CUET (UG) 2024

Questions, Answer Key & Solutions

Subject: Physics | Code: 322 E | Medium: English | Test Date: 16-MAY-2024

(Do not open this Test Booklet until you are asked to do so)

| Time Allowed: 60 minutes | Maximum Marks: 200 | Total Questions : 50 | Number of Questions to be answered : 40 |

Kindly read the Instructions given on this Page and Back Page carefully before attempting this Question Paper

Important Instructions for the Candidates:

1. This Test Booklet contains **50** questions printed in English. Out of these, the candidate is required to answer any **40** questions. If a candidate answers more than 40 questions, the first 40 answered questions will be considered for evaluation.

2. When you are given the OMR Answer Sheet, fill in your particulars on it carefully with blue/black ball point pen only.

3. Use only Blue/Black Ball Point Pen for marking responses.

4. The CODE for this Test Booklet is **C**. Make sure that the CODE printed on the OMR Answer Sheet is the same as that on this Test Booklet. Also ensure that your Test Booklet No. and OMR Answer Sheet No. are exactly the same. In case of discrepancy, the candidate should immediately report the matter to the Invigilator for replacement of both the Test Booklet and the OMR Answer Sheet. No claim in this regard will be entertained after five minutes from the start of the examination.

5. Before attempting the question paper kindly check that this Test Booklet has total **22** pages and OMR Answer Sheet consists of one sheet. At the start of the examination within first five minutes, candidates are advised to ensure that all pages of Test Booklet and OMR Answer Sheet are properly printed and they are not damaged in any manner.]

6. Each question has four answer options. Out of these four options choose the **MOST APPROPRIATE OPTION** and darken/blacken the corresponding circle on the OMR Answer Sheet with a Blue/Black Ball Point Pen.

7. Five (5) marks will be given for each correct answer. One (1) mark will be deducted for each incorrect answer. If more than one circle is found darkened/blacked for a question, then it will be considered as an incorrect answer. Unanswered questions will be given no mark.

Name of the Candidate (in Capital Letters):_____

Application Number (in figures):_____

Roll Number (in figures):)_____

Centre of Examination (in Capital Letters):_____Invigilator's Signature: _____

Facsimile signature stamp of Centre Superintendent:_____

Read carefully the following instructions:

8. No candidate will be allowed to leave the **OMR** Answer Sheet blank. If any OMR Answer Sheet is found blank, it shall be crossed by the Invigilator with his/her signature, mentioning "Cancelled" on it.

9. Do not tear or fold any page of the Test Booklet and OMR Sheet.

10. Candidates are advised to ensure that they fill the correct particulars on the OMR Answer Sheet, i.e., Application No., Roll No., Test Booklet No., Name, Mother's Name, Father's Name and Signature.

11. Rough work is to be done in the space provided for this purpose in the Test Booklet only.

12. The answers will 'be evaluated through electronic scanning process. Incomplete or incorrect entries may render the OMR Answer Sheet invalid.

13. Candidates are advised not to fold or make any stray marks on the OMR Answer Sheet. Use of Eraser, Nail, Blade, White Fluid/Whitener, etc., to smudge, scratch or damage in any manner the OMR Answer Sheet during examination is strictly prohibited. Candidature and OMR Answer Sheet of candidates using Eraser, Nail, Blade or White Fluid/Whitener to smudge, scratch or damage in any manner shall be cancelled.

14. There-will be one copy of OMR Answer Sheet i.e., the Original Copy. After the examination is over, the candidate shall hand over the OMR Answer Sheet to the Invigilator. The candidate can take away the Test Booklet after the examination is over. If the candidates does not hand over the OMR Answer Sheet to the Invigilator and goes away with the OMR Answer Sheet, his/her candidature shall be cancelled and criminal proceedings shall also be initiated against him/her.

15. Candidates are advised strictly not to carry handkerchief, any mobile phone, any type of watch, belt or wear ornaments like ring, chain, ear-ring, etc., electronic or communication device, pen, pencil, eraser, sharpener and correction fluid to the Examination Centre. If candidate is found possessing any such item, he/she will not be allowed to enter the examination centre. Possession of a mobile phone or any other aiding material as mentioned above by the candidate in the examination room will be treated as a serious violation and it may lead to cancellation of the candidature and debarring him/her from future examinations.

16. If a 'candidate violates any instructions or shows any indiscipline or misbehaviour, appropriate action will be taken including cancellation of candidature and debarring from future examinations.

17. Use of electronic/manual calculator is **not** allowed.

PHYSICS

1. The transfer of integral number of _____ is one of the evidence of quantization of electric charge.
Fill in the blank with the correct answer from the options given below.
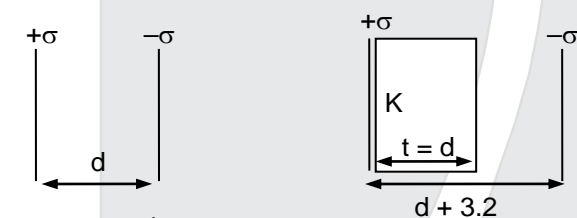(1) photons   (2) nuclei   (3) electrons   (4) neutrons

Ans. (3)

2. When a slab of insulating material 4 mm thick is introduced between the plates of a parallel plate capacitor of separation 4 mm, it is found that the distance between the plates has to be increased by 3.2 mm to restore the capacity to its original value. The dielectric constant of the material is_____.
Fill in the blank with the correct answer from the option given below.
(1) 2   (2) 5   (3) 3   (4) 7

Ans. (2)
Sol.

$+\sigma \quad\quad -\sigma$ $+\sigma \quad\quad\quad -\sigma$

K, t = d

d   d + 3.2

$$c_1 = \frac{\varepsilon_0 A}{d}$$

$$C_2 = \frac{\varepsilon_0 A}{(d'-t) + \dfrac{t}{k}}$$

$$C_2 = \frac{\varepsilon_0 A}{\left(d + 3.2 - d + \dfrac{d}{k}\right)}$$

given $C_1 = C_2$

$$\frac{\varepsilon_0 A}{d} = \frac{\varepsilon_0 A}{3.2 + \dfrac{d}{k}}$$

$$3.2 + \frac{d}{k} = d \Rightarrow 3.2 + \frac{4}{k} = 4$$
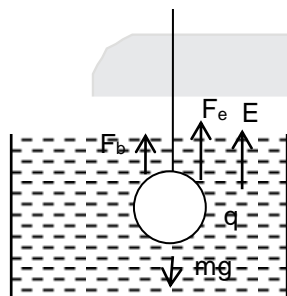
$$\frac{4}{k} = 0.8$$

$$k = \frac{4}{0.8} = 5$$

3. A copper ball of density 8.0 g/cc and 1 cm in diameter is immersed in oil of density 0.8 g/cc. The charge on the ball if it remains just suspended in oil in an electric field of intensity $600\,\pi$ V/m acting in the upward direction is_____.

Fill in the blank with the correct answer from the option given below. (Take g = 10 m/s²)

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

Ans. **(2)**

Sol.

$\rho_{cu} = 8\,\dfrac{g}{cc} = 8 \times 10^{3}\,\dfrac{kg}{m^{3}}$

$\rho_{oil} = 0.8\,\dfrac{g}{cc} = 0.8 \times 10^{3}\,\dfrac{kg}{m^{3}}$

$r = \dfrac{d}{2} = \dfrac{1cm}{2} = 0.5 \times 10^{-2}\,m$

In equilibrium

$F_b + F_e = mg$

$\rho_{oil}Vg + qE = V\rho_{cu}g$

$qE = (\rho_{cu} - \rho_{oil})Vg$

$q \times 600\pi = (8 \times 10^{-3} - 0.8 \times 10^{-3}) \times \dfrac{4}{3}\,\pi r^3\,g$

$q \times 600\,\pi = 7.2 \times 10^{-3} \times \dfrac{4}{3}\,\pi \times (0.5 \times 10^{-2})^3 \times 10$

$q = \dfrac{2.4 \times 4\pi \times 0.5 \times 0.5 \times 0.5 \times 10^{-8}}{600\pi}$

$q = 2 \times 10^{-5}$ C

4. A metal wire is subjected to a constant potential difference. When the temperature of the metal wire increases, the drift velocity of the electron in it_____.

Fill in the blank with the correct answer from the options given below.

(1) increases, thermal velocity of the electrons decreases

(2) decreases, thermal velocity of the electrons decreases

(3) increases, thermal velocity of the electrons increases

(4) decreases, thermal velocity of the electrons increases

Ans. **(4)**

Sol. As the temperature increase, the K.E of electron increases so the thermal velocity will increase Due to increase in number of collision the drift velocity will decrease.
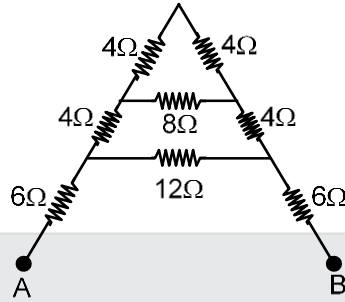
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5. For the given mixed combination of resistors calculate the total resistance between points A and B.
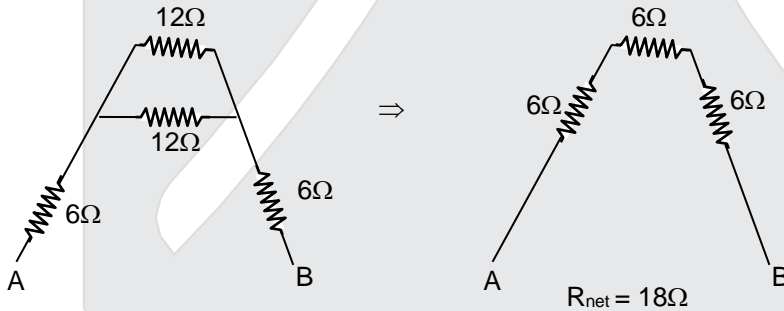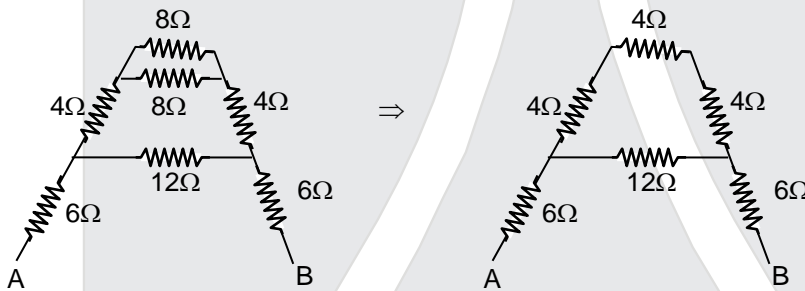

Choose the correct answer from the options given below.

(A) 9 Ω (2) 18 Ω (3) 4 Ω (4) 14 Ω

Ans. (2)

Sol.

$$R = \frac{8 \times 8}{8 + 8} = \frac{64}{16} = 4$$

$R_{net} = 18\,\Omega$

6. A cell of emf 1.1 V and internal resistance 0.5 Ω is connected to a wire of resistance 0.5 Ω. Another cell of the same emf is now connected in series with the intention of increasing the current but the current in the wire remains the same. The internal resistance of the second cell is_____.

Fill in the blank with the correct answer from the options given below.

(1) 1 Ω (2) 2.5 Ω (3) 1.5 Ω (4) 2 Ω

Ans. **(1)**

Sol. Case (1)   Case (2)

$\therefore I = \dfrac{E_{net}}{R + r_{net}}$ $I_2 = \dfrac{E_1 + E_2}{R + r_{net}}$

$I_1 = \dfrac{1.1}{0.5 + 0.5}$ Here current is same so $I_1 = I_2$

$I_1 = 1.1\ A$ $1.1 = \dfrac{1.1 + 1.1}{0.5 + (0.5 + r)}$

                                    $1 + r = \dfrac{2.2}{1.1}$

                                    $r = 1\Omega$

7. P, Q, R and S are four wires of resistances 3, 3, 3 and 4 Ω respectively. They are connected to form the four arms of a wheatstone bridge circuit. The resistance with which S must be shunted in order that the bridge may be balanced is_____.

Fill in the blank with the correct answer from the options given below.

(1) 14 Ω (2) 12 Ω (3) 15 Ω (4) 7 Ω

Ans. **(2)**

Sol.

$\therefore \dfrac{P}{Q} = \dfrac{R}{S}$

$\dfrac{3}{3} = \dfrac{3}{\left(\dfrac{4 \times s}{4 + s} \right)}$

$\dfrac{4s}{4 + s} = 3$

$4s = 12 + 3s$

$s = 12\Omega$

8. Magnetic moment of a thin bar magnet is 'M'. it is bent into a semicircular form, its new magnetic Moment will be_____.
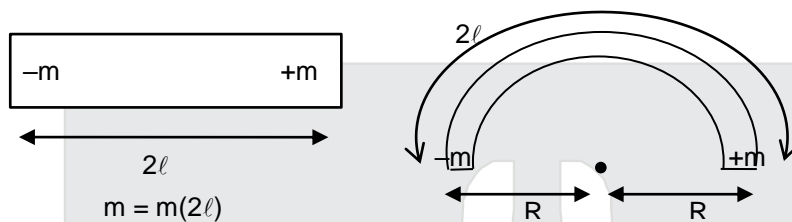Fill in the blank with the correct answer from the options given below.

(1) M/π (2) $M/2$ (3) M (4) $2M/\pi$

Ans. **(4)**

Sol.

$$-m \qquad\qquad +m$$

$$\underset{2\ell}{\longleftrightarrow}$$

$$m = m(2\ell)$$

$$M' = m\,(2R) \qquad\qquad \therefore 2\ell = \pi R$$

$$= m\left(2\times\frac{2\ell}{\pi}\right) \qquad\qquad R = \frac{2\ell}{\pi}$$

$$= \frac{2}{\pi}m(2\ell)$$

$$M' = \frac{2M}{\pi}$$

9. Ferromagnetic material used in Transformers must have_____.
Fill in the blank with the correct answer from the options given below.

(1) Low permeability and High Hysteresis loss   (2) High permeability and Low Hysteresis loss
(3) High permeability and High Hysteresis loss   (4) Low permeability and Low Hysteresis loss

Ans. **(2)**

10. A conducting ring of radius r is placed in a varying magnetic field perpendicular to the plane of the ring. If the rate at which the magnetic field varies is x, the electric field intensity at any point of the ring is____.
Fill in the blank with the correct answer from the egations given below.

(1) rx (2) rx/2 (3) 2rx (4) 4r/x

Ans. **(2)**

Sol. Let $\vec{E}$ be the electric field intensity at a point on the circumference of the ring then, the induced emf

$$\varepsilon = \oint \vec{E}.\,\vec{dl}$$

$$\varepsilon = E\,(2\pi r) \quad ...... \text{ (i)}$$

The induced emf is $\varepsilon = \dfrac{d\phi}{dt} = \pi r^2\ \dfrac{dB}{dt} = \pi r^2 x....\text{(ii)}$

by equation (i) and equation (ii)

$$E(2\pi r) = \pi r^2 x \Rightarrow E = \frac{rx}{2}$$

11. A 50 Hz ac current of crest value 1 A flows through the primary of a transformer. If the mutual inductance between the primary and secondary be 0.5 H, the crest voltage induced in the secondary is_____.
Fill in the blank with the correct answer from the options given below.

(1) 75 V   (2) 150 V   (3) 100 V   (4) 200 V

Ans. **(3)**

Sol.

$$\varepsilon = -M\frac{\Delta i}{\Delta t} \quad = -M\frac{i_m}{T/4} \quad = -M\frac{4i_m}{T} \quad = -M4i_m f \quad = -0.5 \times 4 \times 1 \times 50$$

$$|\varepsilon| = 100 \text{ V}$$

12. A long solenoid of diameter 0.1 m has 2×10^4 turns per meter. At the centre of the solenoid a coil of 100 turns and radius 0.01 m is placed with its axis coinciding with the solenoid axis. The current in the solenoid reduces at a constant rate to 0 A from 4 A in 0.05 s. If the resistance of the coil is $10\pi^2 \ \Omega$, then the total charge flowing through the coil during this time is_____.
Fill in the blank with the correct answer from the options given below.

(1) 16 μC   (2) 32 μC   (3) 16 π μC   (4) 32 π μC

Ans. **(2)**

Sol. According to Lenz's law the induced EMF is $\varepsilon = -N\frac{d\phi}{dt}$

Current is given by $\quad I = \frac{\varepsilon}{R}$

Current (I) is the rate of flow of charge (q) in time (t) : $I = \frac{dq}{dt}$

Magnetic flux is given by $\phi = B\Delta A$
Magnetic field is given by $B = \mu_0 I$
Now, on dividing by R on both sides,

$$\frac{\varepsilon}{R} = -\frac{N}{R}\frac{d\phi}{dt}$$

$$\Delta I = -\frac{N}{R}\frac{d\phi}{dt}$$

$$\frac{\Delta q}{\Delta t} = -\frac{N}{R}\frac{\Delta \phi}{\Delta t}$$

$$\Delta q = -\left[\frac{N}{R}\frac{\Delta \phi}{\Delta t}\right]\Delta t \qquad \text{[Here, the -ve sign shows that induced EMF opposes the change in flux.]}$$

$$\Delta q = -\frac{N\Delta\phi}{R} \quad = -\frac{NB\Delta A}{R} \quad = -\frac{N\mu_0 I\Delta A}{R}$$

$$\Delta q = \frac{4\pi \times 10^{-7} \times 100 \times 4 \times \pi \times (0.01)^2}{10\pi^2}$$

$$\Delta q = 32\mu C$$

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13. Lower half of a convex lens is made opaque. Which of the following statement describes the image of the object placed in front of the lens?

(A) No change in image

(B) Image will show only half of the object

(C) Intensity of image gets reduced

Choose the correct answer from the options given below.

(1) (A) only   (2) (B) only   (3) (C) only   (4) (B) and (C) only

Ans. **(3)**

Sol. Intensity of Image gets reduced.

14. Two slits are made 0.1 mm apart and the screen is placed 2 m away. The fringe separation when a light of wavelength 500 nm is used is _____.

Fill in the blank with the correct answer from the options given below.

(1) 1 cm   (2) 0.15 cm   (3) 1.5 cm   (4) 0.1 cm

Ans. **(1)**

Sol. $d = 0.1$ mm $= 0.1 \times 10^{-3}$ m

$D = 2$m

$\lambda = 500$nm $= 500 \times 10^{-9}$m

$\beta = \dfrac{\lambda D}{d} = \dfrac{500 \times 10^{-9} \times 2}{0.1 \times 10^{-3}} = 1 \times 10^{-2} = 1$ cm

15. For an astronomical telescope having objective lens of focal length 10 m and eyepiece lens of focal length 10 cm, telescope's the tube length and magnification respectively are _____.

Fill in the blank with the correct answer from the options given below.

(1) 20 cm, 1   (2) 1000 cm, 1   (3) 1010 cm, 1   (4) 1010 cm, 100

Ans. **(4)**

Sol. $f_0 = 10$m $= 1000$ cm

$f_e = 10$ cm

$L = f_0 + f_e$

$L = 1000 + 10 = 1010$ cm

$m = \dfrac{f_0}{f_e} = \dfrac{1000}{10} = 100$

16. According to Bohr's Model

(A) The radius of the orbiting electron is directly proportional to 'n'.

(B) The speed of the orbiting electron is directly proportional to '1/n'.

(C) The magnitude of the total energy of the orbiting electron is directly proportional to '1/n²'

(D), The radius of the orbiting electron is directly proportional to 'n²'

Choose the correct answer from the options given below.

(1) (A), (B) and (C) only   (2) (A), (B) and (D) only

(3) (A), (B), (C) and (D)   (4) (B), (C) and (D) only

Ans. **(4)**

Sol. $r \propto n^2$

$v \propto \dfrac{1}{n}$

$E \propto \dfrac{1}{n^2}$

B,C,D only

17. For a full wave rectifier, if the input frequency is 50 Hz, the output frequency will be_____.
Fill in the blank with the correct answer from the options given below.
(1) 50 Hz   (2) 100 Hz   (3) 25 Hz   (4) 0 Hz

Ans. **(2)**

Sol. In full wave Rectifier, the output frequency is double from its input frequency.
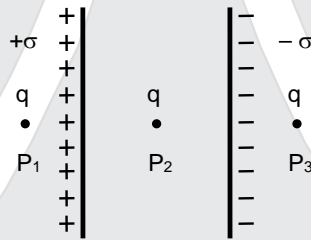
$$\upsilon_{out} = 2 \ \upsilon_{input}$$
$$= 2 \times 50 = 100 \ Hz$$

18. For an electric dipole in a non-uniform electric field with dipole moment parallel to direction of the field,
The force F and torque τ on the dipole respectively are_____.
Fill in the blank with the correct answer from the options given below.
(1) $F=0, \tau = 0$ (2) $F \neq 0, \tau = 0$ (3) $F= 0, \tau \neq 0$ (4) $F \neq 0, \tau \neq 0$

Ans. **(2)**

Sol. Here Non-uniform electric field inwhich dipole moment parallel to the direction of field so $F \neq 0, \tau = 0$

19. Two large plane parallel sheets shown in the figure have equal but opposite surface charge densities $+\sigma$ and $-\sigma$. A point charge q placed at points P_1, P_2 and P_3 experiences forces F_1, F_2 and F_3 respectively. Then
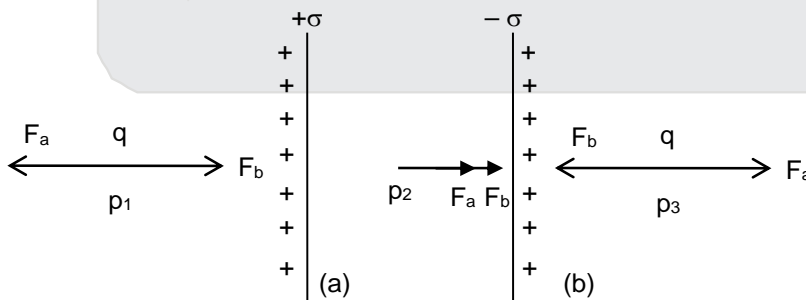

Choose the correct answer from the options given below.

(1) $\vec{F}_1 = 0, \vec{F}_2 = 0, \vec{F}_3 = 0$ (2) $\vec{F}_1 = 0, \vec{F}_2 \neq 0, \vec{F}_3 = 0$

(3) $\vec{F}_1 \neq 0, \vec{F}_2 \neq 0, \vec{F}_3 \neq 0$ (4) $\vec{F}_1 = 0, \vec{F}_2 \neq 0, \vec{F}_3 = 0$

Ans. **(2)**

Sol.

$F_1 = 0, F_2 \neq 0, F_3 = 0$

20. Two charge metallic spheres with radii R_1 and R_2 are brought in contact and then separated. The ratio of final charges Q_1 and Q_2 on the two spheres repectively will be _____ .

Fill in the blank with the correct answer from the options given below.

(1) $\dfrac{Q_1}{Q_2} = \dfrac{R_2}{R_1}$ 　　　 (2) $\dfrac{Q_1}{Q_2} < \dfrac{R_1}{R_2}$ 　　　 (3) $\dfrac{Q_1}{Q_2} > \dfrac{R_1}{R_2}$ 　　　 (4) $\dfrac{Q_1}{Q_2} = \dfrac{R_1}{R_2}$

Ans. **(4)**

Sol. $Q = CV$

$V = \dfrac{Q}{C}$ 　　　 ….(i)

Here $C_1 = 4\pi\varepsilon_0 R_1$, $C_2 = 4\pi\varepsilon_0 R_2$

On bringing the conducting spheres in contact, the potential of the system of spheres will become equal.

$\therefore V_1 = V_2$

$\Rightarrow \dfrac{Q_1}{4\pi\varepsilon_0 R_1} = \dfrac{Q_2}{4\pi\varepsilon_0 R_2}$

$\Rightarrow \dfrac{Q_1}{R_1} = \dfrac{Q_2}{R_2}$

$\Rightarrow \dfrac{Q_1}{Q_2} = \dfrac{R_1}{R_2}$

21. Two charged particles, palced at a distance d apart in vacuum, exert a force F on each other. Now, each of the charges is doubled. To keep the force unchanged, the distance between the charges should be changed to _____.

Fill in the blank with the correct answer from the options given below.

(1) 4d 　　　 (2) 2d 　　　 (3) d 　　　 (4) d/2

Ans. **(2)**

Sol. $F_1 = \dfrac{kq_1 q_2}{d^2}$ 　　　 $F_2 = \dfrac{k(2q_1)(2q_2)}{d_2^2}$

Given $F_1 = F_2$

$\dfrac{kq_1 q_2}{d^2} = \dfrac{4kq_1 q_2}{d_2^2}$

$d_2^2 = 4d^2$

$d_2 = 2d$

22. Two parallel plate capacitors of capacitances $2\mu F$ and $3\mu F$ are joined in series and the combination is connected a battery of V volts. The values of potential across the two capacitors V_1 and V_2 and energy stored in the two capacitors U_1 and U_2 respectively are related as _____.

Fill in the blank with the correct answer from the options given below.

(1) $\dfrac{V_1}{V_2} = \dfrac{U_1}{U_2} = \dfrac{3}{2}$

(2) $\dfrac{V_1}{V_2} = \dfrac{U_1}{U_2} = \dfrac{2}{3}$

(3) $\dfrac{V_1}{V_2} = \dfrac{3}{2}$ and $\dfrac{U_1}{U_2} = \dfrac{2}{3}$

(4) $\dfrac{V_1}{V_2} = \dfrac{2}{3}$ and $\dfrac{U_1}{U_2} = \dfrac{3}{2}$

Ans. **(1)**

Sol. q = same in series combination

Q = CV

$V \propto \dfrac{1}{C}$

i.e. $V_1 : V_2 = C_2 : C_1$
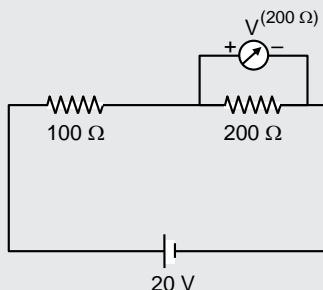
$\because \dfrac{U_1}{U_2} = \dfrac{Q^2/2C_1}{Q^2/2C_2} = \dfrac{C_2}{C_1}$

$\dfrac{U_1}{U_2} = \dfrac{3}{2}$ ...(1)

$\dfrac{U_1}{U_2} = \dfrac{\frac{1}{2}qV_1}{\frac{1}{2}qV_2} \quad \Rightarrow \quad \dfrac{U_1}{U_2} = \dfrac{V_1}{V_2} = \dfrac{3}{2}$ By equation (1)

23. Two resistance of 100 Ω and 200 Ω are connected in series across a 20 V battery as shown in figure below. The reading in a 200 Ω voltmeter connected across the 200 Ω resistance is _____ .

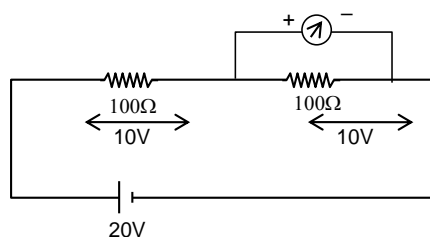Fill in the blank with the correct answer from the options given below.

(1) 4V   (2) $\dfrac{20}{3}$ V   (3) 10 V   (4) 16 V

Ans. **(3)**

Sol. $R = R = \dfrac{R_1 R_2}{R_1 + R_2} = \dfrac{200 \times 200}{200 \times +200} = 100\Omega$
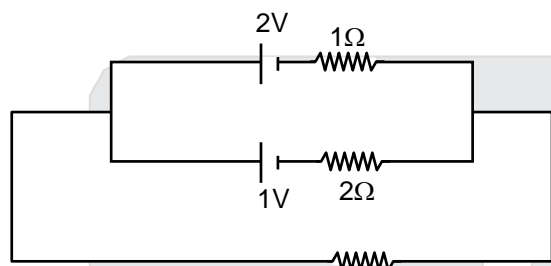

The Reqding of voltmeter is 10V.

24. The current through a 4/3 Ω external resistance connected to a parallel combination of two cells of 2V and 1V emf and internal resistance of 1Ω and 2Ω respectively is _____.

Fill in the blank with the correct answer from the options given below.

(1) 1 A   (2) 2/3 A   (3) 3/4 A   (4) 5/6 A

Ans. **(4)**

Sol.

$$R = \frac{4}{3}\,\Omega$$

$$I = \frac{\varepsilon_{net}}{R + r_{net}}$$

$$r_{net} = \frac{r_1 r_2}{r_1 + r_2} = \frac{1 \times 2}{1 + 2} = \frac{2}{3}\,\Omega$$

$$\frac{E_{net}}{r_{net}} = \frac{E_1 r_2 + E_2 r_1}{r_1 + r_2} = \frac{2 \times 2 + 1 \times 1}{1 + 2}$$

$$E_{net} = \frac{5}{3}\ r_{net} = \frac{5}{3} \times \frac{2}{3} = \frac{10}{9}\,V = \frac{5}{3}\,V$$

$$I = \frac{\dfrac{5}{3}}{\dfrac{4}{3} + \dfrac{2}{3}} = \frac{\dfrac{5}{3}}{\dfrac{6}{3}} = \frac{5}{3} \times \frac{1}{2} = \frac{5}{6}\,A$$

25. A metallic wire of uniform area of cross section has a resistance R, resistivity ρ and power rating P at V volts. The wire is uniformly stretched to reduce the radius to half the original radius. The values of resistance, resistivity and power rating at V volts are now denoted by R', ρ' and P' respectively. The correspoindng values are correctly related as _____ .

Fill in the blank with the correct answer from the options given below.

(1) $\rho' = 2\rho$, R' = 2R, P' = 2P   (2) $\rho' = (1/2)\,\rho$, R' = (1/2) R, P' = (1/2) P

(3) $\rho' = \rho$, R' = 16R, P' = (1/16) P   (4) $\rho' = \rho$, R' = (1/16) R, P' = 16 P

Ans. **(3)**

Sol. $\rho = \rho'$ because resistivity does not depends on length

$$R' = \frac{R}{n^2} = \frac{R}{\left(\dfrac{1}{2}\right)^4} = 16R$$

$$P' = \frac{P}{16}$$

26. Three magnetic materials are listed below
(A) paramagnetics
(B) diamagnetics
(C) ferromagnetics
Choose the correct order of the materials increasing order of magnetic susceptibility.
(1) (A), (B), (C)   (2) (C), (A), (B)   (3) (B), (A), (C)   (4) (B), (C), (A)

Ans. **(3)**

27. Two infinitely long straight parallel conductors carrying currents I_1 and I_2 are held at a distance d apart in vacuum. The force F on a length L of one of the conductors due to the other is _____ .
Fill in the blank with the correct answer from the options given below.
(1) proportional to L but independent of $I_1 \times I_2$ (2) proportional to $I_1 \times I_2$ but independent of length L

(3) proportional to $I_1 \times I_2 \times L$ (4) proportional to $\dfrac{L}{I_1 \times I_2}$

Ans. **(3)**
Sol. $F = \dfrac{\mu_0 I_1 I_2 \ell}{2\pi r}$

28. In the circuit shown below, a current 3 I enters at A. The semicircular parts ABC and ADC have equal radii 'r' but resistances 2R and R respectively. The magnetic field at the center of the circular loop ABCD is _____.
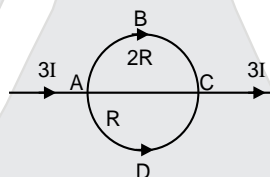
Fill in the blank with the correct answer from the options given below.

(1) $\dfrac{\mu_0 I}{4r}$ out of the plane   (2) $\dfrac{\mu_0 I}{4r}$ into the plane

(3) $\dfrac{\mu_0 3I}{4r}$ out of the plane   (4) $\dfrac{\mu_0 3I}{4r}$ into the plane

Ans. **(1)**

Sol. $B_1 = \dfrac{\mu_0 I}{2R} \times \dfrac{1}{2} = \dfrac{\mu_0 I}{4r}$ $\otimes$

$\mathbf{B_2} = \dfrac{\mu_0 (2I)}{4r} \Rightarrow \dfrac{2\mu_0 I}{4r}$ $\odot$

$B_{net} = B_2 - B_1$

$B_{net} = \dfrac{\mu_0 I}{4r}$ $\odot$

29. A square loop with each side 1 cm, carrying a current of 10 A, is placed in a magnetic field of 0.2 T. The direction of magnetic field parallel to the plane of the loop. The torque experienced by the loop is ____.
Fill in the blank with the correct answer from the options given below.
(1) zero   (2) 2 × 10⁻⁴Nm   (3) 2 × 10⁻²Nm   (4) 2 Nm

Ans. **(2)**
Sol. $\tau = BINA \sin\theta$
    $= \mathbf{0}.2 \times 10 \times 1 \times 1 \times 10^{-4}$
    $= 2 \times 10^{-4}$ Nm

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30. In an ac circuit, the current leads the voltage by $\pi/2$. The circuit is _____.

Fill in the blank with the correct answer from the options given below.

(1) purely resistive

(2) should have circuit elements with resistance equal to reactance.,

(3) purely inductive

(4) purely capacitive

Ans. **(4)**

31. In a pair of adjacent coils, for a change of current in one of the coils from 0 A to 10 A in 0.25 s, the magnetic flux in the adjacent coil changes by 15 Wb. The mutual indutance of the coils is _____.

Fill in the blank with the correct answer from the options given below.

(1) 120 H   (2) 12 H   (3) 1.5 H   (4) 0.75 H

Ans. **(3)**

Sol. $d\text{I}$ = 0 to 10 A

t = 0.25 sec

$d\phi$ = 15 web.

$$M = \frac{\varepsilon}{-\dfrac{d\text{I}}{dt}} \qquad \because \varepsilon = -\frac{d\phi}{dt} = \frac{15}{0.25}$$

$$M = \frac{-15}{0.25 \times -\dfrac{(10-0)}{0.25}} = \frac{3}{2} = 1.5\text{H}$$

32. A wire of irregular shape in figure (a) and a circular loop of wire in figure (b) are placed in different uniform magnetic fields as shown in the figures below. In figure (a), the magnetic field is perpendicular into the plane. In figure (b), the magnetic field is perpendicular out of the plane.
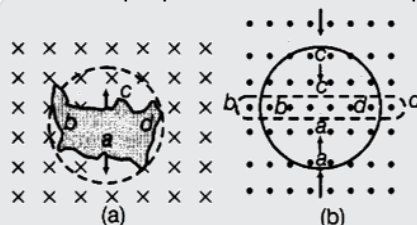
The wire in figure (a) is turning into a circular loop and that in figure (b) into a narrow straight wire. The direction of induced current will be _____.

Fill in the blank with the correct answer from the options given below.

(1) clockwise in both (a) and (b)   (2) anticlockwise in both (a) and (b)

(3) clockwise in (a) and anticlockwise in (b)   (4) anticlockwise in (a) and clockwise in (b)
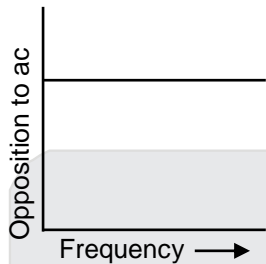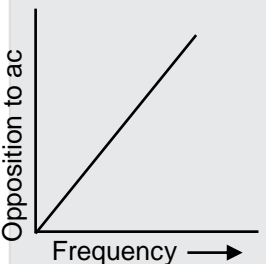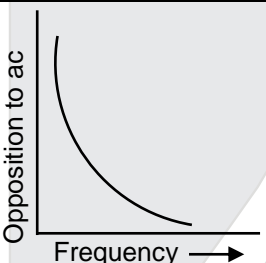
Ans. **(2)**

33. Match List-I has four graphs showing variation of opposition to flow of ac versus frequency with circuit characteristic in List-II.

List-I	List-II
(A)	(I) Impedance
(B)	(II) Capacitive reactance
(C)	(III) Inductive reactance
(D)	(IV) Resistance

Choose the correct answer from the options given below.

(1) (A) - (I), (B) - (II), (C) - (III), (D) - (IV)

(2) (A) - (IV), (B) - (III), (C) - (II), (D),- (I)

(3) (A) - (I), (B) - (II), (C) - (IV), (D) - (III)

(4) (A) - (III), (B) - (IV), (C) - (I), (D)- (II)

Ans. **(2)**

34. In an electromagnetic wave, the ratio of energy densities of electric and magnetic fields is _____.
Fill in the blank with the correct answer from the options given below.

(1) 1:1   (2) 1:c   (3) c:1   (4) $1:c^2$

Ans. **(1)**

Sol. $\dfrac{\overline{U}_e}{\overline{U}_m} = \dfrac{\dfrac{\varepsilon_0 E^2}{2}}{\dfrac{B^2}{2\mu_0}}$

$= \varepsilon_0 E^2 \times \dfrac{\mu_0}{B^2} \Rightarrow \varepsilon_0 \mu_0 \dfrac{E^2}{B^2} \Rightarrow \dfrac{1}{c^2} \times c^2 \Rightarrow 1:1$

35. Of the following, the correct arrangement of electromagnetic spectrum in decreasing order of wavelength is ___

Fill in the blank with the correct answer from the options given below :

(1) Radio waves, X-rays, Infrared waves, microwaves, visible waves
(2) Infrared waves, microwaves, Radio waves, X-rays, visible waves
(3) Radio waves, microwaves, infrared waves, visible waves, X-rays
(4) X-rays, visible waves, infrared waves, microwaves, Radio waves

Ans. **(3)**

36. Match Electromagnetic waves listed in column I with Production method/device in column II

	Column –I Electromagnetic waves	Column –II Production method/device
(A)	Microwaves	(I) LC oscillator
(B)	Infrared	(II) Magnetron
(C)	X-rays	(III) Vibration of atoms/ molecules
(D)	Radio waves	(IV) Bombarding large atomic number metal target with first moving electrons

The correctly matched combination is as in option:

(1) (A) - (I), (B) - (II), (C) - (III), (D) - (IV)
(2) (A) - (II), (B) - (III), (C) - (IV), (D) - (I)
(3) (A) - (II), (B) - (I), (C) - (IV), (D) - (III)
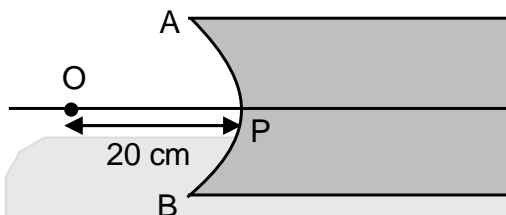(4) (A) - (III), (B) - (IV), (C) - (I), (D) - (II)

Ans. **(2)**

37. In the figure given below, APB is a curved surface of radius of curvature 10 cm separating air and a transparent material (μ = 4/3). A point object O is placed in air on the principal axis of the surface 20 cm from P. The distance of the image of O from P will be ____

Fill in the blank with the correct answer from the options given below.

(1)16 cm left of P in air   (2) 16 cm right of P in water

(3) 20 cm right of P in water   (4) 20 cm left of P in air

Ans. (1)

Sol. R = – 10 cm

u = – 20 cm

$$\frac{\mu_2}{v} - \frac{\mu_1}{u} = \frac{\mu_2 - \mu_1}{R}$$

$$\frac{4}{3v} - \frac{1}{-20} = \frac{\left(\frac{4}{3} - 1\right)}{-10}$$

$$\frac{4}{3v} + \frac{1}{20} = \frac{-1}{30}$$

$$\frac{4}{3v} = \frac{-1}{30} - \frac{1}{20}$$

$$\frac{4}{3v} = \frac{-2-3}{60}$$

$$v = \frac{4}{3} \times \frac{60}{(-5)}$$

v = – 16 cm

38. For fixed values of radii of curvature of lens, power of the lens will be ____

Fill in the blank with the correct answer from the options given below.

(1) P ∝ (μ – 1)   (2) P ∝ μ²   (3) P ∝ 1/ μ   (4) P ∝ μ⁻²

Ans. (1)

Sol. $$\frac{1}{f} = (\mu_{21} - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$$

$$p = (\mu_{21} - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right) \quad \therefore \text{ Given fixed values of radii of curvature.}$$

$$p \propto (\mu_{21} - 1)$$

39. The graph correctly representing the variation of image distance 'v' for a convex lens of focal lengh ' f ' versus object distance 'u' is _____

Fill in the blank with the correct answer from the options given below.
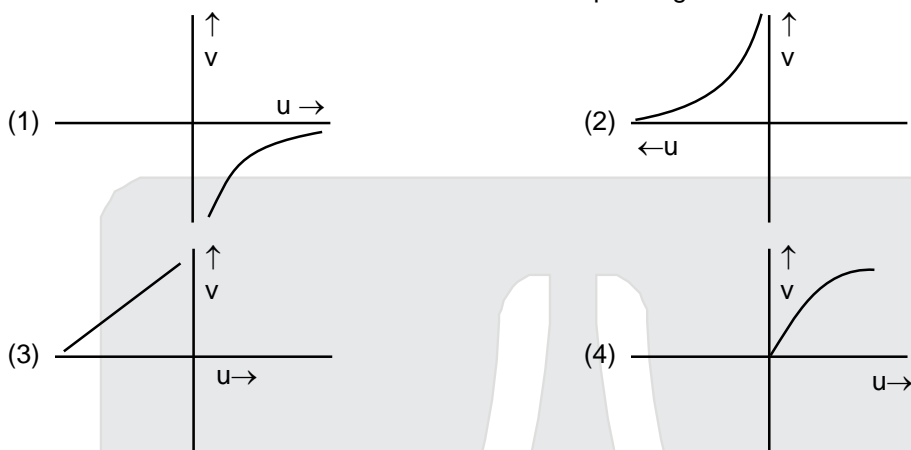
Ans. **(2)**

40. Using light from a monochromatic source to study diffraction in a single slit of width 0.1 mm, the linear width of central maxima is measured to be 5 mm on a screen held 50 cm away. The wavelength of light used is _____.

Fill in the blank with the correct answer from the options given below.

(1) 2.5×10^{-7} m   (2) 4×10^{-7} m   (3) 5×10^{-7} m   (4) 7.5×10^{-7} m

Ans. **(3)**

Sol. a = 0.1 mm

2x = 5 mm

$\dfrac{2\lambda D}{a} = 5 \times 10^{-3}$

$\lambda = \dfrac{5 \times 10^{-3} \times a}{2D}$

$= \dfrac{5 \times 10^{-3} \times 0.1 \times 10^{-3}}{2 \times 50 \times 10^{-2}}$

$= 0.5 \times 10^{-6}$

$= 5 \times 10^{-7}$ m

41. Radiation of frequency $2\nu_0$ is incident on a metal with threshold frequency ν_0. The correct statement of the following is _____.

Fill in the blank with the correct answer from the options given below.

(1) No photoelectrons will be emitted

(2) All photoelectrons emitted will have kinetic energy equal to $h\nu_0$

(3) Maximum kinetic energy of photoelectrons emitted can be $h\nu_0$

(4) Maximum kinetic energy of photoelectrons emitted will be $2h\nu_0$

Ans. **(3)**

Sol. K.E. = $h\nu - h\nu_0$

$= h(2\nu_0 - \nu_0)$

K.E. = $h\nu_0$

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42. A point causing photoelectric emission from a metallic plate is moved away from the plate. The variation of photoelectric current with distance from the source is correctly represented by the graph _____.

Fill in the blank with the correct answer from the options given below.
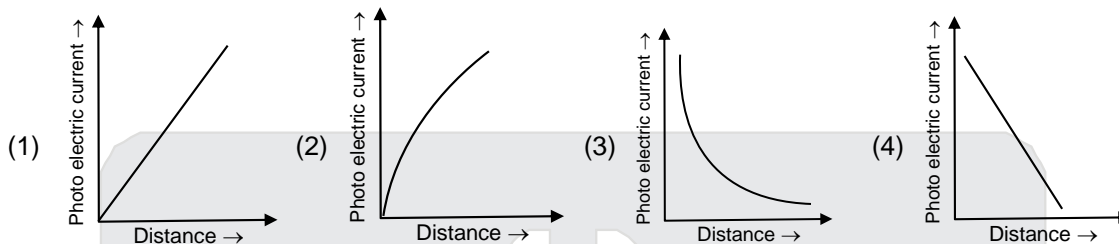
Ans. (3)

Sol. Intensity $\propto \dfrac{1}{(\text{distance})^2}$ and photoelectric current $\propto$ Intensity.

So, Current $\propto \dfrac{1}{(\text{distance})^2}$

43. A proton accelerated through a potential difference V has a de Broglie wavelength λ. On doubling the accelerating potential, de Broglie wavelength of the proton _____.

Fill in the blank with the correct answer from the options given below.

(1) remains unchanged (2) becomes double   (3) becomes four times (4) decreases

Ans. (4)

Sol. $\lambda = \dfrac{h}{\sqrt{2mqV}} \Rightarrow \lambda \propto \dfrac{1}{\sqrt{V}}$

$\lambda_2 \propto \dfrac{1}{\sqrt{2V}} \Rightarrow \lambda_2 = \dfrac{\lambda}{\sqrt{2}}$

44. The kinetic energy of an electron in ground level in hydrogen atom is K units. The values of its potential energy and total energy respectively are_____.

Fill in the blank with the correct answer from the options given below.

(1) – 2K; – K   (2) +2K; –K   (3) – K, + 2K   (4) + K, + 2K

Ans. (1)

Sol. P.E. = – 2K

E = – K

45. Two nuclei have mass numbers A and B respectively. The density ratio of the nuclei is _____.

Fill in the blank with the correct answer from the options given below.

(1) A: B   (2) $\sqrt{A} : \sqrt{B}$ (3) $A^2 : B^2$ (4) 1: 1

Ans. (4)

Sol. 1 : 1

46. The shortest wavelengths emitted in hydrogen spectrum corresponding to different spectral series are under:

(A) Pfund series   (B) Balmer series   (C) Brackett series   (D) Lyman series

The wavelengths arranged correctly in decreasing order are _____.

Fill in the blank with the correct answer from the options given below.

(1) (A), (B), (C), (D)   (2) (A), (C), (B), (D)   (3) (B), (A), (D), (C)   (D) (A), (C), (D), (B)

Ans. **(2)**

47. Silicon can be doped using one of the following elements as dopant:

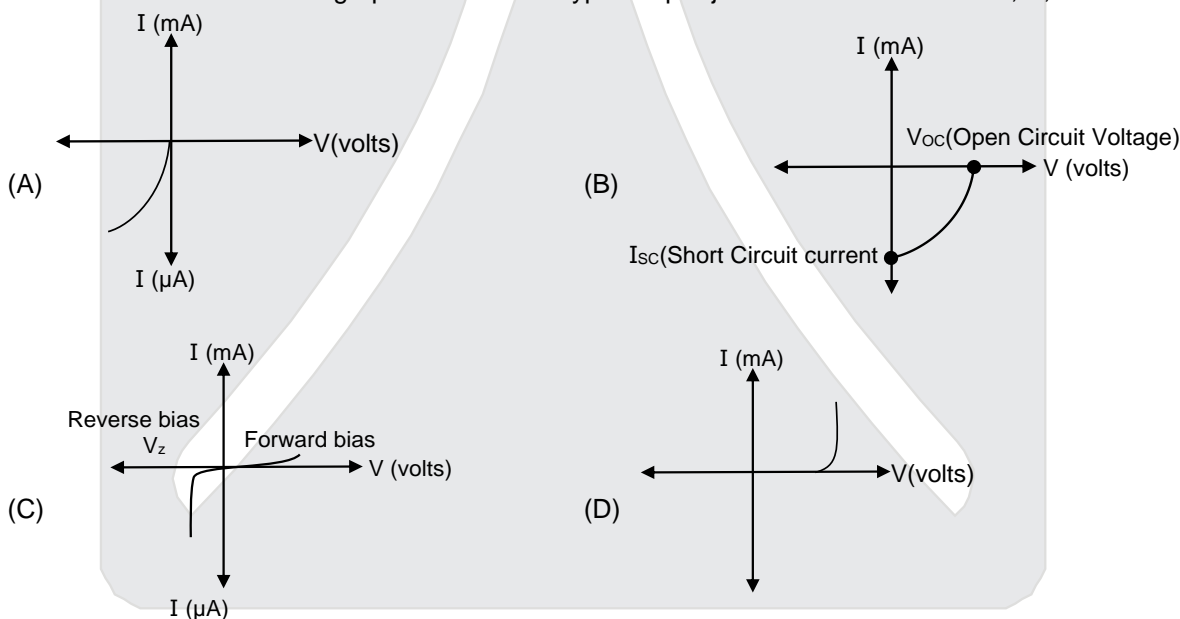(A) Arsenic   (B) Indium   (C) Phosphorus   (D) Boron

To get n-type semiconductor, the dopants that can be used are _____.

Fill in the blank with the correct answer from the options given below.

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

Ans. **(1)**

48. Given below are V versus I graphs for different types of p-n junction diodes marked A, B, C and D.

The correct sequence of graphs corresponding to forward biased p-n junction; Zener diode; Photo diode and Solar cell in order is _____

Fill in the blank with the correct answer from the options given below.

(1) (D), (C), (A), (B)   (2) (A), (C), (B), (D)   (3) (B), (A), (D), (C)   (4) (C),(B), (D), (A)

Ans. **(1)**

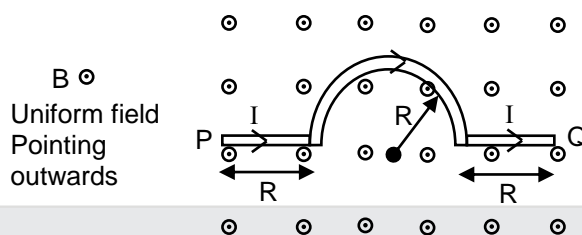**49.** A wire carrying current I, bent as shown in the figure, is placed in a uniform field B that emerges normally out from the plane of the figure. The force on this wire is_____.

B ⊙
Uniform field
Pointing
outwards

Fill in the blank with the correct answer from the options gien below.

(1) 4BIR, directed vertically downward　　　　(2) 3BIR, directed vertically upward

(3) BI(2R + πR), vertically downward　　　　(4) 2π BIR, from P to Q

Ans. **(1)**

Sol. $F = BIL\sin\theta$

$F_{net} = F_1 + F_2 + F_3$

　　$= BIR + 2\,BIR + BIR$

　　$= 4\,BIR$, directed vertically downward

50. The refractive index of the material of an equilateral prism is $\sqrt{2}$. The angle of minimum deviation of that prism is_____.

Fill in the blank with the correct answer from the options given below.

(1) 60º　　　　　　(2) 75º　　　　　　(3) 30º　　　　　　(4) 90º

Ans. **(3)**

Sol. $\mu = \sqrt{2}$

$A = 60°$

$$\mu = \frac{\sin\left(\dfrac{A + \delta_{min}}{2}\right)}{\sin\left(\dfrac{A}{2}\right)}$$

$$\sqrt{2} = \frac{\sin\left(\dfrac{60 + \delta_{min}}{2}\right)}{\sin\left(\dfrac{60}{2}\right)}$$

$$\sqrt{2} \times \frac{1}{2} = \sin\left(\frac{60 + \delta_{min}}{2}\right)$$

$$\sin^{-1}\left(\frac{1}{\sqrt{2}}\right) = \left(\frac{60 + \delta_{min}}{2}\right)$$

$45 \times 2 = 60 + \delta_{min}$

$\delta_{min} = 30°$

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