Aakash
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Corporate Office : Aakash Tower, 8, Pusa Road, New Delhi-110005 | Ph.: 011-47623456

Answers & Solutions

for

CUET UG-2023
(Physics)

Time : 45 min.   **M.M. : 200**

**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.   Four capacitors are connected in circuit as shown in the figure. The equivalent capacitance between *P* and *Q* will be

   (1) 10 μF

   (2) 5 μF

   (3) 2 μF
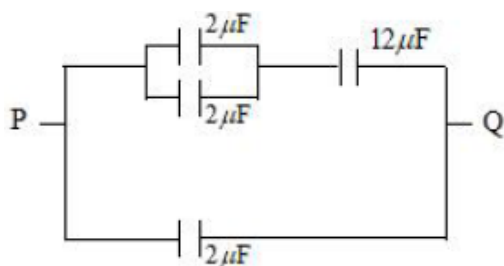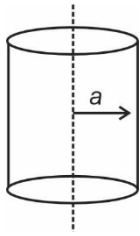
   (4) 7.5 μF

Answer (2)

Sol. $C_{PQ} = \dfrac{4 \times 12}{4 + 12} + 2$

   $C_{PQ} = \dfrac{48}{16} + 2$

   = 3 + 2 = 5 μF

2.   A steady current *I* flow through a long straight wire of radius '*a*'. The current is uniformly distributed across its cross section. The ratio of the magnetic fields due to the wire at distance $\dfrac{a}{4}$ and 3*a* respectively from the axis of the wire is

   (1) 3 : 4

   (2) 4 : 3

   (3) 2 : 3

   (4) 1 : 4

Answer (1)

Sol.

for $r < a$

$$I_{enc} = \frac{I}{\pi a^2} \times \pi\left(\frac{a}{4}\right)^2$$

$$I_{enc} = \left(\frac{I}{16}\right)$$

By Amper's circuit law

$$\oint \vec{B} \cdot d\vec{l} = \mu_0 I_{enc}$$

$$B_1 \times 2\pi \times \frac{a}{4} = \frac{\mu_0 I}{16}$$

$$B_1 = \frac{\mu_0 I}{8\pi a}$$

for $r > a$

$$\oint \vec{B} \cdot d\vec{l} = \mu_0 I_{enc}$$

$$B_2 \times 6\pi a = \mu_0 I$$

$$B_2 = \left(\frac{\mu_0 I}{6\pi a}\right)$$

$$\frac{B_1}{B_2} = \frac{6}{8} = \frac{3}{4}$$

3. The magnetic field of a light wave at given time parallel to *y*-axis and is given by $B = B_m \sin(kz - \omega t)$. In what direction does the wave travel and parallel to which axis does the associated electric field point at the time?

(1) Positive direction of *z*; *y*-axis

(2) Positive direction of *z*; *x*-axis

(3) Negative direction of *z*; *y*-axis

(4) Negative direction of *z*; *x*-axis

Answer (2)

Sol. $B = B_m \sin(kz - \omega t)$

Plane progressive wave is moving in positive *z* direction.

Direction of propagation $= \dfrac{\vec{E}_0 \times \vec{B}_0}{\mu_0}$

$$\hat{k} = \hat{n} \times \hat{j}$$

$$\hat{n} = (\hat{i})$$

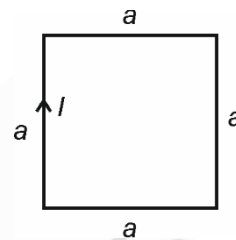$\therefore$ Electric field will be along *x*-axis

4. Two identical wires *X* and *Y*, each of length *L* carry the same current *I*. Wire *X* is bent to form a square of side '*a*' and wire *Y* is bent into a circle of radius *R*. If B_x and B_y are the values of the magnetic field at the centres of the square and the circle respectively, the ratio $B_x : B_y$ is

(1) $\dfrac{8\sqrt{2}\mu_0}{\pi}$

(2) $\dfrac{16\sqrt{2}}{\pi^2}$

(3) $\dfrac{8\sqrt{2}}{\pi^2}$

(4) $\dfrac{16\mu_0}{\pi^2}$

Answer (3)

Sol. For wire *X*
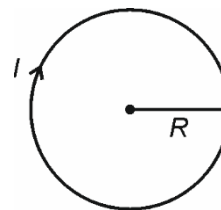

$$a = \frac{L}{4}$$

$$B_X = \left[\frac{\mu_0 I}{4\pi d}[\sin 45° + \sin 45°]\right] \times 4$$

$$B_X = \left[\frac{\mu_0 I}{4\pi\left(\frac{L}{8}\right)}\right] \times \frac{2}{\sqrt{2}} \times 4$$

$$B_X = \frac{8\sqrt{2}I\mu_0}{\pi L}$$

For wire *Y*

$$2\pi R = L$$

$$R = \left(\frac{L}{2\pi}\right)$$

$$B_Y = \frac{\mu_0 I}{2R} = \frac{\mu_0 I \times 2\pi}{2L}$$

$$\frac{B_X}{B_Y} = \frac{\dfrac{8\sqrt{2}I\mu_0}{\pi L}}{\dfrac{\mu_0 I \times \pi}{L}} = \frac{8\sqrt{2}}{\pi^2}$$

5. A metal plate is getting heated: It can be because

A. A direct current is passing through the plate

B. It is placed in a time varying magnetic field

C. It is placed in space varying magnetic field, but doesn't vary with time

D. An alternating current passing through the plate

E. It is placed between the pole pieces of a magnet

Choose the correct answer from the options given below.

(1) A, B & C only

(2) B & C only

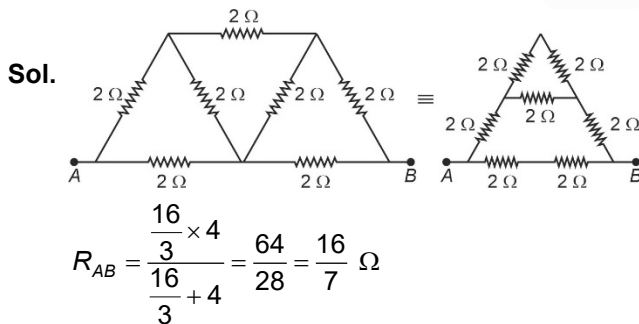(3) A & E only

(4) A, B and D only

Answer (4)

Sol. A metal plate can be heated when a DC or AC current passing through it or it is placed in time varying magnetic field.

6. In the network shown below in the figure below, each resistance is 2 Ω. the effective resistance between A and B would be
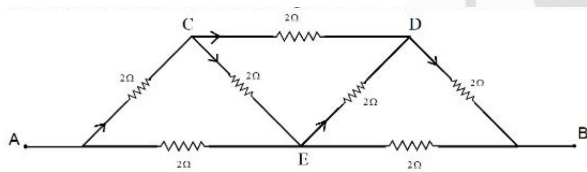
(1) $\dfrac{7}{16}\Omega$

(2) $\dfrac{16}{7}\Omega$

(3) $\dfrac{4}{3}\Omega$

(4) $\dfrac{4}{15}\Omega$

Answer (2)

Sol.

$$R_{AB} = \dfrac{\dfrac{16}{3}\times 4}{\dfrac{16}{3}+4} = \dfrac{64}{28} = \dfrac{16}{7}\ \Omega$$

7. What is the slope of the graph drawn between frequency of incident light and stopping potential for a given surface?

(1) h

(2) he^{-1}

(3) eh

(4) e

Answer (2)

Sol. $E = \phi_0 + eV_0$

$hf = hf_0 + eV_0$

$$V_0 = \dfrac{h}{e}f - \dfrac{h}{e}f_0$$

$y = mx + c$

slope $(m) = \dfrac{h}{e}$

8. The wavelength of matter wave for a moving charged particle is independent of

(1) mass

(2) velocity

(3) momentum

(4) charge

Answer (4)

Sol. de-Broglie wavelength associated with the moving charged particle is given by $\lambda = \dfrac{h}{mv} = \dfrac{h}{P}$

λ depends on mass of particle, velocity of particle and its momentum but not on its charge.

9. Which of the following statements are correct?

A. Photo electric current does not depend on the nature of the emitter material.

B. Photo electric effect is an instantaneous process.

C. The stopping potential is directly related to the maximum kinetic energy of electrons emitted.

D. Energy required for the electron emission from the metal should be less than the work function.

E. The dualism of matter is inherent in the de Broglie relation.

Choose the correct answer from the options given below:

(1) A, D and E only

(2) B, C and E only

(3) A, B and E only

(4) B, D and E only

Answer (2)

Sol. A. We know threshold frequency vary from matter to matter therefore photoelectric current depends on the emitter material.

B. Collision between incident photon and free electron and nucleus lasts for very-very short interval of time $(10^{-9}\ s)$ and there is no time lag between collision and emission of photoelectron so it is instantaneous process.
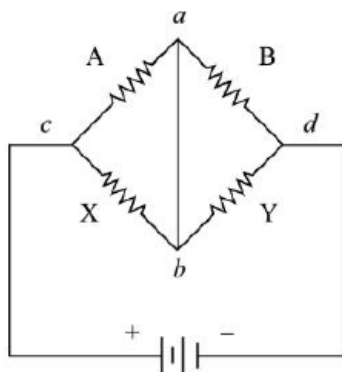
C. We know, $E = \phi + (K.E)_{max}$

or $E = \phi + eV_0$

∴ Yes $K.E_{max}$ is directly proportional to stopping potential.

D. Energy required for e⁻ emission from metal should be greater than work function.

E. de-Broglie proposed that both light and matter exhibit wave & particle nature $E = mc^2$, $E = h\nu$ $\Rightarrow mc^2 = h\nu$ & $\nu = c/\lambda \Rightarrow \lambda = h/mv$.

10. In a Wheatstone bridge shown, $X = Y$ and $A > B$. The direction of current between a & b will be

(1) From a to b

(2) From b to a

(3) From b to a through c

(4) From a to b through c

Answer (2)

Sol. In part cbd

$V_c - V_b = V_b - V_d$ $[X = Y]$

$\dfrac{V_c + V_d}{2} = V_b$

In part cad

$V_c - V_a > V_a - V_d$ $[A > B]$

$\dfrac{V_c + V_d}{2} > V_a$

∴ $V_b > V_a$ so direction of current is from b to a.

11. In cyclotron, an ion is made to travel successively along semi circles of increasing radius under the action of magnetic field. Which of the following factor on which angular velocity of the ion is not dependent?

(1) Mass of the ion

(2) Charge of the ion

(3) Magnetic field

(4) Radius of the circle and speed of the ion

Answer (4)

Sol. Centripetal force on ion $F_c = \dfrac{mv^2}{r}$

Magnetic force on ion $F_m = qvB$

$F_c = F_m$

$\dfrac{mv^2}{r} = qvB$

$v = \dfrac{qBr}{m}$

$v = r\omega$

$\omega = \dfrac{qB}{m}$

∴ Angular velocity is independent of radius of circle and speed of ion.

12. Which of the following statements are correct?

A. The process of generation of conduction electrons and holes and process of recombination is a simultaneous process.

B. To increase the conductivity of a semiconductor manifold, a few parts per million of a suitable impurity is added.

C. Extrinisic semiconductors doped with trivalent impurity are called n-type semiconductors.

D. During the formation of a p-n junction, two processes diffusion and drift occurs.

E. The thickness of depletion region is of the order of a millimeter.

Choose the correct answer from the options given below:

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

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

Answer (2)

Sol. (A) Yes, the process of generation of conduction electrons and holes and process of recombination is simultaneous.

(B) When a small amount says a few ppm of a suitable impurity is added to a pure semiconductor the conductivity of semiconductor is increased manifold.

(C) In extrinsic semiconductors doped with trivalent impurity, electrons become minority carriers and hole the majority carriers. Therefore, p-type semiconductor is formed.

(D) When a p-n junction is formed holes diffuse from p-side to n-side while electrons diffuse from n-side to p-side.

(E) The thickness of depletion layer is of the order of micrometer.

13. Two concentric circular loops of radius 5 cm and 15 cm are placed co-axially. Find e.m.f. induced in the inner loop, if the current through the outer loop is changed at a rate of 10 A/ms. Assume the magnetic field on the inner loop to be uniform.

(1) -5×10^{-6} V (2) 5×10^{-6} V

(3) -3.29×10^{-4} V (4) $+1.04 \times 10^{-4}$ V

Answer (3)

Sol.
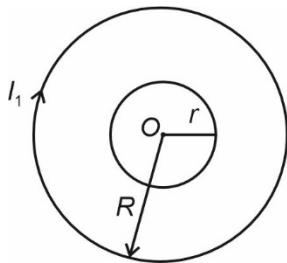
$B = \dfrac{\mu_0 I_1}{2R}$, since $r << R$, this magnetic field can be considered to be constant over the entire face of smaller coil.

$\therefore \quad \phi = \dfrac{\mu_0 I_1}{2R} \pi r^2$

By definition of mutual inductance

$\phi = MI_1 = \dfrac{\mu_0 I_1}{2R} \pi r^2$

$M = \dfrac{\mu_0 \pi r^2}{2R} = \dfrac{4\pi \times 10^{-7} \times 3.14 \times (0.05)^2}{2 \times (0.15)}$

$M = 0.32 \times 10^{-7}$ H

$\dfrac{dI_1}{dt} = 10$ A/ms $= 10 \times 10^3$

$\Rightarrow \varepsilon = -\dfrac{M dI_1}{dt} = -(0.32 \times 10^{-7} \times 10)$

$= -3.29 \times 10^{-4}$ V

14. An electric dipole of moment P is placed along the direction of electric field E. The work done in deflecting the dipole through 180° is equal to

(1) PE (2) $+2PE$

(3) $-2PE$ (4) Zero

Answer (2)

Sol. $W = -pE\cos\theta$

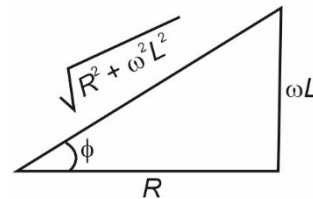$W = W_{180} - W_0 = -pE\cos180° - (-pE\cos0°)$

$= pE + pE = 2pE$

15. What is the power factor of an ac circuit having resistance R and Inductance L connected in series? (ω is the angular frequency)

(1) $(\omega L)R^{-1}$ (2) $R(\omega L)^{-1}$

(3) $R(R^2 - \omega^2 L^2)^{-\frac{1}{2}}$ (4) $R(R^2 + \omega^2 L^2)^{-\frac{1}{2}}$

Answer (4)

Sol. $\tan\phi = \dfrac{\omega L}{R}$

Power factor $= \cos\phi = \dfrac{R}{\sqrt{R^2 + (\omega^2 L^2)}}$

$= R(R^2 + \omega^2 L^2)^{-\frac{1}{2}}$

16. Match List I with List II

	LIST I		LIST II
A.	AC generator	I.	Michael Faraday
B.	Polarity of induced emf	II.	Foucault
C.	Electromagnetic Induction	III.	Nicola Tesla
D	Eddy Current	IV.	Heinrich Friedrich Lenz

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-III, C-IV, D-I

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

Answer (2)

Sol. A.C. Generator – Nicola Tesla

Polarity of induced emf – Heinrich Friedrich Lenz

Electromagnetic induction – Michael Faraday

Eddy current – Foucault

A – III

B – IV

C – I

D – II

17. Match List I with List II

	LIST I		LIST II
A.	Photodiode	I.	
B.	Junction diode	II.	
C.	Zener diode	III.	
D	Solar cell	IV.	

Answer (Correct options are not given)

Sol. A. Photodiode $\rightarrow$ IV

B. Junction diode $\rightarrow$ I

C. Zener diode $\rightarrow$ II

D. Solar cell $\rightarrow$ III

18. A straight wire of mass 200 g and length 1.5 m carries a current of 2 A. It is suspended in mid-air by a uniform horizontal magnetic field B perpendicular to length of wire. The magnitude of B is ($g = 10$ ms^{-2})
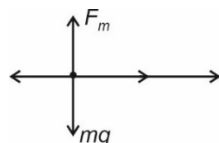
(1) 2 T   (2) 1.5 T

(3) 0.55 T   (4) 0.67 T

Answer (4)

Sol. $BIL = mg$

$B = \dfrac{mg}{IL} = \dfrac{200 \times 10^{-3} \times 10}{2 \times 1.5}$ T

$= \dfrac{10}{15}$ T $= \dfrac{2}{3}$ T $= 0.67$ T

19. A galvanometer of resistance G is converted into a voltmeter to measure upto V volts by connecting a resistance R_1 in series with the coil. If a resistance R_2 is connected in series with it, then it can measure the $\dfrac{V}{3}$ volts. Find the resistance R_3 in terms of R_1 and R_2 required to be connected to convert it into a voltmeter that can read upto $3V$ volts.

(1) $4R_1 - 3R_2$ (2) $3R_1 - 2R_2$

(3) $4R_1 + 3R_2$ (4) $3R_1 + 2R_2$

Answer (1)

Sol. $V = I_g\left(G + R_1\right)$ … (i)

$\dfrac{V}{3} = I_g\left(G + R_2\right)$ … (ii)

$3V = I_g\left(G + R_3\right)$ … (iii)

form (i) and (ii)

$\dfrac{G + R_1}{3} = G + R_2$

$2G = R_1 - 3R_2$ … (iv)

using (i) and (iii)

$3\left(G + R_1\right) = G + R_3$

$3G + 3R_1 = G + R_3$

$2G = R_3 - 3R_1$ … (v)

from (iv) and (v)

$R_1 - 3R_2 = R_3 - 3R_1 \Rightarrow R_3 = 4R_1 - 3R_2$

20. Match List I with List II

	LIST I		LIST II
A.	Output always opposite of input	I.	NOR
B.	Output 1 only when all inputs are 0	II.	NAND
C.	Output 0 only when all inputs are 1	III.	OR
D	Output 1 when all inputs are 1	IV.	NOT

Choose the correct answer from the options given below:

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

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

Answer (1)

Sol. A – IV

For NOT gate output is always opposite to input.

B – I

For NOR gate output is 1 only when all input are 0.

C – II

For NAND gate output is 0, only when all input are 1.

D – III

For OR gate output is 1, when all input are 1.

A-IV, B-I, C-II, D-III

21. Dimensional formula of Planck constant is:

    (1) $[ML^2T^{-3}]$ (2) $[M^0L^0T^0]$

    (3) $[ML^3T^2]$ (4) $[ML^2T^{-1}]$

Answer (4)

Sol. $\Delta E = hf$ (Energy of photon)

Where f is frequency of wave

$[ML^2T^{-2}] = [h] [T^{-1}]$

$[h] = [ML^2T^{-1}]$

22. A magnet of magnetic moment $50\hat{i} Am^2$ is placed along the X-axis in a magnetic field $\vec{B} = (0.5\hat{i} + 3.0\hat{j}) T$

    The torque acting on it is

    (1) $175\hat{k}$ Nm   (2) $150\hat{k}$ Nm

    (3) $75\hat{k}$ Nm   (4) $25\sqrt{37}\hat{k}$ Nm

Answer (2)

Sol. $\vec{\tau} = \vec{m} \times \vec{B}$

$= (50\hat{i}) \times (0.5\hat{i} + 3.0\hat{j})$

$\vec{\tau} = 150\hat{k}$ Nm

23. Which are the correct statement from given below:

    A. Kirchhoff's junction rule is based on conservation of charge.

    B. Current is a vector quantity.

    C. Current density is a vector quantity.

    D. Resistance doesn't depend on dimension of conductor.

    E. Resistivity depends on temperature.

    Choose the correct answer from the options given below:

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

    (3) A, C, E only   (4) A, B only

Answer (3)

Sol. → Kirchhoff's junction rule is based on conservation of charge.

→ Current is a scalar quantity

→ Current density is a vector quantity

→ Resistance depends on dimension of conductor

→ Resistivity depends on temperature

24. Which of the radiation of sun light is used as heat energy

    (1) Radiowaves   (2) Infra-red rays

    (3) Visible light   (4) Micro waves

Answer (2)

Sol. Infrared rays of the radiation of sun light is used as heat energy.

25. What physical quantity is the same for X-rays of wavelength 10^{-10} m, red light of wavelength 680 nm and radiowaves of wavelength 50 m?

    (1) Frequency   (2) Amplitude

    (3) Speed in vacuum   (4) Wave number

Answer (3)

Sol. Speed in vacuum is same for all types of electromagnetic waves.

26. Match List I with List II

	List I		List II
A.	Size of nucleus	I.	A – Z
B.	Number of proton in $_ZX^A$	II.	Z
C.	Size of atom	III.	10^{-10} m
D.	Number of neutrons in $_ZA^A$	IV.	10^{-15} m

Choose the correct answer from the options given below.

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

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

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

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

Answer (1)

Sol. Size of nucleus $\simeq 10^{-15}$ m

Number of proton in $_ZX^A$ = Z
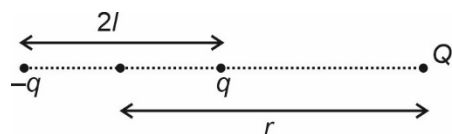
Size of atom $\simeq 10^{-10}$ m

Number of neutrons in $_ZX^A$ = A – Z

27. A point charge is placed at any point on the axis of an electric dipole at some large distance, experiences a force F. The force acting on the point charge when it's distance from the dipole is halved will be

(1) 4F　　　　　　　(2) 8F

(3) $\frac{F}{8}$　　　　　　　(4) $\frac{F}{4}$

Answer (2)

Sol.

$r >> 2l$

Electric field at position of charge varies as $E \propto \frac{1}{r^3}$

Force on charge varies as $F \propto \frac{1}{r^3}$

So, when distance reduced to half the force will become 8 times

28. Three equal resistors connected in series across a source of emf together dissipate 9 W of power. What would be the power dissipated if the same resistors are connected in parallel across the same source?

(1) 9 W　　　　　　(2) 1 W

(3) 81 W　　　　　　(4) 27 W

Answer (3)

Sol. When connected in series

$$3\frac{\left(\frac{V}{3}\right)^2}{R} = 9$$

$$\frac{V^2}{R} = 27$$

When connected in parallel

Power dissipated = $3\left(\frac{V^2}{R}\right) = 3(27)$

= 81 W

29. A ray incident at 50° on one refracting surface of a prism of angle 60°, suffers a deviation of 40°. The angle of emergence is:

(1) 95°　　　　　　(2) 45°

(3) 30°　　　　　　(4) 50°

Answer (4)

Sol. From prism $i + e = A + D$

$e = (A + D) - i$

$= (60° + 40°) - (50°)$

$e = 50°$

30. If $+\sigma$ and $-\sigma$ are the uniform surface charge densities of two parallel infinite thin plane sheets, then the net electric field at the mid point of the two sheets will be given by. (Where ϵ_0 is the permittivity of free pace, where the sheets are kept)
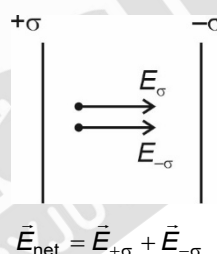
(1) $\frac{\sigma}{2\varepsilon_0}$　　　　　　(2) $\frac{-\sigma}{\varepsilon_0}$

(3) $\frac{\sigma}{\varepsilon_0}$　　　　　　(4) Zero

Answer (3)

Sol. Electric field due to single thin infinite plate is

given by $E = \frac{\sigma}{2\varepsilon_0}$

So,

$\vec{E}_{net} = \vec{E}_{+\sigma} + \vec{E}_{-\sigma}$

$$= \frac{\sigma}{2\varepsilon_0} + \frac{\sigma}{2\varepsilon_0} = \frac{\sigma}{\varepsilon_0}$$

31. In which of the following interference is possible?

(1) Sound waves only

(2) Light waves only

(3) Both light and sound waves

(4) Neither sound nor light waves

Answer (3)

Sol. Interference is possible for light as well as sound waves.

32. The reactance of a circuit is zero. It is possible that the circuit contains:

A. an inductor and a capacitor

B. an inductor but no capacitor

C. a capacitor but no inductor

D. Neither inductor nor capacitor

Choose the correct answer from the options given below:

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

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

Answer (4)

Sol. Reactance is a measurement of capacitance and inductance's resistance.

So, reactance is zero when

(i) $X_C = X_L$

(ii) $X_C = X_L = 0$

33. The half life of a radioactive nuclide is 20 hours. What fraction of original activity will remain after 80 hours?

(1) $\dfrac{1}{8}$ (2) $\dfrac{1}{16}$

(3) $\dfrac{1}{4}$ (4) $\dfrac{1}{32}$

Answer (2)

Sol. $T_{1/2}$ = 2 hours.

Activity remain after time t is $A = \dfrac{A_0}{(2)^{t/T_{1/2}}}$

So, $\dfrac{A}{A_0} = \dfrac{1}{2^{(80/20)}} = \dfrac{1}{2^4} = \dfrac{1}{16}$

34. What is the path difference for destructive interference (if n is an integer)?

(1) $n\lambda$ (2) $(n+1)\dfrac{\lambda}{2}$

(3) $(2n+1)\dfrac{\lambda}{2}$ (4) $(n + 1)\lambda$

Answer (3)

Sol. Path difference for destructive interference is given by

$\Delta X = \dfrac{(2n+1)\lambda}{2}$

35. An unpolarised light of intensity I_0 passes through five identical polarisers arranged in such a manner that the transmission axis of each is set at an angle of 30° with respect to its predecessor. The ratio of the intensity of the final emerging light to that of the unpolarised light is

(1) $\dfrac{27}{128}$ (2) $\dfrac{81}{256}$

(3) $\dfrac{81}{512}$ (4) $\dfrac{27}{64}$

Answer (3)

Sol. Intensity after passing through first polariser $I_1 = \dfrac{I_0}{2}$

From 2nd $\rightarrow I_2 = \dfrac{I_0}{2}\cos^2(30) = \dfrac{3I_0}{8}$

From 3rd $\rightarrow I_3 = \dfrac{3I_0}{8}\cos^2(30) = \dfrac{9I_0}{32}$

From 4th $\rightarrow I_4 = \dfrac{9I_0}{32}\cos^2(30) = \dfrac{27I_0}{128}$

From 5th $\rightarrow I_5 = \dfrac{27I_0}{128}\cos^2(30) = \dfrac{81}{512}I_0$

36. Match List-I with List-II

	List-I		List-II
A.	Charge on an electron	I.	1
B.	Electric permittivity of free space	II.	1.6×10^{-19} C
C.	Number of lines of force from 1 C of charge in free space	III.	8.85×10^{-12} $C^2N^{-1}m^{-2}$
D.	Dielectric constant of vacuum	IV.	1.13×10^{11}

Choose the correct answer from the options given below.

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

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

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

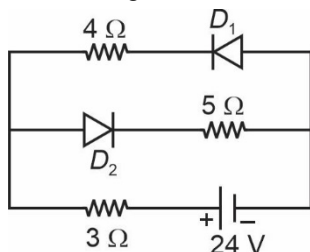(4) A-IV, B-III, C-II, D-I

Answer (1)

Sol.

A. Charge on electron $e = 1.6 \times 10^{-19}$ C (II)

B. Electric permittivity of free space

$\varepsilon_0 = 8.85 \times 10^{-12}$ $C^2N^{-1}m^{-2}$ (III)

C. Number of lines of force from 1 C of charge in free space = 1.13×10^{11} (IV)

D. Di-electric constant of vacuum = 1 (I)

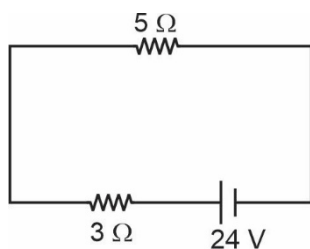**37.** If the diodes D_1 and D_2 are ideal in given diagram. The current flowering in the circuit is

(1) 2 A   (2) 4.59 A

(3) 4.9 A   (4) 3 A

Answer (4)

Sol. D_1 is reverse biased while D_2 is forward biased. Thus, the circuit can be redrawn as

$\therefore \quad I = \dfrac{V}{R_{net}} = \dfrac{24}{5+3}$

$\boxed{I = 3\ A}$

38. An astronomical telescope of ten fold angular magnification has a length of 44 cm. The focal length of the objective is

(1) 4 cm   (2) 40 cm

(3) 440 cm   (4) 44 cm

Answer (2)

Sol. For telescope,

Magnification, $M = \left|\dfrac{f_0}{f_e}\right|$

$\therefore \quad \dfrac{f_0}{f_e} = 10 \qquad \ldots(i)$
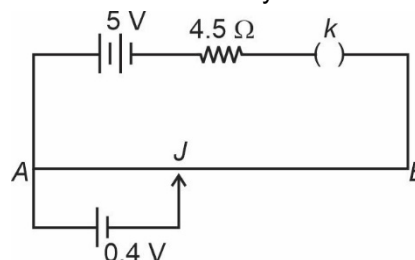
Also,

Length, $L = |f_0| + |f_e| = 44 \quad \ldots(ii)$

From (i) and (ii) we get

$f_e = \dfrac{f_0}{10}$

$\therefore \quad f_0 + \dfrac{f_0}{10} = 44 \implies \dfrac{11f_0}{10} = 44$

$\boxed{f_0 = 40\ cm}$

39. In the given figure, the potentiometer wire, *AB* has a resistance of 5 Ω and length 10 m. The balancing length *AJ* for 0.4 V is nearly

(1) 4 m   (2) 1.52 m

(3) 0.8 m   (4) 0.4 m

Answer (2)

Sol. We know,

$\varepsilon = IR_\ell$ (where, R_ℓ is resistance of balancing length)

$0.4 = \left[\dfrac{5}{(4.5)+5}\right]R_\ell$

$R_\ell = \dfrac{0.4 \times 9.5}{5}$
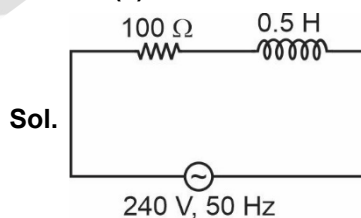
$R_\ell = 0.76\ \Omega$

Now, length of 5 Ω of wire = 10 m

$\therefore$ Length of 0.76 Ω of wire = 1.52 m

40. A coil of inductance 0.50 H and resistance 100 Ω is connected to 240 V, 50 Hz supply. The maximum current in the coil is

(1) 1.72 A   (2) 1.62 A

(3) 1.82 A   (4) 1.92 A

Answer (3)

Sol.

Here, $Z = \sqrt{(X_L)^2 + R^2} = \sqrt{(2\pi f L)^2 + R^2}$

$Z = \sqrt{[(100\pi)(0.5)]^2 + (100)^2}$

$Z = 100\sqrt{\pi^2(0.25) + 1^2}$

$Z = 100\sqrt{3.5}$

$I = \dfrac{V}{Z} = \dfrac{240}{100\sqrt{3.5}}$

$I_0 = I\sqrt{2} = \left(\dfrac{240}{100\sqrt{3.5}}\right)\sqrt{2} = 1.82\ A$

41. The condition for observing diffraction from a single slit is that the light wavefront incident on the slit should be

(1) Cylindrical   (2) Spherical

(3) Plane   (4) Elliptical

Answer (3)

Sol. For Fraunhofer diffraction the wavefront incident should be 'plane'

Here, the most appropriate answer should be (3).

42. What mode of propagation is used for the Ultra high frequency range?

(1) Ground waves   (2) Surface waves

(3) Space waves   (4) Sky waves

Answer (3)

Sol. Due to its high frequency, UHF can neither travel along surface of earth nor can be reflected by ionosphere.

Thus, they are propagated through space wave propagation.

43. Match List I with List II

	LIST-I		LIST-II
A.	The standard resistance coil	I.	Nickel-chromium alloy
B.	The connecting wire	II.	Tin-lead alloy
C.	The heating wire	III.	Copper metal
D.	The fuse wire	IV.	Copper manganese nickel alloy

Choose the correct answer from the options given below:

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

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

Answer (3)

Sol. Standard resistance coil is made of copper-manganese nickel alloy.

While connecting wires are generally made of copper.

Also, the heating wire is made of Nickel-Chromium alloy and fuse wire is generally made of Tin-Lead alloy.

∴ Option (3) is the correct answer.

44. The magnetic susceptibility of material is $\chi = -1$ and relative magnetic permeability is zero. Then the type of material is

(1) Paramagnetic   (2) Ferromagnetic

(3) Diamagnetic   (4) Electromagnetic

Answer (3)

Sol. Magnetic susceptibility is negative for diamagnetic materials.

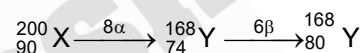**45.** What are the respective numbers of α and β particles emitted respectively in the following radioactive decay?

$$_{90}^{200}X \longrightarrow _{80}^{168}Y$$
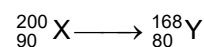
(1) 8 and 8   (2) 8 and 6

(3) 6 and 8   (4) 6 and 6

Answer (2)

Sol. α particle emission decreases mass number by 4 and atomic number by 2.

β particle emission increases atomic number by 1.

Using the above information

$$_{90}^{200}X \xrightarrow{8\alpha} _{74}^{168}Y \xrightarrow{6\beta} _{80}^{168}Y$$

46. Which of the following statements are correct?

A. Dipole field depends on the distance r and also on the angle between the position vector $\vec{r}$ and the dipole moment $\vec{p}$

B. A comb runs through dry hair acquires charge through friction

C. If surface charge density of a plate is positive, the electric field is directed towards the plate

D. Electrostatic field lines cannot form closed loops

E. In a uniform electric field, a dipole experiences a torque and a net force also

Choose the correct answer from the options given below:

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

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

Answer (1)

Sol. • Electric field lines are directed away from a positively charged plate.

• In a uniform electric field, an electric dipole can only experience torque.

Hence, statements (A), (B) and (D) are correct.

47. A convex lens of focal length 30 cm is in contact with a concave lens of focal length 20 cm. Is the system working as a converging or diverging lens. What is the focal length of the combination?

(1) Converging, 10 cm

(2) Diverging, 60 cm

(3) Plane sheet of glass, infinite

(4) Diverging, 40 cm

Answer (2)

Sol. Power of a lens $(P) = \dfrac{1}{\text{focal length}}$

$\therefore P_1 = \dfrac{1}{f_1} = \dfrac{100}{30}$

$P_2 = \dfrac{1}{-f_2} = \dfrac{-100}{20}$

Net power of the lens system will be

$P_{\text{eff}} = P_1 + P_2 = \dfrac{100}{30} - \dfrac{100}{20} = \dfrac{200 - 300}{60}$

$P_{\text{eff}} = \dfrac{-100}{60} = \dfrac{1}{f_{\text{eff}}}$

$\therefore$ Effective focal length is 60 cm and diverging.

48. Match **List I** with **List II**

	List I		List II
A.	Bandwidth	I.	Information converted into electrical form and suitable for transmission
B.	Repeater	II.	Loss of strength of a signal while propagating through a medium
C.	Signal	III.	Range of frequencies over which communication system work
D.	Attenuation	IV.	Combination of receiver and transmitter

Choose the correct answer from the options given below:

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

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

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

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

Answer (2)

Sol. Bandwidth: Range of frequencies over which communication system work.

Repeater: Combination of receiver and transmitter.

Signal: Information converted into electrical form and suitable for transmission.

Attenuation: Loss of strength of a signal while propagating through a medium.

49. Which of the following statements are correct?

A. The various lines in the atomic spectra are produced when electrons jump from higher energy state to a lower energy state.

B. An accelerated atomic electron must spiral into the nucleus as it losses energy.

C. Rutherford scattering determines an upper limit to the size of the nucleus.

D. Angular momentum of the electron orbiting around the nucleus is not quantised.

Choose the correct answer from the options given below:

(1) A, C and D only

(2) B, C and D only

(3) A, B and D only

(4) A, B and C only

Answer (4)

Sol. • Angular momentum of electron orbiting nucleus is:

$L = \dfrac{nh}{2\pi}$, where n = 1, 2, 3 …

$\therefore$ Angular momentum of electron is quantised.

• Electrons move in stationary states around the nucleus, hence even though they are accelerated they don't losses their energy and go inside the nucleus. Therefore, there is no correct option given. But among the available options, the most correct option is 4.

50. Choose the correct option from the following transitions in which the wavelength will be minimum

(1) n = 2 to n = 1

(2) n = 3 to n = 2

(3) n = 4 to n = 3

(4) n = 5 to n = 4

Answer (1)

Sol. Energy is inversely proportional to wavelength for a photon. Hence the maximum energy gap is between n = 2 to n = 1 among the following options, which will result in minimum wavelength.

❑ ❑ ❑