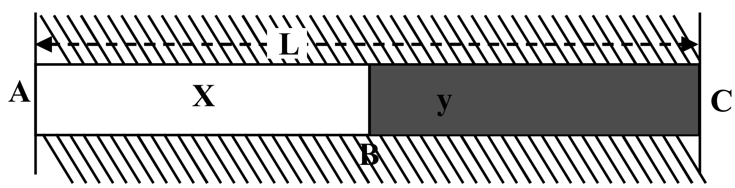
(c) Draw how V_{out} (A.C + D.C) varies with time.

(iv) Draw how V_{out} (A.C) varies with time (Assume that the capacitor blocks D.C and allows only A.C).



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

A. The figure below shows a long composite rod consisting of two different metal rods X and Y which are joined at B. The composite rod is perfectly lagged and the temperature of its ends A and C are maintained at 100°C and 0°C respectively.



The two rods X and Y have the same length and cross-section but their thermal conductivities are K_1 and K_2 respectively ($K_1 > K_2$). Draw a graph to show the variation of temperature gradient along the composite rod from A to C when the rod is at the thermal equilibrium state. Explain the shape of your graph.

Suppose the above rod is made solely by copper and both ends of the rod are kept a temperature of 0°C and that the initial temperature distribution along the rod is given by $\theta = (100\ °C)\ \text{Sin}\left(\pi x / L\right)$,where x is measured from left and of cross - sectional area 1.0 cm^2.

(a) Find the initial temperature of the mid-point of the rod.

(b) Show the initial temperature distribution in a diagram.

(c) What is the initial temperature at a point in the rod 2.0 cm from its left end?

(d) Sketch the graph for the variation of temperature with distance along the rod after a very long period of time has elapsed.

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(e) Sketch curves that you think would represent the temperature distribution at intermediate times.

(f) Calculate the followings :

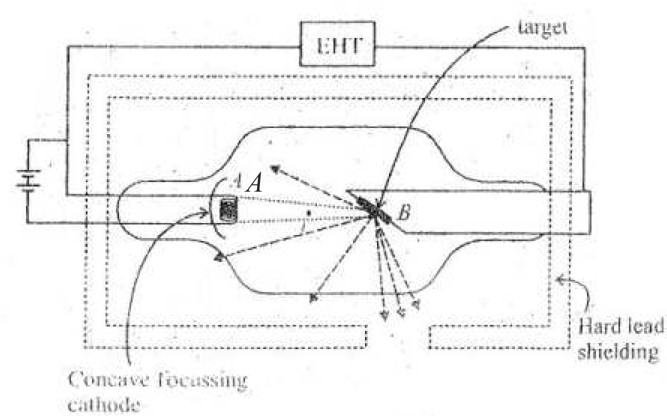
(i) Mass of the rod.

(ii) Total heat energy in the rod at the beginning.

(iii) The average rate of heat flow from the mid point to one of its ends.

(iv) How much time would be required for the center of the rod to reach its final temperature? Use the following data, the density of copper = 8900 kgm^{-3}, the specific heat capacity of copper = 400 Jkg^{-1} K^{-1}.The average temperature of the rod at the beginning = 70°C.The average temperature gradient between the midpoint and one end of the rod = 200°C m^{-1}.
The thermal conductivity of copper = 400 Wm^{-1} K^{-1}.

B. In dentistry, prevention of teeth decay is considered more important than the treatment.X-ray machine is used for this.It can show very small areas of decay inside the teeth. X-rays are produced by bombarding a metal target with high energy electrons. X-ray tube is surrounded by lead screening with just a small hole for the X-ray beam to emerge. This point source beam is directed through the teeth on to a piece of photographic film in a sealed plastic holder.



(a) How are free electrons produced in an X-ray tube?

(b) Explain the importance of using a metal with high melting point as the target material.

(c) Why the target material is embedded in a copper block?

(d) When a high voltage is used in the X-ray tube, what are the polarities of A and B?

(e) (i) Calculate the kinetic energy of an electron, after accelerated by a potential difference of 90 kV. (Charge of an electron is 1.6×10^{-19} C)

(ii) The tube current is 5 mA. How many electrons travel across the tube each second?

(iii) Calculate the power of the X-raytube.

(iv) Calculate the maximum frequency of X-ray photons.

Plank constant h $= 6.6 \times 10^{-34}$ Js
Speed of light c $= 3 \times 10^{8}$ ms^{-1}

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(f) X-ray is an ionising radiation.
  (i) What is meant by an ionising radiation?
  (ii) Describe the effect when a living matter is exposed to an ionising radiation.

(g) A patient recieves a full strength of the X-ray beam while the operator is 2m away from there. But after several years both of them recieved the same safe dose of radiation.Explain how this occured.

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