

CUET UG (Physics) - 21 May 2025 Shift 2

Question1

The elements which may be considered for an ideal inductor as a solenoid,

- (A) which is made of a thick wire
- (B) which has negligible resistance
- (C) which has a sufficiently large inductance
- (D) which is made of a thin wire

Choose the correct answer from the options given below:

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

Options:

A.

1

B.

2

C.

3

D.

4

Answer: A

Solution:

The correct answer is option 1. (A),(B) and (C) only.

Ideal Inductors should have zero resistance

A : It should be made of a **thick wire** (to reduce resistance)

B : It should have **negligible resistance**

C : It should have large inductance to store magnetic energy effectively

D : It should **not** be made of a thin wire as thin wire will increase the resistance as R is inversely proportional to A ($R \propto 1/A$).

Question2

In an experiment on the photoelectric effect, the slope of the cut-off voltage versus frequency of the incident light gives

- 1. h
- 2. h/e

3. e/h

4. V_0

Options:

A. 1

B. 2

C. 3

D. 4

Answer: B

Solution:

Correct Answer: 2. h/e

Einstein's Photoelectric Equation

$$eV_0 = h\nu - \phi.$$

In the photoelectric effect, when you plot the **cut-off voltage (V_0)** against the **frequency (ν)**, the **slope** of the graph gives the value of h/e .

From the equation of a straight line,

$$y = mx + c$$

the photoelectric equation can be rewritten as:

$$V_0 = (h/e)\nu - \phi/e$$

where:

- V_0 (**y-axis**) $\rightarrow$ stopping or cut-off voltage
- ν (**x-axis**) $\rightarrow$ frequency of incident radiation
- **Slope (m)** $\rightarrow h/e$

Question3

A 10 pF capacitor is connected to a 24 V battery. The electrostatic energy stored in the capacitor is:

(1) $11.52 \times 10^{-9} \text{ J}$

(2) $1.2 \times 10^{-9} \text{ J}$

(3) $5.76 \times 10^{-9} \text{ J}$

(4) $2.88 \times 10^{-9} \text{ J}$

Options:

A. 1

B. 2

C. 3

D. 4

Answer: D

Solution:

Formula: $U = \frac{1}{2} CV^2$

Given:

Capacitance, $C = 10 \text{ pF} = 10 \times 10^{-12} \text{ F}$

Voltage, $V = 24 \text{ V}$

Calculation:

$$U = \frac{1}{2} \times 10 \times 10^{-12} \times 24 \times 24$$

$$U = 2.88 \times 10^{-9} \text{ J}$$

Final Answer: $U = 2.88 \times 10^{-9} \text{ J}$

Question4

The output frequency of a (i) half-wave rectifier and (ii) full-wave rectifier, if the input frequency is 50 Hz are, respectively

1. (i) 50 Hz ; (ii) 100 Hz
2. (i) 100 Hz ; (ii) 100 Hz
3. (i) 50 Hz; (ii) 50 Hz
4. (i) 100 Hz ; (ii) 50 Hz

Options:

- A. 1
- B. 2
- C. 3
- D. 4

Answer: A

Solution:

The correct answer is 1.(i) 50 Hz ; (ii) 100 Hz .

Half-wave rectifier: It allows only one half (positive or negative) of the AC signal to pass.

Therefore, the output frequency is the same as the input frequency. Output frequency = 50 Hz.

Full-wave rectifier: It inverts the negative half cycle, so both halves become positive. This means two pulses per input cycle. Output frequency = $2 \times 50 = 100 \text{ Hz}$.

Question5

A point charge Q is kept at the midpoint of a face of cube of side L . The electric flux emerging from the cube is

1. zero
2. $Q(6\epsilon_0)^{-1}$
3. $6Q\epsilon_0^{-1}L^2$
4. $Q(2\epsilon_0)^{-1}$

Options:

- A. 1

- B. 2
- C. 3
- D. 4

Answer: D

Solution:

According to **Gauss's Law**,
Total electric flux,

$$\Phi = \frac{Q_{\text{enclosed}}}{\epsilon_0}$$

Here, the charge **Q** lies exactly on one face of the cube — it is **not completely inside** the cube.

If we imagine **two identical cubes** sharing that face, the charge lies exactly at the boundary between them.
By **symmetry**, the charge is **equally shared** between the two cubes.

Therefore,
Charge enclosed by one cube = $Q / 2$

Applying Gauss's Law:

$$\Phi = \frac{Q_{\text{enclosed}}}{\epsilon_0}$$

$$\Phi = \frac{Q}{2\epsilon_0}$$

Question6

A long straight wire of a circular cross-section of radius 'a' is carrying steady current I . The current I is uniformly distributed across this cross-section. What will be the magnetic field in the region $r < a$ and $r > a$?

1. $B \propto r$ ($r < a$) and $B \propto r^{-1}$ ($r > a$)
2. $B \propto r$ ($r > a$) and $B \propto r^{-1}$ ($r < a$)
3. $B = 0$ ($r < a$) and $B \propto r^{-1}$ ($r > a$)
4. $B \propto r$ ($r < a$) and $B = 0$ ($r > a$)

Options:

- A. 1
- B. 2
- C. 3
- D. 4

Answer: A

Solution:

The correct answer is **1. $B \propto r$ (for $r < a$) and $B \propto r^{-1}$ (for $r > a$).**

Use Ampère's law. For a long straight wire with uniform current density:

For $r < a$ (inside the wire): current enclosed : $I_{\text{enc}} = I \left(\frac{\pi r^2}{\pi a^2} \right) = I \left(\frac{r^2}{a^2} \right)$

Ampère's law: $B(2\pi r) = \mu_0 I_{\text{enc}} \Rightarrow B = \left(\frac{\mu_0 I}{2\pi a^2} \right) r$

So $B \propto r$ for $r < a$

For $r > a$ (outside the wire): $I_{\text{enc}} = I$.

Ampère's law: $B(2\pi r) = \mu_0 I \Rightarrow B = \frac{\mu_0 I}{2\pi r}$

So $B \propto r^{-1}$ for $r > a$.

Direction: azimuthal (circumferential) given by the right-hand rule.

Question7

The fringe width in Young's double slit experiment is 2.4×10^{-4} m, when red light of wavelength 6400

The decrease in the fringe width, if light of wavelength 4000 Å is used instead of red light, will be:

(1) 0.9×10^{-4} m

(2) 9×10^{-4} m

(3) 1.5×10^{-4} m

(4) 2×10^{-4} m

Options:

A. 1

B. 2

C. 3

D. 4

Answer: A

Solution:

Correct Answer: 1.) 0.9×10^{-4} m

In Young's double slit experiment, fringe width (β) $\propto \lambda$

$$\Rightarrow \frac{\beta_1}{\beta_2} = \frac{\lambda_1}{\lambda_2}$$

Given: $\beta_1 = 2.4 \times 10^{-4}$ m, $\lambda_1 = 6400$ Å, $\lambda_2 = 4000$ Å

$$\beta_2 = \beta_1 \times \frac{\lambda_2}{\lambda_1} = 2.4 \times 10^{-4} \times \frac{4000}{6400} = 1.5 \times 10^{-4} \text{ m}$$

$$\text{Decrease in fringe width} = \beta_1 - \beta_2 = 2.4 \times 10^{-4} - 1.5 \times 10^{-4} = 0.9 \times 10^{-4} \text{ m}$$

Question8

The energy of the electron in any given state for the hydrogen atom is $-13.6/n^2$ eV. Identify the correct statements among the following.

- (A) The negative sign in -13.6 eV signifies that the electron is bound to the nucleus.
- (B) The negative sign in -13.6 eV signifies that the electron requires 13.6 eV energy to be separated from the nucleus.
- (C) 3.4 eV energy is required to take the electron from the ground to the first excited state.
- (D) To find the energy of the third excited state, the value of n is 4.

Choose the correct answer from the options given below:

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

Options:

- A. 1
- B. 2
- C. 3
- D. 4

Answer: A

Solution:

The correct answer is 1. **(A), (B) and (D) only.**

Given : $E_n = -13.6/n^2$ eV.

(A) True : negative energy means the electron is bound (**needs energy to remove**).

(B) True : from ground state ($n=1$) energy = -13.6 eV, so **+13.6 eV is required to ionize (separate) the electron.**

(C) False : The energy of ground state $E_1 = -13.6$ eV, first excited $E_2 = -13.6/4 = -3.4$ eV.

Energy needed = $E_2 - E_1 = (-3.4) - (-13.6) = 10.2$ eV, **not** 3.4 eV.

(D) True : ground state is $n=1$, so the third excited state is $n = 1 + 3 = 4$.

Question9

Identify the correct statements from the following in the context of electromagnetic waves.

- (A) X-rays are not electromagnetic waves.
- (B) Electromagnetic waves are transverse in nature.
- (C) Electromagnetic waves can not be polarised.
- (D) Electromagnetic waves travel with the speed of light in vacuum.

Choose the correct answer from the options given below:

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

Options:

- A. 1

- B. 2
- C. 3
- D. 4

Answer: B

Solution:

The correct answer is 2.(B) and (D) only.

(A) False : X-rays are electromagnetic waves.

(B) True : Electromagnetic waves are transverse, meaning electric and magnetic fields **vibrate perpendicular** to the direction of propagation.

(C) False : They can be polarised, since they are transverse.

(D) True : In **vacuum**, all electromagnetic waves travel with the speed of light $c=3 \times 10^8$ m/s.

Question10

A difference of 2.21 eV separates two energy levels in an atom. What is the frequency of radiation emitted when the atom makes a transition from the upper level to the lower level?

1. 5.3×10^{14} Hz
2. 2.3×10^{14} Hz
3. 8×10^{14} Hz
4. 3×10^{14} Hz

Options:

- A. 1
- B. 2
- C. 3
- D. 4

Answer: A

Solution:

The correct answer is 3.) 5.3×10^{14} Hz.

Given : Energy difference, $E = 2.21$ eV

$$1 \text{ eV} = 1.6 \times 10^{-19} \text{ J}$$

$$\text{So, } E = 2.21 \times 1.6 \times 10^{-19} = 3.54 \times 10^{-19} \text{ J}$$

$$E = h\nu \text{ where } h = 6.63 \times 10^{-34} \text{ J-s}$$

$$\nu = \frac{E}{h} = \frac{3.54 \times 10^{-19}}{6.63 \times 10^{-34}} \approx 5.34 \times 10^{14} \text{ Hz}$$

So, frequency $\approx 5.3 \times 10^{14}$ Hz

Question11

Match List-I with List-II

List-I	List-II

Physical quantity	Unit
(A) Electric flux	(I) V m^{-1}
(B) Polarisation	(II) $\text{kg m}^{-1}\text{s}^{-2}$
(C) Electric field	(III) V m
(D) Energy density	(IV) C m^{-2}

Choose the correct answer from the options given below:

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

Options:

A.

1

B.

2

C.

3

D.

4

Answer: B

Solution:

The correct answer is 2. (A) – (III), (B) – (IV), (C) – (I), (D) – (II)

1. : Electric flux= $E \cdot A$

Unit = $(\text{V m}^{-1}) \times (\text{m}^2) = \text{V m}$

1. :Polarisation=dipole moment/volume

Unit = $\text{C m} / \text{m}^3 = \text{C m}^{-2}$

(C) : Electric field= F/q

Unit = V m^{-1}

(D) : Energy density= $(\frac{1}{2})\epsilon E^2$

Unit = $\text{J m}^{-3} = \text{kg m}^{-1} \text{s}^{-2}$

Correct matching:

(A) – (III), (B) – (IV), (C) – (I), (D) – (II)

Question12

A Wheatstone bridge has four resistors: $R_1 = R_2 = R_3 = 1 \, \Omega$ and $R_4 = 2 \, \Omega$. In order to balance the bridge, resistor R_4 has to be shunted by resistance of

1. $0.5 \, \Omega$
2. $1.0 \, \Omega$

3. 2.0Ω
4. 3.0Ω

Options:

- A. 1
- B. 2
- C. 3
- D. 4

Answer: C

Solution:

The correct answer is $3. 2.0\Omega$

Given: Wheatstone bridge has: $R_1 = R_2 = R_3 = 1\Omega$, $R_4 = 2\Omega$

To balance the bridge: $\frac{R_1}{R_2} = \frac{R_3}{R'_4}$

$$\frac{1}{1} = \frac{1}{R'_4} \implies R'_4 = 1\Omega$$

Since R_4 and R are in parallel, $\frac{1}{R'_4} = \frac{1}{R_4} + \frac{1}{R}$

$$\frac{1}{1} = \frac{1}{2} + \frac{1}{R}$$

$$\frac{1}{R} = 1 - \frac{1}{2} = \frac{1}{2}$$

$$R = 2\Omega$$

Question13

In an AC circuit, the instantaneous values of emf and current are $E = 100 \sin(314t)$ V and $I = \sin(314t)$

The average power consumed in the circuit is:

1. 200 W
2. 100 W
3. 50 W
4. 25 W

Options:

- A. 1
- B. 2
- C. 3
- D. 4

Answer: D

Solution:

The correct answer is $4. 25\text{ W}$

$$E_0 = 100\text{ V}, \quad I_0 = 1\text{ A}$$

$$P_{\text{avg}} = E_{\text{rms}} I_{\text{rms}} \cos \phi$$

where ϕ is the phase difference.

$$E_{\text{rms}} = \frac{E_0}{\sqrt{2}} = \frac{100}{\sqrt{2}} = 70.7\text{ V}$$

$$I_{\text{rms}} = \frac{I_0}{\sqrt{2}} = \frac{1}{\sqrt{2}} = 0.707 \text{ A}$$

$$\text{Given } \phi = \frac{\pi}{3}$$

$$P_{\text{avg}} = E_{\text{rms}} I_{\text{rms}} \cos \phi = (70.7)(0.707) \cos \left(\frac{\pi}{3} \right)$$

$$P_{\text{avg}} = 25 \text{ W}$$

Question14

Resistances in two gaps of a metre bridge are 8Ω and 24Ω , respectively. The distance by which the balance point shifts by interchanging the resistances in the two gaps, is

- 1. 1.75 cm
- 2. 50 cm
- 3. 33.3 cm
- 4. 25 cm

Options:

- A. 1
- B. 2
- C. 3
- D. 4

Answer: B

Solution:

The correct answer is 2. 50 cm

Given: Two resistances in the gaps of a metre bridge: $R_1 = 8\Omega$, $R_2 = 24\Omega$

Length of wire = 100 cm

In a metre bridge, at balance point: $\frac{R_1}{R_2} = \frac{l_1}{100 - l_1}$

$$\frac{8}{24} = \frac{l_1}{100 - l_1}$$

$$l_1 = 25 \text{ cm}$$

For the second case (interchanging resistances):

$$\frac{24}{8} = \frac{l_2}{100 - l_2}$$

$$l_2 = 75 \text{ cm}$$

$$\text{Shift} = |l_2 - l_1| = |75 - 25| = 50 \text{ cm}$$

Question15

The magnitude of the magnetic field due to a short bar magnet having a magnetic moment of 0.2 Am^2 , at a distance of 50 cm from the centre of the magnet on its axial line will be:

- 1. $1.2 \times 10^{-7} \text{ T}$
- 2. $6.4 \times 10^{-7} \text{ T}$
- 3. $3.2 \times 10^{-7} \text{ T}$
- 4. $5 \times 10^{-7} \text{ T}$

Options:

- A. 1
- B. 2
- C. 3
- D. 4

Answer: C

Solution:

The correct answer is 3. $3.2 \times 10^{-7} \text{ T}$

For a short bar magnet on its axial line:

Magnetic moment, $M = 0.2 \text{ A}\cdot\text{m}^2$

Distance, $r = 50 \text{ cm} = 0.5 \text{ m}$

$$B = \left(\frac{\mu_0}{4\pi} \right) \times \frac{2M}{r^3}$$

$$B = 10^{-7} \times \frac{2 \times 0.2}{(0.5)^3}$$

$$B = 3.2 \times 10^{-7} \text{ T}$$

Question16

In a single slit experiment, a diffraction pattern is obtained on the screen for yellow light. What will be the effect on the diffraction pattern, if yellow light is replaced by X-rays?

- 1. diffraction pattern will not be observed**
- 2. number of fringes will decrease**
- 3. number of fringes will increase**
- 4. central maximum will become narrower**

Options:

- A. 1
- B. 2
- C. 3
- D. 4

Answer: A

Solution:

The correct answer is 1. **Diffraction pattern will not be observed.**

In single slit diffraction, the angular width of the central maximum is given by : $\theta = \lambda/a$

where λ = wavelength of light, a = slit width.

Smaller wavelength $\Rightarrow$ smaller diffraction angle.

When X-rays (**very small wavelength**) are used instead of yellow light,

the diffraction effect becomes **very small** because X-rays have a much shorter wavelength.

Hence, **no** diffraction pattern will be observed on the screen.

Question17

Match List-I with List-II

List-I	List-II
(Formula)	(Physical Quantity)
(A) $\varepsilon = -L \frac{dI}{dt}$	(I) Self inductance
(B) $\varepsilon = -M \frac{dI}{dt}$	(II) Mutual inductance
(C) $L = \frac{\Phi}{I}$	(III) Mutual Induced emf
(D) $M = \frac{\Phi}{I}$	(IV) Self Induced emf

Choose the correct answer from the options given below:

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

Options:

A.

1

B.

2

C.

3

D.

4

Answer: B

Solution:

The correct answer is 2. (A) - (IV), (B) - (III), (C) - (I), (D) - (II)

(A) $\varepsilon = -L (dI/dt) \rightarrow$ **emf induced in the same coil** $\rightarrow$ Self Induced emf $\rightarrow$ (IV)

(B) $\varepsilon = -M (dI/dt) \rightarrow$ **emf induced in another coil** $\rightarrow$ Mutual Induced emf $\rightarrow$ (III)

(C) $L = \Phi/I \rightarrow$ **ratio of flux linkage to current in same coil** $\rightarrow$ Self Inductance $\rightarrow$ (I)

(D) $M = \Phi/I \rightarrow$ **ratio of flux linkage in one coil to current in another** $\rightarrow$ Mutual Inductance $\rightarrow$ (II)

Question18

A wire carries a current of 2.0 A. The number of electrons crossing through its cross-section in 10 s will be

1. 1.6×10^{19}
2. 1.25×10^{18}
3. 2.5×10^{20}
4. 1.25×10^{20}

Options:

- A. 1
- B. 2
- C. 3
- D. 4

Answer: D

Solution:

The correct answer is 4. 1.25×10^{20}

Given: Current, $I = 2.0 \text{ A}$; Time, $t = 10 \text{ s}$; Charge of one electron, $e = 1.6 \times 10^{-19} \text{ C}$

$$Q = I \times t$$

$$n = \frac{Q}{e}$$

$$Q = 2.0 \times 10 = 20 \text{ C}$$

$$n = \frac{20}{1.6 \times 10^{-19}} = 1.25 \times 10^{20}$$

Question19

In Young's double slit experiment, slits are illuminated by light of wavelength 650 nm. The slits are 0.13 cm apart and the screen is placed 1.2 m away. What will be the separation of the adjacent maxima?

- 1. 0.0006 mm
- 2. 0.006 mm
- 3. 0.06 mm
- 4. 0.6 mm

Options:

- A. 1
- B. 2
- C. 3
- D. 4

Answer: D

Solution:

The correct answer is 4. **0.6 mm**

Given: Wavelength, $\lambda = 650 \text{ nm} = 650 \times 10^{-9} \text{ m}$

Distance between slits, $d = 0.13 \text{ cm} = 0.0013 \text{ m}$

Distance between slits and screen, $D = 1.2 \text{ m}$

fringe separation: $\beta = \lambda D / d$

$$\beta = 650 \times 10^{-9} \times 1.2 / 0.0013 = 6.0 \times 10^{-4} \text{ m} = 0.6 \text{ mm}$$

Question20

The armature coil of a generator has 20 turns and its area is 0.127 m^2 . How fast approximately should it be rotated in a magnetic field of 0.2 Wbm^{-2} , so that the peak value of induced emf is 160 V?

1. 20 rps
2. 50 rps
3. 100 rps
4. 200 rps

Options:

- A. 1
- B. 2
- C. 3
- D. 4

Answer: B

Solution:

The correct answer is 2. **50 rps**

Given:

Number of turns, **N**=20

Area of coil, **A**= 0.127 m^2

Magnetic field, **B**= 0.2 Wb/m^2

Peak emf, **E_o**=160 V

The peak emf induced in a rotating coil is **E_o=NBA ω** where **$\omega=2\pi n$** and n = revolutions per second (rps).

Substituting values: $160=20 \times 0.2 \times 0.127 \times 2\pi n \approx 50.16 \text{ rps}$

Hence, Required speed = 50 rps

Question21

A photo cathode is illuminated by a very small bright source placed 1 m away. When the same source of light is placed 0.5 m away, the number of electrons emitted by the photo cathode would become

1. four times
2. twice
3. one fourth
4. half

Options:

- A. 1
- B. 2
- C. 3
- D. 4

Answer: A

Solution:

The correct answer is 1. **four times**

Given:

Distance of light source initially = 1 m

New distance = 0.5 m

The number of emitted electrons in the photoelectric effect is directly proportional to the intensity of light incident on the photocathode and for a point source, the intensity varies inversely as the square of the distance from the source.

$$\frac{I_2}{I_1} = \left(\frac{R_1}{R_2} \right)^2 = 4$$

$$\text{Since } N \propto I : \quad \frac{N_2}{N_1} = 4$$

Question22

The necessary conditions for total internal reflection are

- (A) Light must travel from denser to rarer medium.
- (B) The angle of incidence in the denser medium must be less than the critical angle for the two media.
- (C) Light must travel from rarer to denser medium.
- (D) The angle of incidence in the denser medium must be greater than the critical angle for the two media.

Choose the correct answer from the options given below:

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

Options:

- A. 1
- B. 2
- C. 3
- D. 4

Answer: C

Solution:

The correct answer is 3. (A) and (D) only

Total internal reflection occurs only when:

- Light travels from a denser medium to a rarer medium.
 - The angle of incidence in the denser medium is greater than the critical angle for the two media.
-

Question23

The mass defect (ΔM) for a nucleus of mass number (A), atomic number (Z) and mass (M) is given by

$$1. \Delta M = [Zm_p + (Z - A)m_n] - M$$

$$2. \Delta M = [Zm_p + (A - Z)m_n] + M$$

$$3. \Delta M = [Zm_p + (A - Z)m_e] - M$$

$$4. \Delta M = [Zm_p + (A - Z)m_n] - M$$

Options:

- A. 1
- B. 2
- C. 3
- D. 4

Answer: D

Solution:

The correct answer is 4. $\Delta M = [Zm_p + (A - Z)m_n] - M$

Mass defect is the difference between the total mass of nucleons (protons + neutrons) and the actual mass of the nucleus.

$$\Delta M = [Zm_p + (A - Z)m_n] - M$$

Where m_p = mass of one proton and m_n = mass of one neutron.

$A - Z$ = number of neutrons.

Question24

Arrange the following electromagnetic waves in decreasing order of their frequencies.

- (A) FM radio waves
- (B) UV rays
- (C) Gamma rays
- (D) X-rays

Choose the correct answer from the options given below:

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

Options:

- A. 1
- B. 2
- C. 3
- D. 4

Answer: B

Solution:

The correct answer is 2.(C), (D), (B), (A)

The electromagnetic spectrum (from highest to lowest frequency):Gamma rays>X-rays>Ultraviolet rays>Visible>Infrared>Microwaves>Radio waves

(A) FM radio waves → **lowest** frequency

(B) UV rays → **lower than X-rays**

(C) Gamma rays → **highest** frequency

(D) X-rays → **less than Gamma, greater than UV**

So, (C) Gamma rays > (D) X-rays > (B) UV rays > (A) FM radio waves

Question25

An electron moves with a velocity of 1200 m s^{-1} in a magnetic field of 0.4 T at an angle of 30° .

What will be the approximate radius of its path?

(Take $\frac{e}{m}$ of electron = $1.76 \times 10^{11} \text{ C kg}^{-1}$)

1. $9 \times 10^{-8} \text{ m}$

2. $8.6 \times 10^{-9} \text{ m}$

3. $4.4 \times 10^{-10} \text{ m}$

4. $1.5 \times 10^{-11} \text{ m}$

Options:

A. 1

B. 2

C. 3

D. 4

Answer: B

Solution:

The correct answer is $2.86 \times 10^{-9} \text{ m}$

Given: $v = 1200 \text{ m/s}$, $B = 0.4 \text{ T}$, $\theta = 30^\circ$, $\frac{e}{m} = 1.76 \times 10^{11} \text{ C/kg}$

$$r = \frac{v \sin \theta}{\left(\frac{e}{m}\right) B} = \frac{1200 \times 0.5}{1.76 \times 10^{11} \times 0.4} = 8.6 \times 10^{-9} \text{ m}$$

Question26

In a step-down transformer, 22 kV is converted into 220 V . The number of turns in the primary coil is 60000 . The number of turns in the secondary coil will be

1. 60000

2. 6000

3. 600

4. 60

Options:

A. 1

- B. 2
- C. 3
- D. 4

Answer: C

Solution:

The correct answer is 3. 600

Given: $V_p = 22 \text{ kV} = 22000 \text{ V}$, $V_s = 220 \text{ V}$, $N_p = 60000$

To find: N_s

For a transformer: $\frac{V_p}{V_s} = \frac{N_p}{N_s}$

$$\frac{22000}{220} = \frac{60000}{N_s} = 600$$

Therefore, the number of turns in the secondary coil is $N_s = \mathbf{600}$.

Question27

A parallel beam of monochromatic light of wavelength 900 nm passes through a long slit of width 0.4 mm.

The angular divergence in which most of the light is diffracted, is:

- 1. $8.9 \times 10^{-3} \text{ rad}$
- 2. $7.2 \times 10^{-3} \text{ rad}$
- 3. $3.6 \times 10^{-3} \text{ rad}$
- 4. $4.5 \times 10^{-3} \text{ rad}$

Options:

- A. 1
- B. 2
- C. 3
- D. 4

Answer: D

Solution:

The correct answer is 4. $4.5 \times 10^{-3} \text{ rad}$

Given: $\lambda = 900 \text{ nm} = 9 \times 10^{-7} \text{ m}$, $a = 0.4 \text{ mm} = 4 \times 10^{-4} \text{ m}$

For small angles: $\sin \theta \approx \theta = \frac{\lambda}{a}$

$$\theta = \frac{9 \times 10^{-7}}{4 \times 10^{-4}} = 2.25 \times 10^{-3} \text{ rad}$$

Angular width $= 2\theta = \mathbf{4.5 \times 10^{-3} \text{ rad}}$

Question28

The resistivity of a conductor in which a current density of 3.5 A m^{-2} is found to exist on applying an electric field of 28 V m^{-1} will be:

1. $0.125 \Omega \text{ m}$
2. $4 \Omega \text{ m}$
3. $8 \Omega \text{ m}$
4. $98 \Omega \text{ m}$

Options:

- A. 1
- B. 2
- C. 3
- D. 4

Answer: C

Solution:

The correct answer is 3. **$8 \Omega \text{ m}$**

Given: $\mathbf{J} = 3.5 \text{ A/m}^2$, $\mathbf{E} = 28 \text{ V/m}$

Ohm's law in terms of current density and electric field: $\mathbf{E} = \rho \mathbf{J}$

So, $\rho = \mathbf{E}/\mathbf{J} = 28/3.5 = 8 \Omega \text{ m}$

Question 29

The frequency of revolution of an electron revolving in a circular path in a magnetic field of $7.8 \times 10^{-4} \text{ T}$ will be

(Take $e = -1.6 \times 10^{-19} \text{ C}$, $m_e = 9.1 \times 10^{-31} \text{ kg}$, $\pi = \frac{22}{7}$)

1. 42 MHz
2. 21.8 MHz
3. 220 MHz
4. 46 MHz

Options:

- A. 1
- B. 2
- C. 3
- D. 4

Answer: B

Solution:

The correct answer is 2. 21.8 MHz

Given: $B = 7.8 \times 10^{-4} \text{ T}$, $e = 1.6 \times 10^{-19} \text{ C}$, $m_e = 9.1 \times 10^{-31} \text{ kg}$

The frequency of revolution of an electron in a magnetic field is given by:

$$f = \frac{eB}{2\pi m_e}$$

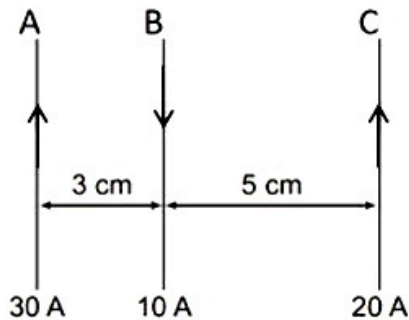
Substitute the values: $f = \frac{1.6 \times 10^{-19} \times 7.8 \times 10^{-4}}{2\pi \times 9.1 \times 10^{-31}}$

$$f = \frac{1.248 \times 10^{-22}}{5.72 \times 10^{-30}} = 2.18 \times 10^7 \text{ Hz}$$

$$\therefore f = 21.8 \text{ MHz}$$

Question30

Consider three long straight parallel wires as shown in the figure. Length of wire B is 25 cm. Choose the correct options



- (A) Net force experienced by wire B is $2 \times 10^{-4} \text{ N}$ towards left
- (B) Magnitude of repulsion force by wire A on B is $5 \times 10^{-4} \text{ N}$
- (C) Magnitude of repulsion force by wire C on B is $2 \times 10^{-4} \text{ N}$
- (D) Net force experienced by wire B is $2 \times 10^{-4} \text{ N}$ towards right

Choose the **correct** answer from the options given below:

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

Options:

- A. 1
- B. 2
- C. 3
- D. 4

Answer: B

Solution:

The correct answer is 2. (B) and (C) only

Given:

Length of wire $B = L = 25 \text{ cm} = 0.25 \text{ m}$

Distances: $A-B = 3 \text{ cm} = 0.03 \text{ m}$, $B-C = 5 \text{ cm} = 0.05 \text{ m}$

Currents: $I_A = 30 \text{ A}$ (up), $I_B = 10 \text{ A}$ (down), $I_C = 20 \text{ A}$ (up)

$$\text{Formula: } F = \frac{\mu_0 I_1 I_2 L}{2\pi d}$$

Force on B due to A (opposite directions $\rightarrow$ repulsion):

$$F_{AB} = 2 \times 10^{-7} \times \frac{(30)(10)(0.25)}{0.03} = 5.0 \times 10^{-4} \text{ N}$$

Direction: A is to the left of B and repels B $\rightarrow$ pushes B to the right.

Force on B due to C (opposite directions $\rightarrow$ repulsion):

$$F_{CB} = 2 \times 10^{-7} \times \frac{(20)(10)(0.25)}{0.05} = 2.0 \times 10^{-4} \text{ N}$$

Direction: C is to the right of B and repels B $\rightarrow$ pushes B to the left.

Net force on B = $(5.0 \times 10^{-4})_{\text{right}} - (2.0 \times 10^{-4})_{\text{left}} = 3.0 \times 10^{-4} \text{ N}$ (to the right).

$\therefore$ (B) and (C) are correct.

Question31

When a semiconductor is doped with a donor impurity, the number of _____

1. the electrons and holes decrease
2. the electrons and holes increase
3. the holes decrease and the electrons increase
4. the holes increase and the electrons decrease

Options:

- A. 1
- B. 2
- C. 3
- D. 4

Answer: C

Solution:

The correct answer is 3. **The holes decrease and the electrons increase.**

A donor impurity (like phosphorus or arsenic in silicon) donates extra electrons to the semiconductor. This forms an **n-type semiconductor**, where electrons are the majority carriers. Since electrons increase, **holes (minority carriers)** decrease due to recombination. Hence, **when doped with a donor impurity $\rightarrow$ electrons increase, holes decrease.**

Question32

The coil of a moving coil galvanometer is wound over a metallic frame

1. to increase moment of inertia
2. to provide electromagnetic damping

- 3. to increase its sensitivity
- 4. to reduce hysteresis loss

Options:

- A. 1
- B. 2
- C. 3
- D. 4

Answer: B

Solution:

The correct answer is 2. **to provide electromagnetic damping.**

The metallic frame (**usually made of aluminum**) in a moving coil galvanometer provides **eddy current damping**, which helps the coil to come to rest quickly without oscillations.

Question33

A system has two charges, $q_A = 5 \times 10^{-7} \text{ C}$ and $q_B = -5 \times 10^{-7} \text{ C}$, located at points $A : (0, 0, -10 \text{ cm})$ and $B : (0, 0, +10 \text{ cm})$, respectively. Which of the following are true?

- (A) The electric field of dipole at point $(0, 0, -15 \text{ cm})$ is $1.73 \times 10^6 \text{ NC}^{-1}$
- (B) Electric field intensity is zero at origin $(0, 0, 0)$
- (C) dipole moment $(p) = 5 \times 10^{-8} \text{ C-m}$
- (D) direction of the dipole moment is along the negative z - axis

Choose the **correct** answer from the options given below:

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

Options:

- A. 1
- B. 2
- C. 3
- D. 4

Answer: A

Solution:

The correct answer is 1. **(A) and (D) only.**

(A) True — The electric field at $(0, 0, -15 \text{ cm})$ due to this dipole is indeed **$1.73 \times 10^6 \text{ N/C}$** .

(B) False — The field at the origin is **not zero**; both charges produce fields in the same direction.

(C) False — Dipole moment **$p = q \times 2d = 5 \times 10^{-7} \times 0.20 = 1 \times 10^{-7} \text{ C-m}$**

(D) True — Dipole moment is directed **from negative to positive charge**, here that is along the **$-z$** axis (since $+q$ is at $z = -0.10$ and $-q$ at $z = +0.10$).

Question34

For which pair among the following, the refractive index will have the minimum and maximum value, respectively ?

1. Vacuum, diamond
2. Air, glass
3. Water, diamond
4. Crown glass, flint glass (dense)

Options:

- A. 1
B. 2
C. 3
D. 4

Answer: A

Solution:

The correct answer is 1. **Vacuum, diamond**.

The refractive index is minimum for vacuum ($n = 1$) and maximum for diamond ($n \approx 2.42$).

Hence, the pair with minimum and maximum refractive indices respectively is **vacuum and diamond**.

Question35

Match List-I with List-II (Symbols have their usual meanings)

List-I	List-II
Physical Quantity	Expression
(A) Current density	(I) $\frac{-eE\tau}{m}$
(B) Drift velocity	(II) $\frac{ne^2\tau}{m}$
(C) Conductivity	(III) $\frac{e\tau}{m}$
(D) Mobility	(IV) nev_d

Choose the correct answer from the options given below:

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

Options:

- A.
1
B.

2

C.

3

D.

4

Answer: A

Solution:

The correct answer is 3. (A) – (IV), (B) – (I), (C) – (II), (D) – (III).

(A) Current density ($\mathbf{J}$) = $n\mathbf{e}\mathbf{v}_d \rightarrow$ (IV)

(B) Drift velocity ($\mathbf{v}_e$) = $-(\mathbf{eE}\tau)/\mathbf{m} \rightarrow$ (I)

(C) Conductivity (σ) = $ne^2\tau/m \rightarrow$ (II)

(D) Mobility (μ) = $e\tau/m \rightarrow$ (III)

Question 36

The energy of a Hydrogen atom in its first excited state is

1. - 3.4 eV

2. 13.6 eV

3. - 6.8 eV

4. - 13.6 eV

Options:

A. 1

B. 2

C. 3

D. 4

Answer: A

Solution:

The correct answer is 1. - 3.14 eV

Energy of an electron in the n^{th} orbit of hydrogen atom is given by:

$$E_n = \frac{-13.6}{n^2} \text{ eV}$$

For the first excited state, $n = 2$

$$E_2 = \frac{-13.6}{(2)^2}$$

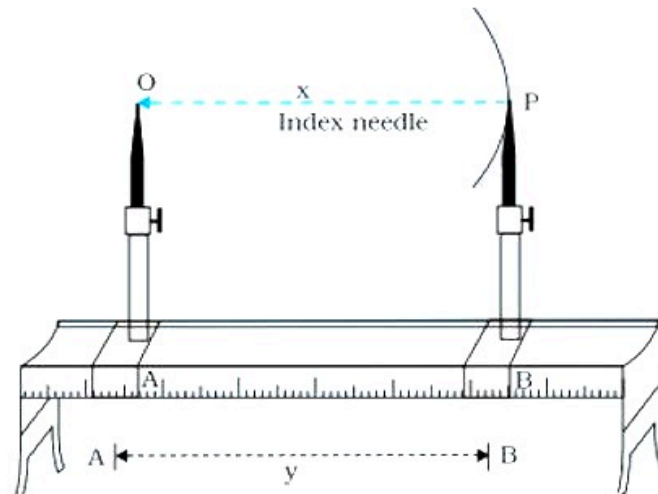
$$E_2 = \frac{-13.6}{4}$$

$$E_2 = -3.4 \text{ eV}$$

Hence, the energy of the first excited state is $\boxed{-3.4 \text{ eV}}$.

Question 37

Arrange the following steps (A, B, C and D) in proper sequence to determine the index correction in the given arrangement.



- (A) The difference between the two gives the correction to be applied to the observed distance.
- (B) The positions of the uprights are read on the scale. Their difference gives the observed distance between tip of the pin and the pole of the mirror.
- (C) A thin straight index needle OP is placed so that its one end O touches the tip of the pin and the other end P touches the pole of the mirror.
- (D) Length of the needle OP is measured by placing it on the scale which is the actual distance between the points in question.

Choose the **correct** answer from the options given below:

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

Options:

- A. 1
- B. 2
- C. 3
- D. 4

Answer: D

Solution:

The correct answer is 4. **(B),(C),(D),(A)**

(B) First, read the positions of the uprights on the scale. Their difference gives the observed **distance between the tip of the pin and the pole of the mirror**.

(C) Next, place a thin straight index needle OP so that one end O touches the tip of the pin and the other end P touches the pole of the mirror.

(D) Measure the length of the needle **OP** by placing it on the scale. This gives the **actual distance between the two points**.

(A) Finally, calculate the difference between the observed **distance and the actual distance**. This difference is the correction to be applied to the observed distance.

.....

Question38

The force between two small charged spheres having charges of 2×10^{-7} C and 3×10^{-7} C, respectively, placed 30 cm apart in air would be.

1. 2×10^{-3} N
2. 6×10^{-7} N
3. 6×10^{-3} N
4. 5×10^{-7} N

Options:

- A. 1
- B. 2
- C. 3
- D. 4

Answer: C

Solution:

The correct answer is 3.6×10^{-3} N

The force between two charged spheres is given by Coulomb's law:

$$F = k \frac{q_1 q_2}{r^2}$$

Where:

$$k = \frac{1}{4\pi\epsilon_0} = 9 \times 10^9 \text{ N}\cdot\text{m}^2/\text{C}^2$$

$$q_1 = 2 \times 10^{-7} \text{ C}, \quad q_2 = 3 \times 10^{-7} \text{ C}$$

$$r = 0.3 \text{ m}$$

Substitute the values:

$$F = 9 \times 10^9 \times \frac{(2 \times 10^{-7})(3 \times 10^{-7})}{(0.3)^2}$$

$$F = 9 \times 10^9 \times \frac{6 \times 10^{-14}}{0.09}$$

$$F = 9 \times 10^9 \times 6.67 \times 10^{-13}$$

$$F = 6 \times 10^{-3} \text{ N}$$

$$\boxed{F = 6 \times 10^{-3} \text{ N}}$$

Question39

Two capacitors of capacitances $2 \mu\text{F}$ and $4 \mu\text{F}$ are connected in parallel. A charge of $6 \mu\text{C}$ is given to the combination which gets shared. The ratio of the charges on the two capacitors, respectively will be

1. 1:1
2. 2:3
3. 1:2
4. 2:1

Options:

- A. 1
- B. 2

C. 3

D. 4

Answer: C

Solution:

The correct answer is 3.) $1 : 2$

For capacitors connected in parallel, the potential difference (V) across each capacitor is the same.

Charge on each capacitor is given by: $Q = C \times V$

Since V is the same for both, the ratio of charges is directly proportional to their capacitances:

$$\frac{Q_1}{Q_2} = \frac{C_1}{C_2}$$

$$Q_1 : Q_2 = C_1 : C_2 = 2 : 4 = 1 : 2$$

$$\boxed{Q_1 : Q_2 = 1 : 2}$$

Question 40

A semicircular arc of radius R is charged uniformly and its linear charge density is λ . What will the electric field at the center be?

1. $\frac{\lambda}{2\pi\epsilon_0 R}$

2. $\frac{\lambda}{4\pi\epsilon_0 R}$

3. $\frac{\lambda}{2\pi^2\epsilon_0 R}$

4. $\frac{\lambda 2\pi R}{\epsilon_0}$

Options:

A. 1

B. 2

C. 3

D. 4

Answer: A

Solution:

The correct answer is 1. $\lambda / (2 \pi \epsilon_0 R)$.

For a uniformly charged **semicircular arc** of radius R and linear charge density λ ,
The electric field at the center (**due to symmetry**) is directed along the axis of the semicircle.

Question 41

Which of the following statements are true?

- (A) The potential energy for a system of two negative point charges is negative
- (B) Electrostatic force is a conservative force
- (C) Negative potential energy between two charges implies that the force between them is repulsive
- (D) Electrostatic potential energy is a scalar quantity

Choose the correct answer from the options given below:

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

Options:

- A. 1
- B. 2
- C. 3
- D. 4

Answer: A

Solution:

The correct answer is 1. **(B) and (D) only**.

- (A) False. For two negative charges $U > 0$ (positive), **not negative**.
 - (B) Electrostatic force is **conservative**.
 - (C) Negative potential energy means **attractive force** (not repulsive).
 - (D) Potential energy is a **scalar quantity**.
-

Question 42

Match List-I with List-II

List-I	List-II
(Physical quantity)	(Formula)
(A) Current sensitivity of galvanometer	(I) $\frac{\mu_0 I}{2R}$
(B) Magnetic field at the centre of a circular coil	(II) $\frac{NAB}{kR}$
(C) magnetic field due to a long straight wire carrying a current	(III) $\frac{NAB}{k}$
(D) Voltage sensitivity of galvanometer	(IV) $\frac{\mu_0 I}{2\pi R}$

Choose the correct answer from the options given below:

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

Options:

A.

1

B.

2

C.

3

D.

4

Answer: C

Solution:

The correct answer is 3. (A) – (III), (B) – (I), (C) – (IV), (D) – (II).

(A) Current sensitivity of galvanometer $\rightarrow NAB/k \rightarrow$ (III)

(B) Magnetic field at the centre of a circular coil $\rightarrow \mu_0 I/2R \rightarrow$ (I)

(C) Magnetic field due to a long straight wire $\rightarrow \mu_0 I/2\pi R \rightarrow$ (IV)

(D) Voltage sensitivity of galvanometer $\rightarrow NAB/kR \rightarrow$ (II)

Question 43

A planoconvex lens has the radius of curvature of its curved surface 50 cm and the refractive index of its material is 1.5.

Its focal length will be

- 1.) 1 m
- 2.) 0.5 m
- 3.) 2 m
- 4.) 0.25 m

Options:

A. 1

B. 2

C. 3

D. 4

Answer: A

Solution:

The correct answer is 1. 1 m.

For a plano-convex lens, $\frac{1}{f} = (\mu - 1) \left(\frac{1}{R_1} - \frac{1}{R_2} \right)$

Given: $R_1 = 50 \text{ cm} = 0.5 \text{ m}$, $R_2 = \infty$

$$\frac{1}{f} = (1.5 - 1) \left(\frac{1}{0.5} - 0 \right)$$

$$\frac{1}{f} = 0.5 \times 2 = 1$$

$$f = 1 \text{ m}$$

Question44

A 1.0 m long metallic rod is rotated with an angular frequency of 500 rad s^{-1} with one end other end at the circumference of a circular metallic ring of radius 1 m about an axis passing perpendicular to the plane of the ring. A constant and uniform magnetic field of 0.6 T parallel everywhere. The emf developed between the center and the ring is

1. 300 V
2. 375 V
3. 225 V
4. 150 V

Options:

- A. 1
- B. 2
- C. 3
- D. 4

Answer: A

Solution:

The correct answer is 4. **150 V**

Given : $L=1.0 \text{ m}$, $\omega=500 \text{ rad/s}$, $B=0.6 \text{ T}$

For a rod rotating about its end in a magnetic field along the axis, **motional emf between centre (axis) and rim : $E=B\omega L^2/2$**

$E=1/2 \times 0.6 \times 500 \times 1^2 = 150 \text{ V}$.

Question45

A metallic plate exposed to white light emits electrons. The colour of light for which the stopping potential will be minimum is

1. Indigo
2. Orange
3. Green
4. Blue

Options:

- A. 1
- B. 2
- C. 3
- D. 4

Answer: B

Solution:

The correct answer is 2. **Orange**

Higher frequency $\rightarrow$ **higher energy photons** $\rightarrow$ larger stopping potential

Lower frequency $\rightarrow$ **smaller stopping potential**

Therefore, the colour with the *minimum stopping potential* is the **lowest frequency** light among those listed — **Orange**.

Question 46

Identify the correct statements among the following.

- (A) The number of electrons (n_e) is more than the number of holes (n_h) in intrinsic conductors.
- (B) Semiconductors are elements (Si, Ge) type as well as compounds (GaAs, CdS).
- (C) The number of charge carriers can be changed by 'doping' of a suitable impurity in pure semiconductors.
- (D) Holes are essentially electron vacancies in a valence band.

Choose the correct answer from the options given below:

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

Options:

- A. 1
- B. 2
- C. 3
- D. 4

Answer: D

Solution:

The correct answer is 4. **(B), (C), and (D) only**

(A) For **intrinsic semiconductors**, the number of electrons = number of holes:

$$n_e = n_h$$

Hence, n_e is **not more than** n_h .

(B) *Correct* : Semiconductors can be **elemental** (e.g., Si, Ge) and **compound** (e.g., GaAs, CdS).

(C) *Correct* : By **doping** (adding impurities), we can increase or decrease the number of charge carriers (electrons or holes).

(D) *Correct* : A **hole** represents the **absence of an electron** in the valence band — essentially an electron vacancy.

Correct statements: (B), (C), and (D)

Question 47

A copper wire of area of cross-section $2 \times 10^{-6} \text{ m}^2$ and electron density 10^{28} m^{-3} carries a current of 1.6 A. Time taken by an electron to drift from one end of a 1.0 m long wire to its other end will be

1. $2 \times 10^3 \text{ s}$
2. 10^3 s
3. $2 \times 10^{-3} \text{ s}$
4. $1 \times 10^{-3} \text{ s}$

Options:

- A. 1
- B. 2
- C. 3
- D. 4

Answer: A

Solution:

The correct answer is **1 : $2 \times 10^3 \text{ s}$** .

Given: $A = 2 \times 10^{-6} \text{ m}^2$, $n = 10^{28} \text{ m}^{-3}$, $I = 1.6 \text{ A}$, $L = 1.0 \text{ m}$, $e = 1.6 \times 10^{-19} \text{ C}$

Drift velocity: $v_d = \frac{I}{neA}$

Time taken to drift through the wire: $t = \frac{L}{v_d} = \frac{LneA}{I}$

$$t = \frac{1.0 \times (10^{28}) \times (1.6 \times 10^{-19}) \times (2 \times 10^{-6})}{1.6}$$

$t = 2 \times 10^3 \text{ s}$

Question48

In visible light, orange differs from violet as they have

1. same frequencies and different wavelengths
2. same frequencies and same wavelengths
3. different frequencies and different wavelengths
4. different frequencies and same wavelengths

Options:

- A. 1
- B. 2
- C. 3
- D. 4

Answer: C

Solution:

The correct answer is 3 :**different frequencies and different wavelengths**

For light in a given medium (like air or vacuum): $c = \lambda \nu$

Thus, **if wavelength changes, frequency must also change.**

Orange light $\rightarrow$ longer wavelength (~ 600 nm) $\rightarrow$ lower frequency

Violet light $\rightarrow$ shorter wavelength (~ 400 nm) $\rightarrow$ higher frequency

So, they differ in **both wavelength and frequency**.

Question 49

A resistor connected to a battery is heated due to the current. The quantity which does not change is

- 1. drift speed of the charge carriers**
- 2. number of free electrons**
- 3. conductance**
- 4. resistivity**

Options:

- A. 1
- B. 2
- C. 3
- D. 4

Answer: B

Solution:

The correct answer is 2. **number of free electrons**

When a resistor is heated: **Temperature increases**,

For a metallic conductor: **Resistivity increases** (since collisions between electrons and lattice ions increase), **Conductance decreases** (since $G = 1/R$), **Drift speed** may change slightly because current and potential difference can **vary** depending on resistance.

However, the **number of free electrons (n)** depends on the **material's atomic structure**; it **does not change with temperature** (for metals, n remains essentially constant).

Question 50

The susceptibility of magnesium at 27°C is 1.2×10^{-5} .

Its susceptibility at 200 K will be

1. 8×10^{-6}
2. 1.8×10^{-5}
3. 4.43×10^{-5}
4. 1.2×10^{-5}

Options:

- A. 1
- B. 2

C. 3

D. 4

Answer: B

Solution:

The correct answer is **2. 1.8×10^{-5}** .

Magnesium is a paramagnetic material.

For paramagnets, magnetic susceptibility (χ) varies inversely with absolute temperature (T)

according to Curie's Law: $\chi \propto \frac{1}{T}$

$$\frac{\chi_2}{\chi_1} = \frac{T_1}{T_2}$$

Given: $\chi_1 = 1.2 \times 10^{-5}$, $T_1 = 27^\circ\text{C} = 300\text{ K}$, $T_2 = 200\text{ K}$

$$\chi_2 = \chi_1 \times \frac{T_1}{T_2}$$

$$\chi_2 = 1.2 \times 10^{-5} \times \frac{300}{200} = \boxed{1.8 \times 10^{-5}}$$
