ZAHIRA COLLEGE
Board of Examinations
Sixth Term-2021

E I

GRADE 13 | **PHYSICS I** | **2 HRS**

Admission No :..... **Class :**

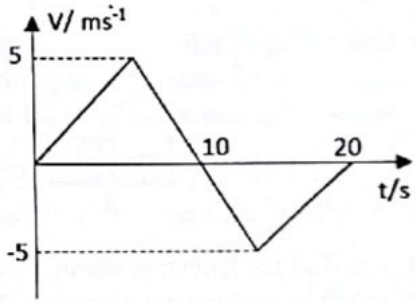
Important

- **This questions paper consists of 50 MCQ and one essay questions**
- **Answer all the questions**
- **In each of the question 1 to 50, pick one of the alternatives (1), (2), (3), (4), (5)**
- **Which is correct or most appropriate and mark your response on the answer sheet in accordance with the instructions given therein.**

1. The ratio of dimensions of Plank's constant and that of moment of inertia is the dimension of
   (1) angular momentum (2) Velocity (3) Energy (4) Time (5) frequency

2. The unit of gravitational potential is
   (1) J (2) V (3) $J\,kg^{-1}$ (4) $J\,C^{-1}$ (5) $N\,kg^{-1}$

3. The velocity(V)- time (t) graph of an object moves in straight line as shown in figure. The average velocity of the object during first 20 s is
   (1) 0 (2) 1.25 ms^{-1} (3) 2.5 ms^{-1}
   (4) 5 ms^{-1} (5) 10 ms^{-1}



4. An object A starts from rest at t= 0 with an acceleration α. When t= 2 s another body B starts from rest with an acceleration β. If they travel equal distances in fifth second after the starts of A. the ratio of $\frac{\alpha}{\beta}$ will be equal to
   (1) 1 : 1 (2) 9 : 5 (3) 5 : 7 (4) 5 : 9 (5) 7 : 9

5. The most stable quark and lepton among the following quarks and leptons respectively is
   (1) electron & up (2) top & electron (3) top & Tau (4) down & electron (5) Strange & Tau

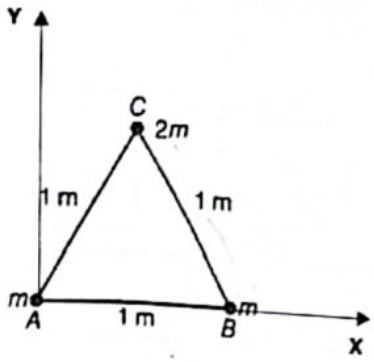
6. When the temperature of diode is increases,
   (A) Barrier potential difference decreases.
   (B) Reverse saturation current will be increase.
   (C) PIV value of diode decreases.

   Among the above statements, the correct statement is/are
   (1) All (2) Only A (3) Only A & B (4) Only A & C (5) Only B & C

7. An external force is applied on a rigid body so that it comes in motion. consider the following statements
   (A) If resultant force on the body is zero, then the total linear momentum of the body does not change with time.
   (B) If the resultant torque on the body is zero, the total angular momentum of the body does not change with time.
   (C) The moment of inertia of the body remains constant.

   True statement is/are
   (1) All (2) Only A (3) Only B (4) Only A &.B (5) Only A & C

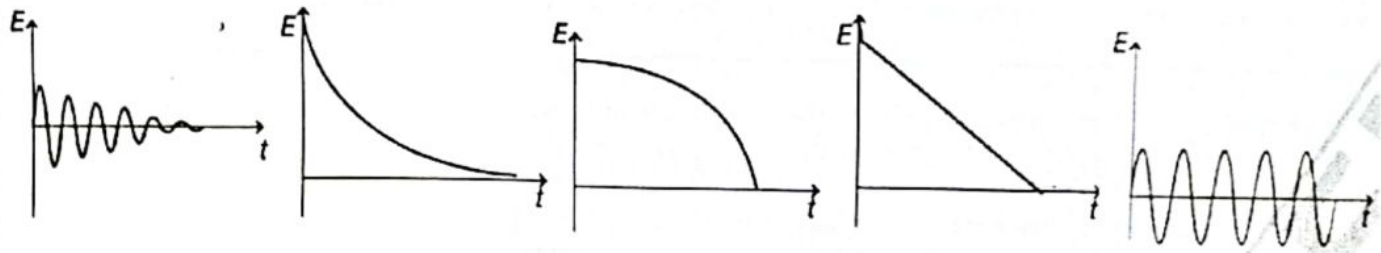
8. Two solid object of mass m are placed on the vertices A and B an equilateral triangle ABC of of side 1 m. Another solid object of mas 2m is placed at vertex C. The coordinates of center of mass of this system from vertex A (located at origin) is



(1) $\frac{1}{2}m, \frac{1}{2}m$ (2) $\frac{1}{2}m, \frac{\sqrt{3}}{2}m$ (3) $\frac{1}{2}m, \frac{\sqrt{3}}{4}m$

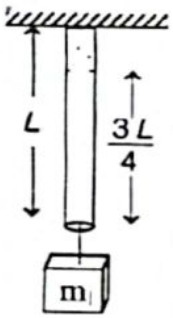
(4) $\frac{\sqrt{3}}{4}m, \frac{\sqrt{3}}{2}m$ (5) $\frac{\sqrt{3}}{4}m, \frac{\sqrt{3}}{4}m$

9. Which of the following diagrams shown in figure represents variation of total mechanical energy (E) of a pendulum oscillating in air as a function of time (t) ?



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

10. One end of a uniform wire of length L and of mass M is attached rigidly to a point in the roof and mass m is suspendered from its lower end. If A is the area of cross section of the wire, the tensile stress in the wire at a height **3L/4** from lower end is



(1) $\frac{mg}{A}$ (2) $\frac{\left[m+\left(\frac{M}{4}\right)\right]g}{A}$ (3) $\frac{3(m+M)g}{4A}$ (4) $\frac{\left[m+\left(\frac{3M}{4}\right)\right]g}{A}$ (5) $\frac{(m+M)g}{A}$

11. Consider the following statements about X-ray spectrum.

(A) The minimum wave length of X-ray is decreases with increase of potential difference of supply.

(B) The peak intensity of the linear spectrum depends on target metal and external potential difference.

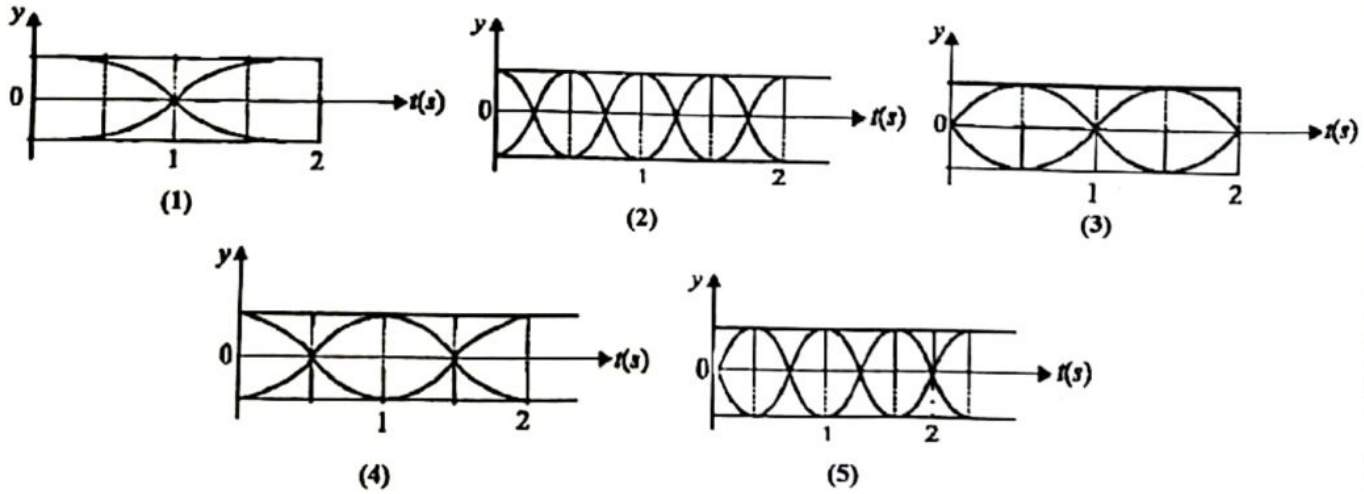
(C) The wave length corresponding to peak intensity of linear spectrum decreases with increase of external potential difference.

(D) The wave length of X-ray depends on the deceleration of electron inside the metal.

The true statement is/are

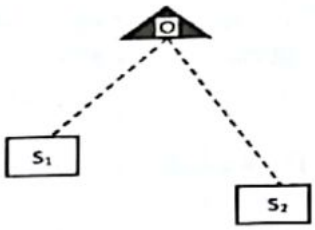
(1) Only A (2) Only A & D (3) Only B & C (4) Only A, C & D (5) All

12. The correct figure shows, schematically the wave pattern produced by superposition of two sound sources of frequencies 16 HZ and 17 Hz is



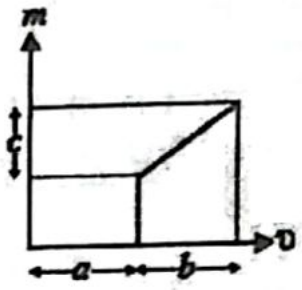
(1) (2) (3) (4) (5)

13. Two identical two sound source of S_1 and S_2 is emitted sound wave of wave length 2 m that in same phase. The constructive sound was detected by detector at O as shown in figure. If $S_1O = 1$ m, the possible value of S_2O is



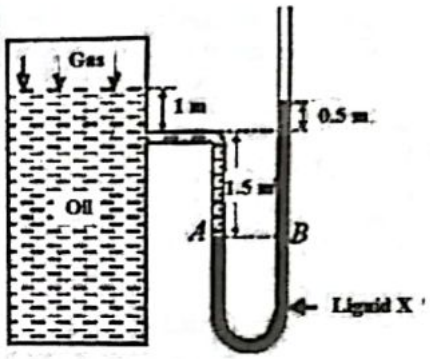
(1) 1 m (2) 2.5 m (3) 5 m (4) 6 m (5) 7.5 m

14. The graph of linear magnification (m) vs image distance (v) of thin lens is shown in figure. the focal length of the lens is



(1) $\frac{b^2}{ac}$ (2) $\frac{b}{c}$ (3) $\frac{c}{b}$
(4) $\frac{a}{c}$ (5) $\frac{c}{a}$

15. A gas is trapped inside a large oil tank of density 800 kgm^{-3} that connected to U tube which partially filled with liquid of density 10,000 kgm^{-3} as shown in figure. the pressure of gas inside the tank is

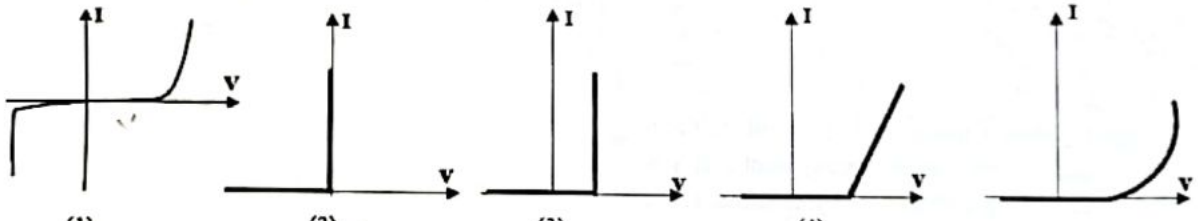


(1) 2×10^5 Pa
(2) 2.4×10^5 Pa
(3) 2.8×10^5 Pa
(4) 3.2×10^5 Pa
(5) 3.6×10^5 Pa

16. A clean capillary tube is immersed vertically in water and the height of water column raised is h_1. When this arrangement is taken into a mine of depth d, the height raised in tube is h_2. If R is the radius of the earth, the ratio $\frac{h_1}{h_2}$ is

(1) $\left(\frac{R-d}{R+d}\right)$ (2) $\left(\frac{R+d}{R-d}\right)$ (3) $\left(\frac{R}{R+d}\right)$ (4) $\left(\frac{R-d}{R}\right)$ (5) $\left(\frac{2R}{R+d}\right)$

17. Among the following I-V graphs, the correct graph of simple diode is



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

18. The n number of identical cells of emf E and internal resistance r send the same amount of current through an external resistance R whether the cells are connected in parallel or in series. The ratio of R/r is

(1) $1/n^2$ (2) $1/n$ (3) 1 (4) n (5) n^2

19. A deuteron (^2_1H) of kinetic energy 100 keV is moving in circular orbit of radius 4 m in a plane perpendicular to the magnetic field B. The kinetic energy of proton that moves in circular orbit of radius 2 m inside the magnetic field 2B is

(1) 400 keV (2) 200 keV (3) 100 keV (4) 50 keV (5) 25 keV

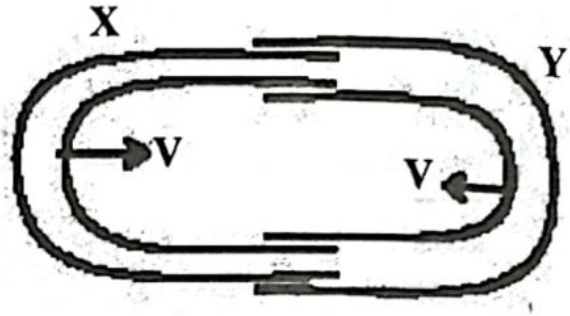
20. A nut of mass m is tied to one end of a wire of length L. The diameter of the wire is D and it is suspended vertically. The nut is now rotated in a horizontal plane and makes an angle θ with the vertical. If Young modulus of the wire is Y, the increase in length of wire is

(1) $\frac{4\,mg\,L}{\pi\,D^2Y}$ (2) $\frac{4\,mg\,L}{\pi\,D^2Y\,Sin\,\theta}$ (3) $\frac{4\,mg\,L}{\pi\,D^2Y\,Cos\,\theta}$ (4) $\frac{4\,mg,L}{\pi\,D^2Y\,tan\,\theta}$ (5) $\frac{4\,mg\,L}{\pi\,D^2Y\,(1-Sin\,\theta)}$

21. Two plane mirror are inclined at an angle θ in a medium of refractive index 5/4. A light ray incident on the first mirror that parallel to the second mirror and finally reflected from second mirror that parallel to the first mirror. The θ is

(1) 30^0 (2) 45^0 (3) 50^0 (4) 60^0 (5) 75^0

22. The X conducting tube can slide inside another conducting U tube Y as shown in figure, maintaining electrical contact between the tubes. The magnetic field B is perpendicular to the plane of the figure. If each tube moves towards each other at constant speed V, then induced emf in the circuit will be (L- width of each tube)



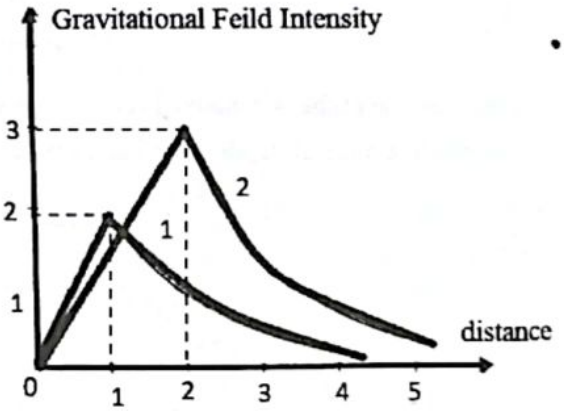
(1) Zero (2) – 3 BLV (3) - BLV (4) BLV (5) 2 BLV

23. Consider the important statement/theories made about black body spectrum by scientists of Max Plank, Wein and Rayleigh-Jean. Consider among following combination, the true combination is

A - Only explain the shorter wave length and deviated from larger wave length.
B – Only explain the higher wave length and deviated from shorter wave length.
C- Explained the shorter and longer wave length.

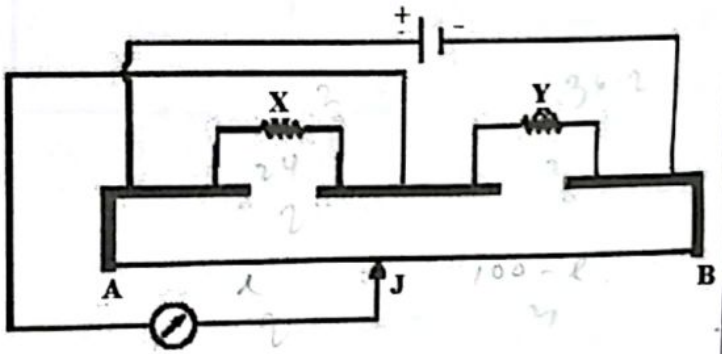
	Wein's	Max Plank	Rayleigh-Jean
(1)	A	C	B
(2)	B	C	A
(3)	C	A	B
(4)	B	A	C
(5)	A	B	C

24. Gravitational field intensity vs distance graph of planet 1 and planet 2 as shown in figure. The ratio of $\frac{Mass\ of\ planet\ 1}{Mass\ of\ planet\ 2}$ is



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

25. The figure shows a meter bridge circuit, initially X = 24 Ω and Y = 36 Ω at balancing point J. If Y is made 16 Ω, sliding key moves by Z cm distance from J. Z will be



(1) 10 (2) 20 (3) 30
(4) 40 (5) 60

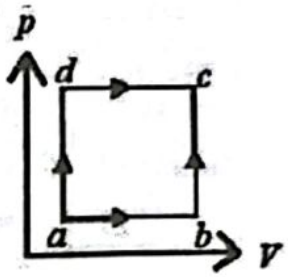
26. Two horizontal narrow tube of length L and 2L, radius R and 2R are connected in series manner. The net rate of flow of fluid them in term of X will be [where $X = \frac{\pi \times (Pressure\ difference\ between\ ends\ of\ composite\ tube) \times R^4}{8 \times coefficient\ of\ viscosity \times L}$]

(1) $\frac{3X}{8}$ (2) $\frac{8X}{9}$ (3) $\frac{9X}{8}$ (4) $\frac{5X}{7}$ (5) $\frac{7X}{5}$

27. When 200 g of a liquid A at 100^0C is added to 100g of liquid B at 75^0C, the final temperature of the mixture becomes 90^0C. If 200 g of liquid A at 100^0C is added to 100 g of liquid B at 50^0C, the temperature of mixture will be

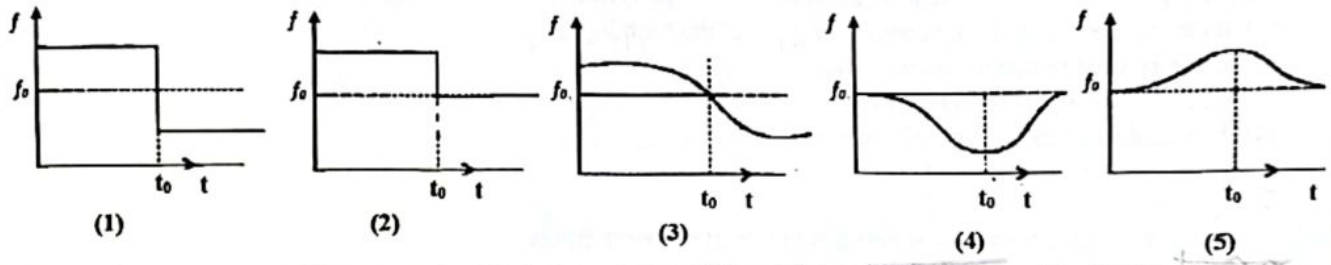
(1) 85^0C (2) 80^0C (3) 75^0C (4) 70^0C (5) 60^0C

28. A closed system is taken from a to c by two paths ***adc*** and ***abc*** as shown in figure. The internal energy at a is $U_a = 4J$. Along the path ***adc*** the amount of heat absorbed 50 J and work done 20J whereas along the path ***abc*** heat absorbed 36 J. The amount of work done along the path ***abc*** is



(1) 2 J (2) 6 J (3) 10 J (4) 10 J (5) 30 J

29. A sound source is moving along the straight line track with uniform speed and emitting a sound of frequency f. An observer is standing at a finite distance at the point O from the track (not in the straight line track). The variation of frequency with time heard by the observer is best representation is (to represents the instant when the distance between the source and observer is minimum)



30. When the temperature of Invar metal rod is increased from 0^0C to 10^0C, its length increased by 0.02%. the percentage change of its density will be

(1) 1×10^{-2} (2) 2×10^{-2} (3) 2.3×10^{-2} (4) 6×10^{-2} (5) 8×10^{-2}

31. Two point charges -Q and + 4Q are placed at a distance R apart. If third charge q is placed on the line that goes through the -Q and + 4Q charges, the system is attained in equilibrium. The charge of q and position of q from + 4Q will be

	Charge of q	Position from +4Q
(1)	Any values/	R
(2)	± 4Q	R
(3)	-4Q	2R
(4)	+4Q	2R
(5)	+ 2Q	R

32. The density of gas X is 0.06 kgm^{-3} and the root mean square speed of gas molecules is 500 ms^{-1}. The pressure exerted by gas X on the walls of the vessels is

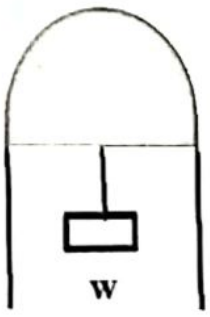
(1) 0.8×10^{-4} Pa (2) 1.2×10^{-4} Pa (3) 30 Pa (4) 5×10^{3} Pa (5) 7.5×10^{3} Pa

33. Two identical particles of mass M and charge q are placed at a distance R in a medium of dielectric constant K. If they do not move, the value of $\frac{q}{M}$ is [symbols have usual meaning]

(1) 1 (2) $\sqrt{4\pi K \varepsilon_0 G}$ (3) $\sqrt{\frac{4\pi K \varepsilon_0 R}{G}}$ (4) $\sqrt{\frac{G}{4\pi K \varepsilon_0}}$ (5) $\sqrt{\frac{\pi K \varepsilon_0}{G R}}$

34. A thin soap film is formed between a U shaped wire and slider of mass 0.3 g is supporting a mass 1.2 g as shown in figure. The length of the slider is 30 cm. If the system in equilibrium, the surface tension of the soap is

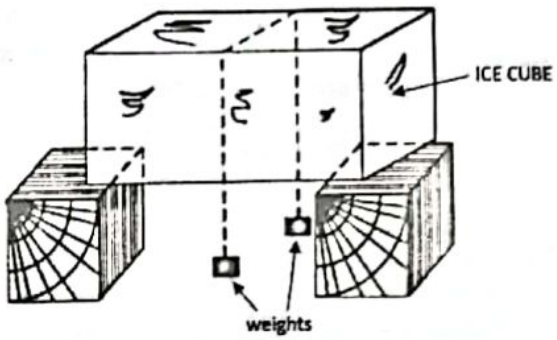
(1) 0.02 Nm^{-1} (2) 0.025 Nm^{-1} (3) 0.04 Nm^{-1} (4) 0.05 Nm^{-1} (5) 0.1 Nm^{-1}



35. The uniform planets of mass M and radius R each are contacted in such a way that each touches the other two. The magnitude of gravitational force on any of planets due to the other two is

(1) $\frac{\sqrt{3}\,GM^2}{8R^2}$ (2) $\frac{\sqrt{3}\,GM^2}{4R^2}$ (3) $\frac{3GM^2}{2R^2}$ (4) $\frac{\sqrt{3}\,GM^2}{2R^2}$ (5) $\frac{\sqrt{3}\,GM^2}{R^2}$

36. If the ends of the wire are connected to two weights and wire is pressed over a slab of ice as shown figure.



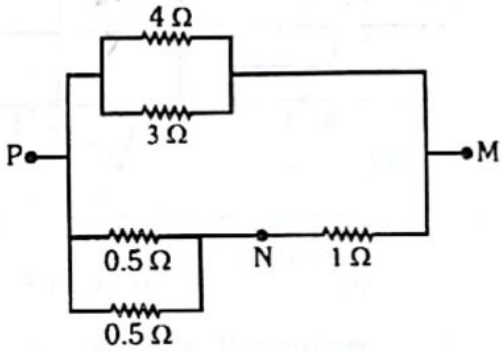
Among the following statements, true statement is

1) String remains over the slab as initial placed.
2) Ice slab melts completely.
3) Ice slab cut into 2 parts and pass to other side after some time.
4) String is stuck inside the slab and slab does not split.
5) String passes through the slab completely while Ice slab does not split.

37. Consider the following statements made about uses of polarization of electromagnetic waves. The false statement is

(1) It can be used to reducing/ control the glare of the head light.
(2) It can be used to curtainless windows.
(3) It can be used to 2D or 3D movies.
(4) It is used to stress analysis of material.
(5) It is used find habitable planets.

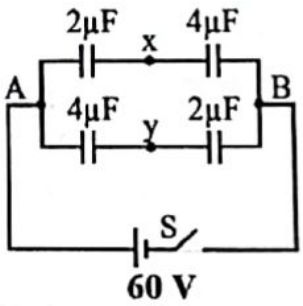
38. The current through the 4 Ω resistor is 2 A in circuit shown in figure when DC voltage source is connected between P and M. the potential difference between M and N is



(1) 0.8 V (2) 1.6 V (3) 3.2 V (4) 4.8 V (5) 6.4 V

39. If S switch is closed, the potential difference $V_x - V_y$ is

(1) - 20 V
(2) -10 V
(3) 0
(4) +10 V
(5) + 20 V

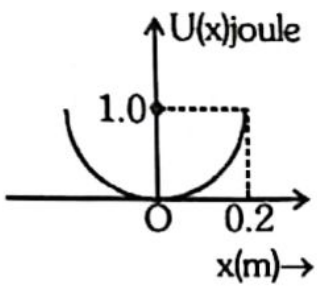


40. A moving coil galvanometer of resistance 50 Ω is connected to a battery of 10 V along with a resistance 1950 Ω in series. A full-scale deflection of 30 divisions is obtained in the galvanometer. In order to reduce this deflection to 20 divisions, the additional resistance should connect in series is

(1) 1000 Ω (2) 1950 Ω (3) 2950 Ω (4) 4000 Ω (5) 4450 Ω

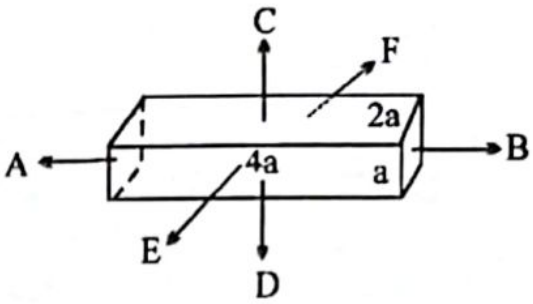
41. A particle of mass 2 kg moves in a simple harmonic motion and its potential energy (U) varies with position X from equilibrium position as shown in figure. The period of oscillation is

(1) $\frac{2\pi}{25}$ (2) $\frac{2\pi}{5}$ (3) $\frac{4\pi}{5}$ (4) $\frac{\sqrt{2}\,\pi}{5}$ (5) $\frac{2\sqrt{2}\,\pi}{5}$

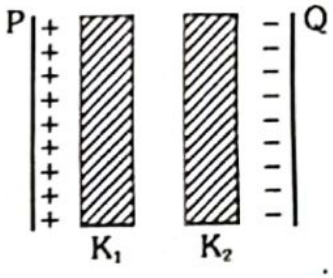


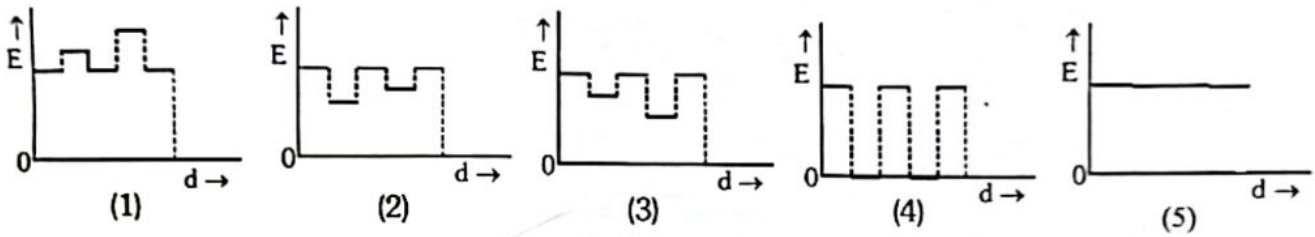
42. A cross section of copper rectangular rod has dimensions a × 2a × 4a as shown in figure. the resistance across AB, CD and EF is X, Y and Z respectively. The ratio of X : Y : Z is

(1) 1 : 1 : 1 (2) 8 : 1 : 2 (3) 16 : 4 : 1
(4) 16 : 1 : 4 (5) 4 : 16 : 1



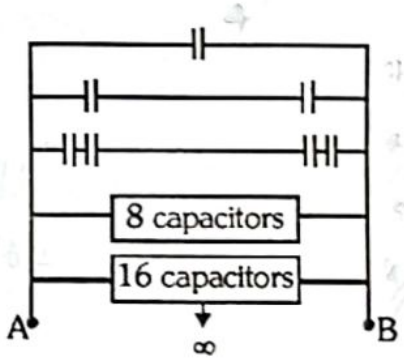
43. Two thin dielectric slabs of dielectric constant K_1 and K_2 ($K_1 > K_2$) are inserted between the parallel plates capacitor in free space as shown in figure. The variation of electric field intensity E with distance as measured from plate P is correctly shown by





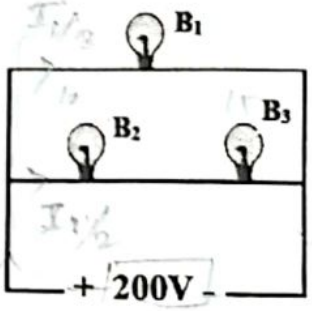
44. An infinite number of identical capacitors each of capacitance 4 μF are connected as shown in figure. the equivalent capacitance between A and B is

(1) 0
(2) 2 μF
(3) 4 μF
(4) 8 μF
(5) infinite capacitance



45. Three bulbs of B_1, B_2 and B_3 have rated power 10 W, 10W and 15 W and rated voltage is 800 V each. If 200 V DC potential difference is applied as shown in figure, the power dissipated in the circuit is

(1) 1 W (2) 2 W (3) 2.4 W (4) 3 W (5) 3.5 W



46. A total charge Q is distributed over two concentric hollow conducting spheres of radii r_1 and r_2 ($r_2 > r_1$) such that the surface charge densities on the two spheres are equal. The electric potential at the common center is

(1) $\frac{(r_2-r_1)Q}{4\pi\varepsilon_0(r_1^2+r_2^2)}$ (2) $\frac{(r_2+r_1)Q}{8\pi\varepsilon_0(r_1^2+r_2^2)}$ (3) $\frac{(r_2^2-r_1^2)Q}{4\pi\varepsilon_0(r_1^2+r_2^2)}$ (4) $\frac{(r_2-r_1)Q}{8\pi\varepsilon_0(r_1^2+r_2^2)}$ (5) $\frac{(r_2+r_1)Q}{4\pi\varepsilon_0(r_1^2+r_2^2)}$

47. A ball is moving without spinning in a straight line through a fluid as shown in figure. The pressure at A and B are ρ_A and ρ_B respectively. The figure- (2) shows a ball is moving in a straight line through a fluid which is spinning its own center of mass.

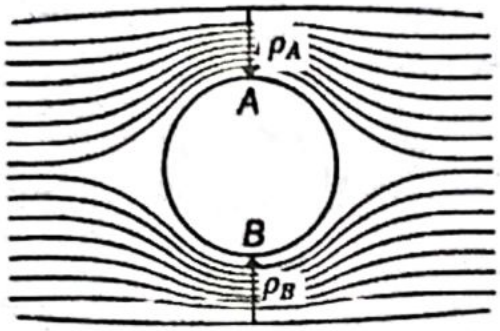


Figure-(1)

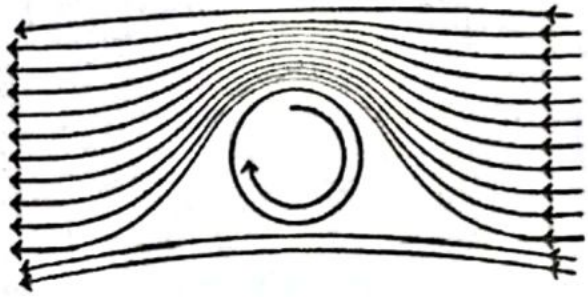
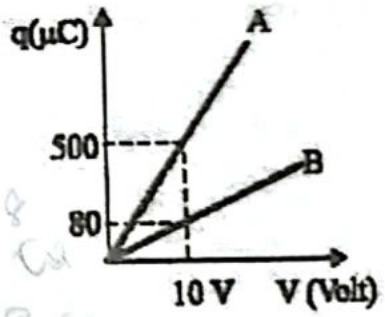


Figure – (2)

Among the following statements, the true statement regarding figure-(1) & figure-(2) is

(1)	$\rho_A = \rho_B$	Ball experiences an upward force
(2)	$\rho_A = \rho_B$	Ball experiences a downward force
(3)	$\rho_A = \rho_B$	No force at all
(4)	$\rho_A < \rho_B$	Ball experiences an upward force
(5)	$\rho_A > \rho_B$	Ball experiences a downward force

48. The variation charge (q) vs potential difference (V) for series and parallel combination of two capacitors of capacitance C_1 and C_2 as shown in figure. The C_1 and C_2 are

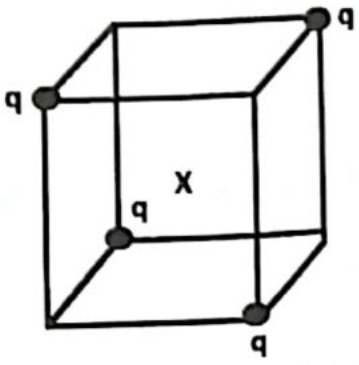


(1) 20 μF, 5 μF (2) 30 μF, 20 μF (3) 40 μF, 10 μF
(4) 50 μF, 30 μF (5) 60 μF, 40 μF

49. Two spherical bodies of masses M and 5M and radii R and 2R are released in free space with initial separation between their centers equal to 12R. If they attract each other and due only gravitational force and they moves continuously with respective initial acceleration, the distance covered by the smaller body before collision is

(1) R (2) 1.5 R (3) 2.5 R (4) 4.5 R (5) 7.5 R

50. Four identical charges of q each are placed at corners of the cube of each side L as shown in figure. Electrostatic potential energy of a charge +q which is placed at the center (X) of cube will be



(1) 0 (2) $\frac{\sqrt{2}\,q^2}{\pi\,\varepsilon_0\,L}$ (3) $\frac{2\sqrt{2}\,q^2}{\pi\,\varepsilon_0\,L}$

(4) $\frac{2\,q^2}{\sqrt{3}\,\pi\,\varepsilon_0\,L}$ (5) $\frac{2\sqrt{2}\,q^2}{\pi\,\varepsilon_0\,L}$

ZAHIRA COLLEGE
Board of Examinations

E II

Sixth Term Test-2021

GRADE 13	PHYSICS II (B)	3 HRS

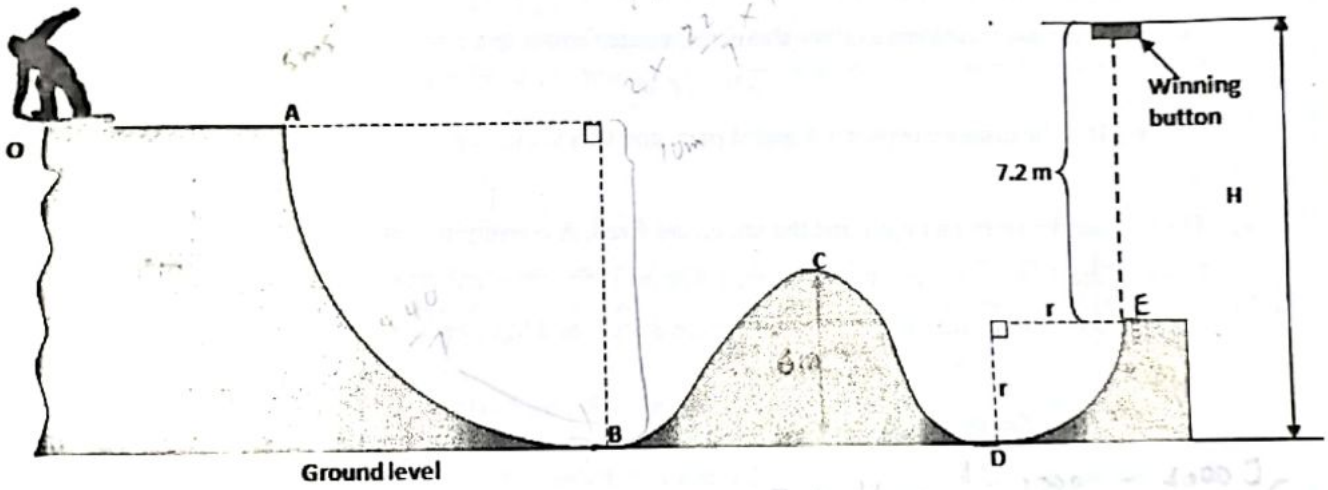
Admission No :..... Class :

PART B – Essay

Answer four questions only

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

05) A small boy with skateboards moves an indoor play ground ramp. The total mass of boy and his skateboards is 40 kg. He starts with speed 10 ms^{-1} at a point 0. OA is a surface of distance 10 m. The velocity of boy is 5 ms^{-1} when he reaches A. From A to B the surface is smooth quarter circular path and B to D the surface is assumed to be equally rough and the coefficient of friction is 0.5.



a) Find the total energy at 0.

b) Find the coefficient of friction of surface OA

c) Find the velocity of the boy at B.

d) Find normal force that acts on him at the bottom of curve at B.

e) The work done against the friction in travelling g from B to C is 100J. Find the velocity of the boy at C.

f) If the work done against the friction in travelling from B to D is 580 J. Find the velocity at D.

g) What is the reason for the energy loss due to friction in CD is greater than BC?

h) The track DE is smooth circular track of radius r. The boy moves D to E and leaves the track of E, finally just touch and press the winning button at F.

I. Find the height H of winning board from ground level.

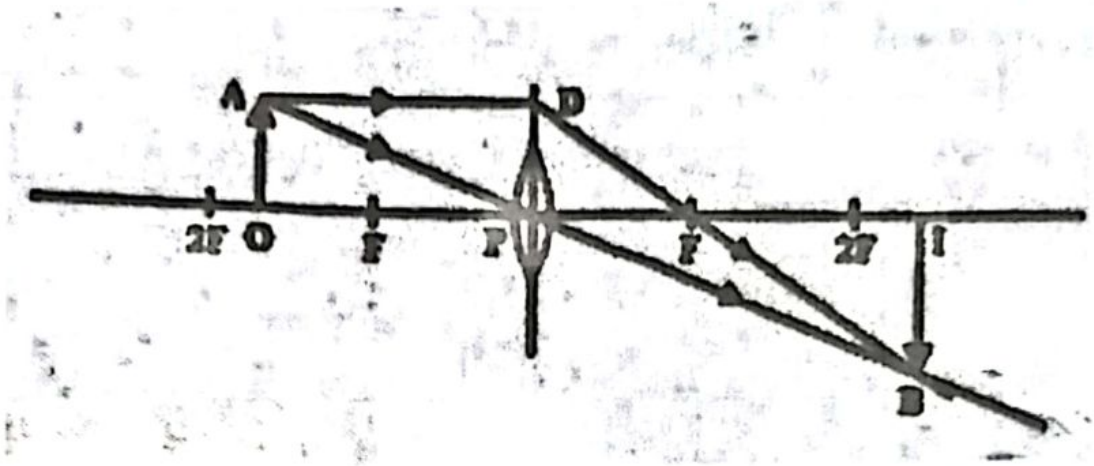
II. Find the normal reaction force on boy exerted by surface at E.

III. How many times boy passes the point B before he comes to rest? (Including first one)

IV. At which point he come to rest?

06.

a) The lens formula is representing the equation of object, image distances with focal length of the lens. Derive the lens formula by only using following diagram. Assume OP = U and IP = V



b) The image of an object placed at a point A on the principal axis of convex lens focal length *f* is upright. When this object is shifted to a point B on the axis the image formed is of the same size as the former image but it is inverted. Draw two diagrams to show these images are formed and prove that

$$AB = 2f/m$$

Where AB is the distance between A and B point and *m* is the ratio of the size of the image to size of the object.

c) The distance between an object and the screen are fixed. A converging lens is moved between them until a clear image of the object is obtained on the screen. The position of the lens is then changed until another clear image is obtained on the screen. These two positions of lens are L and M respectively.

i) Describe the formation of the images.

ii) Describe nature of the images.

iii) Show the product of linear magnification for two situations is one.

iv) Show that the focal length of converging lens F is given by

$$F = \frac{D^2 - l^2}{4D},$$

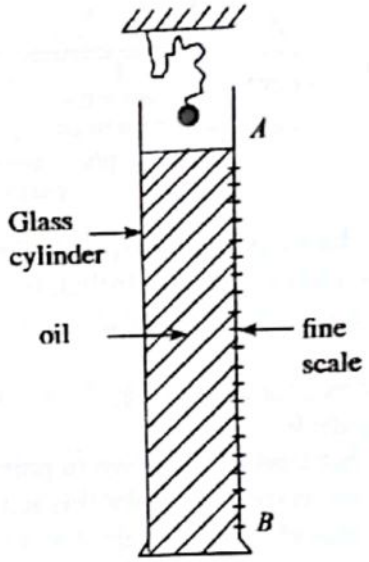
Where *l* is the displacement of the lens and D is the distance between the object and the distance.

v) If heights of the first and second images are 16cm and 4cm, calculate the height of the object.

vi) If the distance of the screen and the object is 80 cm and displacement of lens is 40 cm, calculate the focal length of lens.

vii) What is the minimum distance between the screen and the object?

7. A set up prepared to find the viscosity of a fluid using small spheres made of same material but with different radii, falling in the fluid is shown in the figure. Each sphere attached to the string is released carefully from the position *A*. The string attached is long enough to reach *B*. The position of sphere is read by using the stop watch and the scale. Then having identified the terminal velocity, it is plotted with the radius of the sphere.



(a) Write the equation for the viscous force in a viscous medium on a sphere of radius *r*, when it is falling at a velocity of *V*. Prove that it is dimensionally correct.

(b) Build up an equation for the terminal velocity of a sphere, if the density of the material used to make the sphere is *d*, density of oil is ρ and coefficient of viscosity of oil is η.

(c) Plot variation of the terminal velocity with the radius of the sphere.

(d) (i) Plot the variation in terminal velocity with the square of the radius.

(ii) If the gradient of the above graph is *m*, build up an expression for the coefficient of viscosity.

(iii) If $m = 800\ m^{-2}s^{-1}$, density of oil is 700 kgm^{-3} density of the material used to make spheres is 1240 kgm^{-3}, find the value of η.

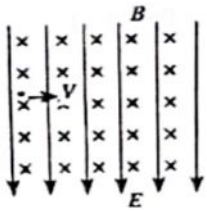
(iv) What is the terminal velocity of the sphere of radius 10 cm?

(e) Plot the variation in viscosity with the temperature.

(f) (i) Find the minimum force needed, when the above oil is speared on a horizontal surface with a thickness of 1 mm and a cube of surface area 400 cm^2 and mass of 500 g is dragged with a velocity of 8 ms^{-1} on it.

(ii) Plot the variation in velocity of oil layers from top to bottom.

8. A positively charged particle carrying a charge *q*, enters perpendicularly to a uniform electric field of field intensity *E* with a velocity *V* as shown in the diagram. A magnetic field of flux density *B* is created from the moving charge, perpendicular to its direction of motion.



(a) (i) Write an expression for the force F_E created on the charged particle by the electric field.

(ii) Write an expression for the magnetic force F_B created on the charged particle.

(iii) Clearly mark the forces acting on the moving charge *q* (Ignore gravitational forces).

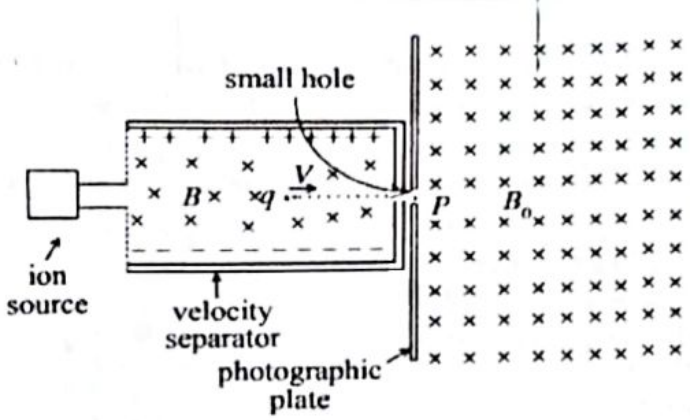
(iv) Clearly draw the paths of the charge when $F_E > F_B$, $F_E < F_B$ and $F_E = F_B$.

(b) The mass spectrometer is an important instrument used in atomic physics, which is based on forces acting on charged particles moving in electric and magnetic fields. It consists of three main parts.

(1) Ion source - Emits ions with different velocities.

(2) Velocity Separator - Ions which move at different velocities are sent through a uniform electric field of field intensity *E* and a uniform magnetic field of flux density *B* perpendicular to each other, and hence ions which move with a definite velocity are taken out from the hole *P*.

(3) Photographic Plate - This is placed in a uniform magnetic field of flux density B_0. The ions that enter in to this field incident on the photographic plate. and create sensations.



A charge q ejected from the ion source enters the velocity separator with a velocity V. Obtain the requirements fulfilled, for the charge to leave or to not to leave from the hole P. Used the results obtained in part (*a*)(iv) above.

(*c*) Now consider a charge q of mass m enters perpendicularly to the uniform magnetic field B_0 with a velocity V.

(i) What kind of a motion (a path) will this charge show in the magnetic field B_0?

(ii) What is the reason for this nature (path) of motion?

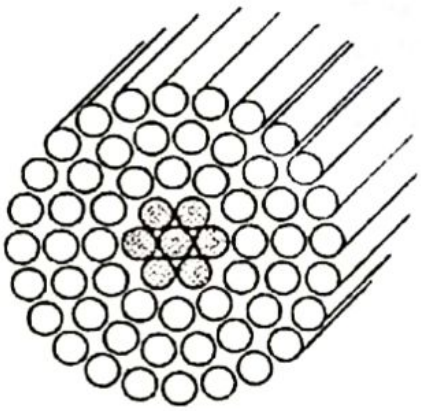
(iii) If this charge q incident at a place at a distance d from P on the photographic plate, obtain an expression for the ratio m/q in terms of d, B_0, E and B.

(*d*) The charges which enter the field B_0 from the velocity separator, incident at various places on the photographic plate. What is the reason for this? (Assume that the charge q on the particles is constant.)

(*e*) How can the above process be used in atomic physics for the separation of isotopes?

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

Part (A)



○ aluminium

○ steel

i) An electric cable shown in the diagram consists of seven steel wires and 54 aluminum wires. The diameter of every cable is 3.0 mm.

a) Calculate the resistance of the aluminum wires of a 1 Km long cable. Resistivity of aluminum is $2.5 \times 10^{-8}\ \Omega$ cm.

b) The resistance of 1 Km long steel wires at the core of the cable is 4 Ω. Considering that steel wires and aluminum wires as two resistors in parallel, show that the resistance of the steel wires does not affect the total resistance of the cable considerably.

c) Taking non-electrical properties of steel into consideration, explain briefly why steel is used in the cable.

ii) To pump water from a well located 15 m away from a house, a 1.6 kw, 240 V pump has to be installed.

a) If the resistance of one of the two wires connecting the pump and the house is 1 Ω, what potential difference is supplied to the pump?

b) What is the power of the pump working in this instance?

c) Find the resistance of the wire that should be used to make the minimum power provided to the pump is 1.5 kw.

d) What is the starting current of the motor when it is given 240 V?

e) State the strategy used to decrease the start-up current of the motor and explain how that strategy decreases the current.

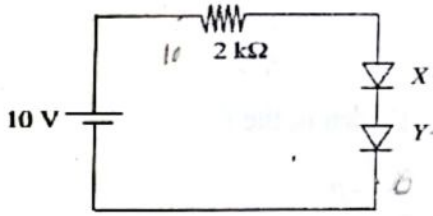
Part (B)

(a) (i) Draw the I - V characteristics for

(1) Real Diode
(2) Ideal Diode
(3) Close to Ideal
(4) Simple Diode

(ii) when temperature of diode increases, what will happen to barrier voltage, reverse saturation current and PIV either increases, decreases or remain constant? state your answer.

(b) 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?**

(c) It has become necessary to operate a certain electronic device that requires a precise 10 V supply voltage, by a 12 V battery. A circuit suitable for this purpose, which can reduce a 12 V supply to 10 V, is shown in figure 1. In this circuit, the load resistance of the electronic device is represented by R_L. The break down voltage of the Zener diode is 10 V.

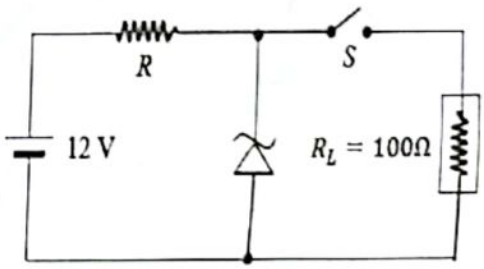


Figure 1

(a) Assuming that the battery has no internal resistance, calculate the value of *R* that will allow a 10mA current through the Zener diode, when the switch *S* is closed.

(b) For the value of *R* obtained in *(a)* above, calculate the power dissipation of the Zener diode when

(1) the switch *S* is closed, and

(2) the switch *S* is opened.

Hence state the minimum power rating of the Zener diode required for the proper operation of the circuit.

(10) **Answer either Part (A) or Part (B) only.**

Part (A)

Air conditioners are used to cool the closed chambers when the hotness is high. When cooling the space, done by maintaining the absolute humidity at a low value and keeping the relative humidity at a higher value.

(a) What is absolute humidity?

(b) What is relative humidity?

(c) How the absolute humidity is maintain at a lower value and relative humidity is maintain at a higher value in an air conditioned room?

(d)

Temperature °C	0	2	4	6	8	10	12	14	16	18
Saturated vapour pressure Hg mm	4.08	5.29	6.10	7.01	6.04	9.21	10.50	12	13.6	15.5
Temperature °C	20	22	24	26	28	30	32	34	36	38
Saturated vapour pressure Hg mm	17.5	19.8	22.3	25.10	28.30	31.70	35.50	39.80	44.4	47.50

The room temperature was 30 °C and relative humidity is 80 % in a certain day. If the volume of the room is 60 m^3.

(i) What is the absolute humidity in the room?

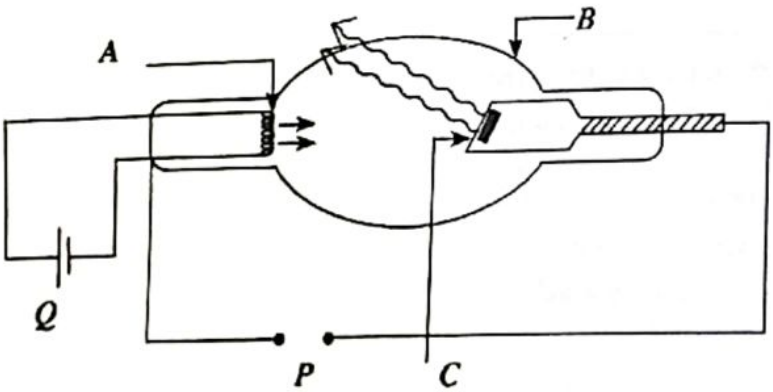
(ii) Find the dew point.

(iii) Find the mass of water vapour condensed, when the relative humidity is brought down up to 50 % at 24 °C room temperature. (Density of mercury 13600 kgm^{-3}, R = 8.3 $Jmol^{-1}k^{-1}$.)

(e) It is important to drink more water when staying in an air conditioned room. Explain the reason.

Part (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 = 3×10^8 m s^{-1}, Charge of an electron = 1.6×10^{-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)