23/05/2023

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Answers & Solutions

Time : 45 min.

for

M.M. : 200

CUET UG-2023

(Physics)

IMPORTANT INSTRUCTIONS:

1. The test is of 45 Minutes duration.
2. The test contains 50 Questions out of which 40 questions need to be attempted.
3. Marking Scheme of the test:
   a. Correct answer or the most appropriate answer: Five marks (+5).
   b. Any incorrect option marked will be given minus one mark (–1).
   c. Unanswered/Marked for Review will be given no mark (0).

Choose the correct answer :

1. In a potentiometer arrangement, a cell of emf 1.5 V gives a balance point at 45.0 cm length of the wire. If the cell is replaced by another cell of emf 2.25 V. Where will the balance point shift to?

(1) 63.0 cm (2) 67.5 cm
(3) 100.0 cm (4) 90.0 cm

Answer (2)

Sol. Emf of any experimental cell $\varepsilon = Kl$

So, $\frac{\varepsilon_1}{\varepsilon_2} = \frac{l_1}{l_2}$

$\Rightarrow \frac{1.5}{2.25} = \frac{45}{l_2}$

on solving $l_2 = 67.5$ cm

2. What is the approximate wavelength of the radiation emitted when the electron in an hydrogen atom jumps from $n = \infty$ to $n = 3$?

(1) 822 Å (2) 822 nm
(3) 8220 nm (4) 365 nm

Answer (2)

Sol. Energy of hydrogen atom jumps from $n = \infty$ to $n = 3$

$$E = 13.6Z^2\left[\frac{1}{3^2} - \frac{1}{\infty}\right] \text{ eV}$$

$$= \frac{13.6(1)^2}{9} \text{ eV}$$

Now, wavelength of radiation emitted

$$\lambda = \frac{12400}{E} \text{ Å}$$

= 8205 Å = 820 nm ≈ 822 nm

3. Which of the following is not the property of β^- ray?

(1) The ionising power is less than that of α-particles.
(2) The penetrating power is greater than that of α-particles.
(3) It is made of positively charged particles.
(4) It is deflected by an electric as well as by a magnetic field.

Answer (3)

Sol. Negative β particles are electrons.

$\beta^- \rightarrow -1e^{\circ}$

4. If potential difference V applied across a metallic wire is increased by V, how will the drift velocity of the electron change?

(1) Becomes half (2) Becomes twice

(3) Becomes four times (4) Remains the same

Answer (2)

Sol. On increasing potential difference current also increases.

Here $V' = 2V$

So $I' = 2I$

$neAv_d' = 2neAv_d$

$\therefore$ $v_d' = 2v_d$ (n, e and A remains constant)

5. When a steady current flows in a metallic conductor of non-uniform cross section. Which of these quantities is constant along the conductor?

A. Current B. Electric field

C. Drift speed D. Current density

E. Potential gradient

Choose the correct answer from the options given below:

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

(3) C and E only (4) A only

Answer (4)

Sol. If area of cross section is not constant then

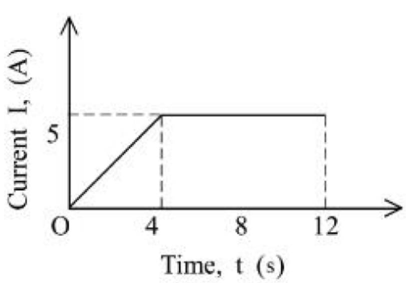
$j = \frac{I}{A}$ varies and thus $E = \frac{j}{\sigma}$ also varies

$\therefore$ Potential gradient varies

also $v_d \propto \frac{1}{A}$

Thus, it keeps varying while current remains constant throughout

6. Figure below shows a plot of current I through the cross-section of a wire over a time interval of 12 s. How much charge flows through the wire during this time period?



(1) 10 C (2) 50 C

(3) 20 C (4) 25 C

Answer (2)

Sol. Since $Q = \int I dt$, therefore area under current versus time curve gives charge flow through the wire.

Area $= \frac{1}{2} \times 4 \times 5 + (12 - 4) \times 5$

= 10 + 40 = 50 units

$\therefore$ Charge flown is equal to 50 C

7. Which of the following statements are correct?

A. Two major types of resistors are wire bound resistors and carbon resistors.

B. Mobility is the drift velocity per unit electric field.

C. The internal resistance of dry cells is much lower than the common electrolytic cells.

D. In electrolytic liquids, electrons carry the electric current.

E. Potentiometer is unaffected by the internal resistance of the source.

Choose the correct answer from the options given below:

(1) A, B and E Only

(2) B, C, D and E Only

(3) C, D and E Only

(4) D and E Only

Answer (1)

Sol.
- Resistors are mainly of two types which are wire bound and Carbon resistors
- Mobility is defined as drift velocity per unit electric field

  $\mu = \frac{v_d}{E}$
- Potentiometer works on the principle of null deflection hence its result remains unaffected by the internal resistance of experimental cell.
- In electrolytic liquids current is due to flow of ions.
- Internal resistance of dry cells is generally higher than the common electrolytic cells.

8. Match List I with List II

LIST I (Quantity)		LIST II (Variation with distance 'r')	
A.	Electric field intensity (E) due to a single charge	I.	$\propto \frac{1}{r}$
B.	Electric field intensity due to electric dipole	II.	$\propto \frac{1}{r^4}$
C.	Electric potential (V) due to a single charge	III.	$\propto \frac{1}{r^3}$
D.	Electric field intensity due to a quadrupole	IV.	$\propto \frac{1}{r^2}$

Choose the correct answer from the options given below:

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

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

Answer (4)

Sol. A. $E = \frac{F_{\text{electrostatic}}}{q} = \frac{kq}{r^2}$

$E \propto \frac{1}{r^2}$

B. Electric field intensity due to electric dipole at a point on axis

$\vec{E}_{\text{axis}} = \frac{2k\vec{p}}{r^3}$

$\vec{E}_{\text{axis}} \propto \frac{1}{r^3}$

C. Electric potential due to single charge $= \frac{kq}{r} \Rightarrow V \propto \frac{1}{r}$

D. Electric field intensity at large distances simplifies to $E_r \approx \frac{3qd^2}{4\pi\varepsilon_0 r^4}$

$E \propto \frac{1}{r^4}$

$A \to IV$

$B \to III$

$C \to I$

$D \to II$

9. Arrange the following in the increasing order of de-Broglie wavelength:

A. A bullet of mass 0.02 kg travelling at the speed of 3.3 km/s.

B. A ball of mass 0.0331 kg moving with speed of 2 m/s.

C. A dust particle of mass 2 x 10^{-10} kg drifting with a speed of 3.3 m/s.

D. A photon having a momentum of 6.63 × 10^{-26} kg m/s.

E. An electron accelerated through a potential difference of 100 V.

Choose the correct answer from the options given below:

(1) B < A < C < E < D (2) B < A < C < D < E

(3) B < A < D < C < E (4) A < B < C < E < D

Answer (4)

Sol. A. $\lambda = \frac{h}{mv}$

$m = 0.02$ kg, $v = 3.3$ km/s

= 3300 m/s

$\lambda = \frac{6.626\times10^{-34}}{0.02\times3300} = \boxed{0.1003\times10^{-34}\text{m}}$

B. $\lambda = \frac{h}{mv} = \frac{6.626\times10^{-34}}{0.0331\times2} = \boxed{100.09\times10^{-34}\text{ m}}$

C. $\lambda = \frac{6.626\times10^{-34}}{2\times10^{-10}\times3.3} = \boxed{1\times10^{-24}}$

D. $\lambda = \frac{h}{P} = \frac{6.63\times10^{-34}}{6.63\times10^{-26}}$

$\lambda = 10^{-34+26}$

$\boxed{\lambda = 10^{-8}\text{m}}$

E. $(\lambda_{\text{electron}})_{\text{de-Broglie}} = \frac{12.27}{\sqrt{V}}\text{nm}$

$= \frac{12.27\times10^{-9}}{\sqrt{100}} = \frac{12.27\times10^{-9}}{10}$

$\lambda = \boxed{12.27\times10^{-10}\text{m}}$

A < B < C < E < D

10. A pure silicon crystal has 5×10^{28} atoms m^{-3}. It is doped by 2 ppm concentration of pentavalent arsenic. The number of holes are:

Consider $n_i = 1.5 \times 10^{16}\, m^{-3}$

(1) $4.5 \times 10^9\, m^{-3}$ (2) $2.25 \times 10^9\, m^{-3}$

(3) $2.25 \times 10^{-9}\, m^{-3}$ (4) $4.5 \times 10^{-9}\, m^{-3}$

Answer (2)

Sol. 10^6 parts of Si have $\rightarrow$ 2 impurities

1 part of Si have $\frac{2}{10^6}$ impurities

5×10^{28} parts of Si $\rightarrow \frac{2}{10^6} \times 5 \times 10^{28} = 10^{23}$ impurities

Each As impurity has $1e^-$ in excess

$\therefore \quad n_e = 10^{23}$

$$\therefore\ n_h = \frac{n_i^2}{n_e} = \frac{(1.5 \times 10^{16})^2}{10^{23}}$$

$= 2.25 \times 10^9\ m^{-3}$

11. The capacitance of a capacitor is 4 μF and it's potential is 100 V. The energy released on discharging it fully will be

(1) 0.02 J (2) 0.04 J

(3) 0.025 J (4) 0.05 J

Answer (1)

Sol. $C = 4\ \mu F$

$V = 100$ V

$$E = \frac{1}{2} CV^2$$

$$= \frac{1}{2} \times 4 \times 10^{-6} \times 10^4$$

$= 2 \times 10^{-2}$ J

$E = 0.02$ J

12. In a feedback amplifier, if the feedback voltage is in opposite phase, the gain is less than 1. Then it will

(1) Never work as an Oscillator

(2) Work as an Oscillator

(3) Not work as an Oscillator

(4) Work as a rectifier

Answer (1)

Sol. Never work as an oscillator it will be an amplifier with reduced gain.

13. Which of the following statements are correct?

A. Moving charges produce a magnetic field in the surrounding space.

B. An instrument called the current balance is used to measure mechanical force between two parallel conductors.

C. The electron has an intrinsic magnetic moment, which is known as the orbital magnetic moment.

D. Magnetic field of several sources is the vector addition of magnetic field of each individual source.

E. The radius of the circular component of motion is called the radius of the helix.

Choose the correct answer from the options given below:

(1) A and C Only (2) B, C and E Only

(3) A, C, D and E Only (4) A, B, D and E Only

Answer (4)

Sol. A. Moving charge produces magnetic field in the surrounding space is a correct statement.

B. Calibration of an ammeter has been checked using current balance. The current balance measures current by measuring force between two parallel wires carrying current.

C. The electron magnetic moment or more specifically the electron magnetic dipole moment is the magnetic moment of electron resulting from its intrinsic properties of spin and electric charge.

D. Yes, because it follows principle of superposition.

E. The radius of circular component of motion is radius of helix.

14. There is a solenoid of length 1 m has a radius of 1 cm and is made up of 1000 tums. It carries a current of 10 A. The magnitude of magnetic field inside the solenoid is

(1) $8\pi \times 10^{-3}$ T (2) $40\pi \times 10^{-3}$ T

(3) $4\pi \times 10^{-3}$ T (4) $0.4\pi \times 10^{-3}$ T

Answer (3)

Sol. $l = 1$ m

$r = 1$ cm $= 1 \times 10^{-2}$ m

$B = \mu_0 n i$

$$= \frac{\mu_0 N}{l} i$$

$$= 4\pi \times 10^{-7} \times \frac{1000}{1} \times 10$$

$= 4\pi \times 10^{-3}$ T

15. The electron in a hydrogen atom rises from its n = 1 state to n = 4 state by absorbing energy. The energy of the electron in the n = 1 state is –13.6 eV. How much energy is absorbed by the electron in transition?

(1) – 0.85 eV (2) 12.75 eV

(3) –12.75 eV (4) 0.85 ev

Answer (2)

Sol. We know that, $E_n = -\dfrac{13.6\,Z^2}{n^2}$, for hydrogen atom, Z = 1

Now, $E_1 = \dfrac{-13.6}{1}$ = – 13.6 eV and

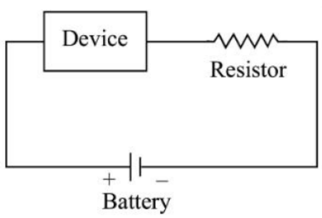
$E_4 = -\dfrac{13.6}{16}$ = – 0.85 eV

Energy absorbed = $E_4 - E_1$

= – 0.85 eV – (– 13.6 eV)

= – 0.85 eV + 13.6 eV = 12.75 eV

16. A semiconducting device is connected as shown in the figure



A current is found to pass through the circuit. On reversing the polarity of the battery. The current in the circuit drops to almost zero. What is the device?

(1) A P-type semiconductor

(2) An N-type semiconductor

(3) An intrinsic semiconductor

(4) A p-n junction diode

Answer (4)

Sol. The device must be a p-n junction diode as it allows electric current in one direction but does not allow it in the opposite direction.

17. A resistance of 15 Ω is connected in series with an unknown resistance R_1. This combination is connected to one gap of a meter bridge, while a resistance R_2 is connected in the other gap. The balance point is at 50 cm. When 15 Ω is removed, the balance point shifts by 10 cm. The value of R_1 is

(1) 20 Ω (2) 30 Ω

(3) 40 Ω (4) 60 Ω

Answer (2)

Sol. From the given initial condition and concept of metre bridge we can conclude that,

$$\frac{15+R_1}{50} = \frac{R_2}{50} \Rightarrow 15 + R_1 = R_2 \quad \text{...(i)}$$

When 15 Ω is removed, balance point shifts by 10 cm.

$$\Rightarrow \frac{R_1}{40} = \frac{R_2}{60} \Rightarrow R_2 = \frac{3R_1}{2} \quad \text{...(ii)}$$

Using equation (i) and (ii)

R_1 = 30 Ω

18. At the time of sunset, the sun appears to be at an altitude higher than its actual position. This is because of

(1) Absorption of light (2) Reflection of light

(3) Refraction of light (4) Dispersion of light

Answer (3)

Sol. At the time of sunset, the sun appears to be at an altitude higher than its actual position due to the refraction of light.

19. The magnetic flux passing perpendicular to the plane of coil is changing according to the equation $\phi = 6t^2 + 7t + 1$, where 'ϕ' is in mWb and 't' in sec.

The magnitude of induced emf at t = 2 s is

(1) 31 mV (2) 38 mV

(3) 39 mV (4) 32 mV

Answer (1)

Sol. Magnetic flux, $\phi = 6t^2 + 7t + 1$

Induced emf, $\varepsilon = \dfrac{-d\phi}{dt} = -(12t+7)$

$\Rightarrow |\varepsilon| = |-(12t+7)|$ = 31 mV

20. X-rays of wavelength λ = 1Å have frequency

(1) 3×10^8 Hz (2) 3×10^{18} Hz

(3) 3×10^{10} Hz (4) 3×10^{15} Hz

Answer (2)

Sol. We know that, $v = f\lambda$,

Where $v \rightarrow$ Velocity of wave

$f \rightarrow$ Frequency of wave

$\lambda \rightarrow$ Wavelength of wave

Now, $\lambda = 1 \times 10^{-10}$ m and $v = 3 \times 10^8$ ms^{-1}

$$\Rightarrow f = \frac{v}{\lambda} = \frac{3\times10^8}{1\times10^{-10}} = 3 \times 10^{18}\text{ Hz}$$

21. A parallel plate air capacitor has a capacity 'C', distance of separation between its plates is 'x' and potential difference applied across the plates is V. What is the force of attraction between the plates of the parallel plate air capacitor?

(1) $\frac{C^2V^2}{2x^2}$ (2) $\frac{CV^2}{x}$

(3) $\frac{C^2V^2}{2x}$ (4) $\frac{CV^2}{2x}$

Answer (4)

Sol. We know that the plates of a parallel plate capacitor attract each other with force,

$$F = \frac{Q^2}{2A\varepsilon_0}$$

Also, $Q = CV$ and $C = \frac{A\varepsilon_0}{x}$ $\Rightarrow$ $A\varepsilon_0 = Cx$

$$\Rightarrow F = \frac{C^2V^2}{2Cx} = \frac{CV^2}{2x}$$

22. The refractive index of air with respect to glass $\frac{2}{3}$.

The refractive index of diamond will respect to air is 2.4. What will be the refractive index of glass with respect to diamond?

(1) 0.28 (2) 0.625

(3) 1.60 (4) 3.60

Answer (2)

Sol. ${}_g\mu_a = \frac{\mu_a}{\mu_g} = \frac{2}{3}$ ...(1)

${}_a\mu_d = \frac{\mu_d}{\mu_a} = 2.4$ ...(2)

(1) × (2)

$$\frac{\mu_d}{\mu_g} = \frac{2}{3} \times 2.4 = 1.6$$

$${}_d\mu_g = \frac{\mu_g}{\mu_d} = \frac{1}{1.6} = 0.625$$

23. When temperature of a ferromagnetic material is increased by 20%, what is the percentage change in its magnetic susceptibility?

(1) 16.7% (2) 83.3%

(3) 1.67% (4) 8.33%

Answer (1)

Sol. $\chi \propto \frac{1}{T}$

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

$T_1 = T$, $T_2 = T + \frac{20}{100}T = T + 0.2T$

$= 1.2T$

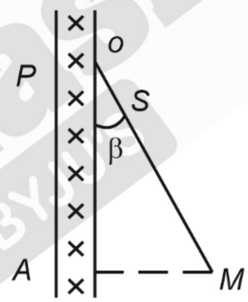
$$\frac{\chi}{\chi_2} = \frac{1.2T}{T}$$

$$\chi_2 = \frac{1}{1.2}\chi$$

% change in $x = \frac{\chi - \frac{1}{1.2}\chi}{\chi} \times 100\%$

$= 16.7\%$

24. A charged ball 'M' hangs from a silk thread 'S' which makes an angle β, with a large charged conducting sheet 'P' as shown. The surface charge density σ of the sheet is proportional to

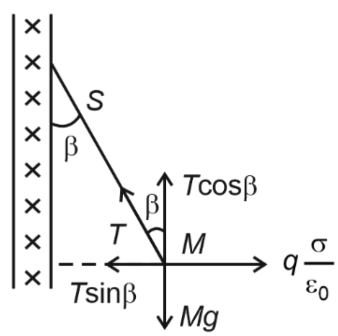


(1) tan B (2) sin B

(3) cot B (4) cos B

Answer (2)

Sol.



$$\frac{q\sigma}{\varepsilon_0} = T\sin\beta$$

$\sigma \propto \sin\beta$

25. Which one among the following shows particle nature of light?

(1) Refraction (2) Interference

(3) Photoelectric effect (4) Polarisation

Answer (3)

Sol. Photoelectric effect shows particle nature of light.

26. A telescope has an objective lens of 0.1 m diameter and is situated at a distance of 500 m from two objects. What will be the minimum distance between these two objects which can be resolved by the telescope? The mean wavelength of light is 600 nm.

(1) 1.46 mm (2) 0.37 mm

(3) 3.66 mm (4) 1.21 mm

Answer (3)

Sol. $\frac{x}{r} = \frac{1.22\lambda}{d}$

$x = \frac{1.22\lambda}{d}r$

$= \frac{1.22 \times 600 \times 10^{-9} \times 500}{0.1}$

$x = 3.66$ mm

27. For transmitting a modulated signal of wavelength λ, the antenna should have minimum size

(1) λ (2) $\frac{\lambda}{2}$

(3) $\frac{\lambda}{4}$ (4) 2λ

Answer (3)

Sol. Minimum size of the antenna should be one fourth of the wavelength of the signal used.

28. The total charge of an electric dipole is

(Where '*q*' is the point charge on either side of the dipole and '*e*' is the charge of an electron)

(1) $2e$ (2) $-2q$

(3) $2q$ (4) Zero

Answer (4)

Sol. Total charge of an electric dipole is zero.

29. Which one of the following cannot be polarized?

(1) Light waves (2) Sound waves

(3) X-rays (4) Radio-waves

Answer (2)

Sol. Sound waves cannot be polarized.

30. Which of the following statements are correct?

A. Dispersion is the splitting of light into it's constituent colours.

B. The unit for power of a lens is m^{-1}.

C. Optical fibres consist of glass fibres coated with a thin layer of material of higher refractive index.

D. Cassegrain telescope has the advantages of a large focal length in a short telescope.

E. Glass is a dispersive medium.

Choose the correct answer from the options given below:

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

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

Answer (2)

Sol. A. Splitting of light into different colours. This phenomenon is known as dispersion.

B. The unit for power of lens is m^{-1}.

C. Optical fibres consists of glass fibres coated with a thin layer of material of lower refractive index.

D. The Cassegrain telescope is an astronomical reflecting telescope, in which the light is incident on large concave paraboloid mirror. It has advantage of a large focal length in short telescope.

31. A television transmitting antenna is 84 m tall. How much service area can it cover, if the receiving antenna is at the ground level?

$\left(\text{Given } \pi = \frac{22}{7}\right)$

(1) 721 km^2 (2) 1075 km^2

(3) 1690 km^2 (4) 3379 km^2

Answer (4)

Sol. $d_m = \sqrt{2hR}$

Area $= \pi d_m^2$

$= \frac{22}{7} \times 2hR$

$= \frac{22}{7} \times 2 \times 84 \times 6400 \times 1000$

$= 33792 \times 10^5 \approx 3379$ km^2

32. A charge Q is divided into two parts, q and $(Q - q)$. The repulsion between them is maximum when $Q : q$ is

(1) 2:1 (2) 1:2

(3) 4:1 (4) 1:4

Answer (1)

Sol. $F = \dfrac{Kq(Q-q)}{d^2}$

For F_{max}

$\Rightarrow \dfrac{dF}{dq} = 0 \rightarrow$ after solving we get

$q = \dfrac{Q}{2}$

$\Rightarrow \dfrac{Q}{q} = 2$

33. In a concave mirror, an object is placed at a distance x from the focus and the image is formed at a distance y from the focus. What is the focal length of the mirror?

(1) $(xy)^{\frac{1}{2}}$ (2) $\dfrac{(x+y)}{2}$

(3) xy^{-1} (4) xy

Answer (1)

Sol. Newton's formula $\rightarrow$

$X_1 X_2 = f^2$

$X_1 \rightarrow$ Distance of object from focus

$X_2 \rightarrow$ Distance of image from focus

$$xy = f^2$$

$$f = (xy)^{\frac{1}{2}}$$

34. Two coherent monochromatic light beams of intensities $16I$ and $4I$ are superposed. The maximum and minimum possible intensities in the resulting beam are

(1) $20I$ and I (2) $36I$ and $4I$

(3) $20I$ and $12I$ (4) $36I$ and I

Answer (2)

Sol. $I_1 = 16I$ and $I_2 = 4I$

$I_{max} = \left(\sqrt{I_1} + \sqrt{I_2}\right)^2 = \left(\sqrt{16I} + \sqrt{4I}\right)^2 = 36I$

$I_{min} = \left(\sqrt{I_1} - \sqrt{I_2}\right)^2 = \left(\sqrt{16I} - \sqrt{4I}\right)^2 = 4I$

35. A radioactive isotope has a half life of T years. How long (in years) will it take the activity to reduce to 3.125% of it's original value?

(1) $4T$ (2) $5T$

(3) $3T$ (4) $6T$

Answer (2)

Sol. $3.125\ \% = \dfrac{3.125}{100} = 0.03125 = \dfrac{1}{32} = \dfrac{1}{2^5}$

So, time to reduce 3.125% is 5 half life

$t = 5T$

36. Match list I with List II

	List-I		List-II
A.	Magnifying power of a simple microscope	I.	$\dfrac{L}{f_0} \times \dfrac{D}{f_e}$
B.	Magnifying power of a compound microscope	II.	$\dfrac{f_o}{f_e}\left(1+\dfrac{f_e}{D}\right)$
C.	Magnifying power of a telescope (normal adjustment)	III.	$\left(1+\dfrac{D}{f_e}\right)$
D.	Magnifying power of a telescope when final image is formed at least distance of distinct vision	IV.	$f_o f_e^{-1}$

(Symbols have their usual meanings)

Choose the correct answer from the options given below.

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

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

Answer (3)

Sol.

	List-I		List-II
A.	Magnifying power of a simple microscope	III.	$\left(1+\dfrac{D}{f_e}\right)$
B.	Magnifying power of a compound microscope	I.	$\dfrac{L}{f_o} \times \dfrac{D}{f_e}$
C.	Magnifying power of a telescope (normal adjustment)	IV.	$\dfrac{f_o}{f_e}$
D.	Magnifying power of a telescope when final image is formed at least distance of distinct vision	II.	$\dfrac{f_o}{f_e}\left(1+\dfrac{f_e}{D}\right)$

37. Match the different types of Electro Magnetic Waves and their detections

	List-I Electro Magnetic Waves		List-II Detection of Electromagnetic Wave
A.	Light	I.	Receiver's arial
B.	Infra-red	II.	Point contact diodes
C.	Radio wave	III.	Photocells
D.	Microwave	IV.	Thermopiles

Choose the correct answer from the options given below.

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

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

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

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

Answer (2)

Sol. Light can be detected by photocells.

Infra-red is detected by thermopiles

Radio waves are detected by receiver's arial

Microwaves are detected by point contact diodes

38. When a number of capacitors are connected in parallel between two points increases, the equivalent capacitance

(1) Decreases (2) Increases

(3) Remains the same (4) Zero

Answer (2)

Sol. We know, for parallel combination of capacitors

$C_{net} = C_1 + C_2 + C_3 + ...$

Thus $C_{net} > C_1$ or C_2 or C_3.

Thus, equivalent capacitance increases

39. Which of the following combinations should be used for better tuning of an LCR circuit used for communication?

(1) $R = 25\ \Omega$, $L = 1.5$ H, $C = 35\ \mu$F

(2) $R = 25\ \Omega$, $L = 2.0$ H, $C = 45\ \mu$F

(3) $R = 15\ \Omega$, $L = 3.5$ H, $C = 30\ \mu$F

(4) $R = 15\ \Omega$, $L = 1.0$ H, $C = 40\ \mu$F

Answer (3)

Sol. For better tuning of an LCR circuit quality factor (Q) should be high.

We know, $Q = \frac{1}{R}\sqrt{\frac{L}{C}}$

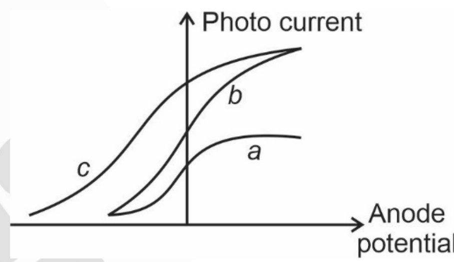
Clearly option (3) and (4) have low resistance so they can be better than (1) and (2)

But $Q_3 = \frac{1}{15}\sqrt{\frac{3.5}{30\times 10^{-6}}} = 13.37$

And $Q_4 = \frac{1}{15}\sqrt{\frac{1}{40\times 10^{-6}}} = 10.53$

Thus, (3) is best for tuning of an LCR circuit for communication.

40. The figure shows the variation of photo current with anode potential for a photo-sensitive surface for three different radiations. Let I_a, I_b and I_c be the intensities and λ_a, λ_b, and λ_c be the frequencies for the curves a, b and c respectively. Choose the correct statement.



(1) $\lambda_a = \lambda_b$; $I_b = I_c$ (2) $\lambda_b = \lambda_c$; $I_a = I_b$

(3) $\lambda_a = \lambda_c$; $I_c = I_b$ (4) $\lambda_a = \lambda_b$; $I_a = I_b$

Answer (1)

Sol. We know, when incident frequency of radiation is high then stopping potential is more negative. While, for high intensity of incident radiation the saturation photocurrent is high.

Here, b and c have same saturation photocurrent thus, their intensity is same,

And, a and b have same stopping potential

$\therefore$ Their frequency is same

i.e., $\lambda_a = \lambda_b$ and $I_b = I_c$

41. A proton and an alpha particle enter a uniform magnetic field with the same velocity and move along circular paths. The time period of the alpha particle will be:

(1) Four times that of proton

(2) Three times that of proton

(3) Same as that of proton

(4) Two times that of proton

Answer (4)

Sol. We know time period, $T = \frac{2\pi m}{qB}$

Thus, $T \propto \frac{m}{q}$

$$\frac{T_p}{T_\alpha} = \frac{\left(\frac{m}{q}\right)_p}{\left(\frac{m}{q}\right)_\alpha} = \frac{\frac{m}{e}}{\frac{4m}{2e}} = \frac{1}{2}$$

$$\boxed{2T_p = T_\alpha}$$

42. For which of the following, a capacitor acts as an infinite resistance component in the circuit?

(1) Alternating current

(2) Direct current

(3) Alternating current as well as direct current

(4) Neither alternating current nor direct current

Answer (2)

Sol. Capacitor reactance $X_c = \frac{1}{\omega C}$

For D.C. $\omega = 0$

$\therefore$ $X_c = \infty$

Hence, capacitor blocks D.C. only

43. Match List I with List II

LIST I		LIST II	
A.	Gyromagnetic ratio	I.	4×10^{-5} T
B.	Permeability of free space	II.	9.27×10^{-24} A m^2
C.	Earth's magnetic field at equator	III.	8.8×10^{10} C/kg
D.	Bohr magnetron	IV.	12.56×10^{-7} T m A^{-1}

Choose the correct answer from the options given below:

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

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

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

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

Answer (3)

Sol. We know

Gyromagnetic ratio = 8.8×10^{10} C/kg

Permeability of free space = 12.56×10^{-7} Tm/A

Earth's magnetic field = 4×10^{-5} T

Bohr magnetron = 9.27×10^{-24} Am^2

44. A metal conductor of length 1 m rotates in vertical plane about an axis passing through one of its ends at angular velocity 4 rad s^{-1}. What is the emf developed between the two ends of the conductor, if the horizontal component of the earth's magnetic field is 0.2 G?

(1) 4 m V (2) 40 m V

(3) 4 μ V (4) 40 μ V

Answer (4)

Sol.

emf developed between the two ends is equal to $\frac{B\omega l^2}{2}$

$\therefore \quad \varepsilon = \frac{0.2 \times 10^{-4} \times 4 \times 1^2}{2}$

$\varepsilon = 0.4 \times 10^{-4} = 40\ \mu$V

45. Which of the following gates can give AND gate by its repetitive use?

(1) Both NAND gate and NOR gate

(2) NOT gate only

(3) OR gate only

(4) NAND gate only

Answer (1)

Sol. Nand and NOR gates are known as universal gates. Any logic gate can be prepared with the repetitive use of these gates.

46. In Young's double slits experiment, the light has a frequency 12×10^{14} Hz and the distance between the centers of adjacent fringes is 0.8 mm. If the screen is 1.6 m away, what is the distance between the slits? (Take speed of light 3×10^8 m s^{-1})

(1) 5.00×10^{-4} m (2) 5.92×10^{-4} m

(3) 2.00×10^{-4} m (4) 1.25×10^{-4} m

Answer (1)

Sol. In YDSE, fringe width $\beta = \frac{\lambda D}{d}$ ...(i)

Given $f = 12 \times 10^{14}$ Hz; $\beta = 0.8$ mm;

$D = 1.6$ m; $c = 3 \times 10^8$ m/s

$c = \lambda \times f$

$\Rightarrow \lambda = \frac{c}{f}$

Distance between the slits:

$d = \frac{\lambda D}{\beta} = \frac{c\,d}{f\,\beta}$

$\therefore d = \frac{3 \times 10^8 \times 1.6}{12 \times 10^{14} \times 0.8 \times 10^{-3}} = 5 \times 10^{-4}$ m

47. An infinitely long straight conductor carries a current of 150 A. At what distance from the conductor is the magnetic field caused by the current equal to 10^{-4} T?

(1) 1.5 m (2) 0.3 m

(3) 3.0 m (4) 0.15 m

Answer (2)

Sol. Magnetic field due to an infinite straight conductor is given $\frac{\mu_0 I}{2\pi R}$

$B = \frac{\mu_0 I}{2\pi R} \Rightarrow R = \frac{\mu_0 I}{2\pi B}$

$\therefore R = \frac{2 \times 10^{-7} \times 150}{10^{-4}}$

$R = 0.3$ m

48. The current and voltage in ac circuit are given by $I = 5\sin\left(100t - \frac{\pi}{2}\right)$ A and $V = 200\sin(100t)$ V. The power dissipated in the circuit is

(1) 20 W (2) 40 W

(3) 0 (4) 1000 V

Answer (3)

Sol. Power dissipation in an AC circuit:

$P = V_{rms} I_{rms} \cos\phi$

Where ϕ is the phase difference between current and voltage.

Here $\phi = \frac{\pi}{2}$, which can be observed by current and voltage equations.

Hence, $P = V_{rms} I_{rms} \cos\frac{\pi}{2} = 0$

49. As per Bohr's model the energy (in eV) required to remove electron from ground state of Li^{++} (doubly ionised lithium atom) is

(1) 1.51 (2) 13.6

(3) 40.8 (4) 122.4

Answer (4)

Sol. As per Bohr's model, the energy of electron is given by

$E = -13.6 \times \frac{Z^2}{n^2}$ eV

For an electron in ground state of Li^{++} ion:

$n = 1$ and $Z = 3$

$\therefore E = -13.6 \times 9$ eV $= -122.4$ eV

Therefore, the amount of energy required to remove electron from ground of Li^{++} ion is 122.4 eV

50. A metal plate is getting heated. It can be because of

A. An alternating current is passing through the plate.

B. It is placed in a time varying magnetic field.

C. A direct current is passing through the plate.

D. It is placed in a space varying magnetic field, but does not vary with time

E. It is placed in a time constant magnetic field

Choose the correct answer from the options given below:

(1) A, B, C Only

(2) C, D, E Only

(3) A, D, E Only

(4) B, C, D Only

Answer (1)

Sol. A metal plate can be heated by passing alternating current as well as direct current through it.

Varying magnetic field induce electric current in metal plate which will heat the metal plate.

Time constant magnetic field cannot induce current; hence it will not be able to heat the metal plate.

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