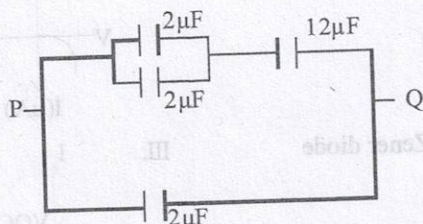


CUET Physics Solved Paper-2023

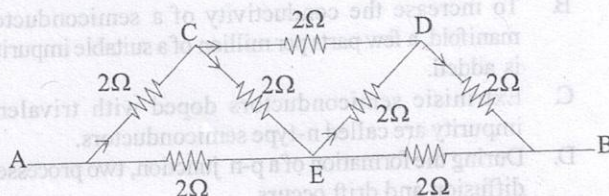
Held on 27 May 2023

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

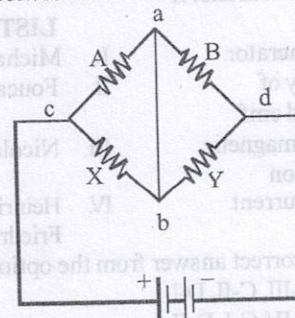


- (a) $10 \mu\text{F}$ (b) $5 \mu\text{F}$ (c) $2 \mu\text{F}$ (d) $7.5 \mu\text{F}$
2. A steady current I flow through a long straight wire of radius 'a'. The current is uniformly distributed across its cross section. The ratio of the magnetic fields due to the wire at distance $\frac{a}{4}$ and $3a$ respectively from the axis of the wire is
- (a) 3:4 (b) 4:3 (c) 2:3 (d) 1:4
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?
- (a) Positive direction of z; y-axis
(b) Positive direction of z; x-axis
(c) Negative direction of z; y-axis
(d) Negative direction of z; 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
- (a) $\frac{8\sqrt{2}\mu_0}{\pi}$ (b) $\frac{16\sqrt{2}}{\pi^2}$
(c) $\frac{8\sqrt{2}}{\pi^2}$ (d) $\frac{16\mu_0}{\pi^2}$
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.
- (a) A, B & C only (b) B & C only
(c) A & E only (d) A, B and D only

6. In the network shown below in the figure below, each resistance is 2Ω . the effective resistance between A and B would be



- (a) $\frac{7}{16}\Omega$ (b) $\frac{16}{7}\Omega$ (c) $\frac{4}{3}\Omega$ (d) $\frac{4}{15}\Omega$
7. What is the slope of the graph drawn between frequency of incident light and stopping potential for a given surface?
- (a) h (b) $h e^{-1}$ (c) eh (d) e
8. The wavelength of matter wave for a moving charged particle is independent of
- (a) mass (b) velocity
(c) momentum (d) 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:
- (a) A, D and E only (b) B, C and E only
(c) A, B and E only (d) B, D and E only
10. In a Wheatstone bridge shown, $X = Y$ and $A > B$. The direction of current between a & b will be



- (a) From a to b (b) From b to a
(c) From b to a through c (d) From a to b through c

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?

(a) Mass of the ion
(b) Charge of the ion
(c) Magnetic field
(d) Radius of the circle and speed of the 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. Extrinsic 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:

(a) C, D and E Only (b) A, B and D Only
(c) A, D and E Only (d) B, C and E Only

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.

(a) -5×10^{-6} V (b) 5×10^{-6} V
(c) -3.29×10^{-4} V (d) $+1.04 \times 10^{-4}$ 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

(a) PE (b) $+2PE$
(c) $-2PE$ (d) Zero

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

(ω is the angular frequency)

(a) $(\omega L)R^{-1}$ (b) $R(\omega L)^{-1}$
(c) $R(R^2 - \omega^2 L^2)^{\frac{1}{2}}$ (d) $R(R^2 + \omega^2 L^2)^{\frac{1}{2}}$

16. Match List I with List II

LIST I
A. AC generator
B. Polarity of induced emf
C. Electromagnetic Induction
D. Eddy Current

LIST II
I. Michael Faraday
II. Foucault
III. Nicola Tesla
IV. Heinrich Friedrich Lenz

Choose the correct answer from the options given below:

(a) A-IV, B-III, C-II, D-I
(b) A-III, B-IV, C-I, D-II
(c) A-II, B-III, C-IV, D-I
(d) A-I, B-II, C-III, D-IV

17. Match List I with List II

LIST I

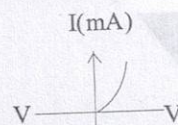
A. Photodiode

B. Junction diode

C. Zener diode

D. Solar cell

LIST II



$I(\mu A)$

II.

$I(\mu A)$

III.

V_{OC}

I_{sc}

IV.

V

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 ($g = 10 \text{ ms}^{-2}$)

(a) 2 T (b) 1.5 T (c) 0.55 T (d) 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 $\frac{V}{3}$ 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.

(a) $4R_1 - 3R_2$ (b) $3R_1 - 2R_2$
(c) $4R_1 + 3R_2$ (d) $3R_1 + 2R_2$

20. Match List I with List II

LIST I

A. Output always opposite I. of input
B. Output 1 only when all inputs are 0
C. Output 0 only when all inputs are 1
D. Output 1 when all inputs are 1

LIST II

NOR
II. NAND
III. OR
IV. NOT

Choose the correct answer from the options given below:

(a) A-IV, B-I, C-II, D-III (b) A-III, B-II, C-I, D-IV
(c) A-I, B-II, C-III, D-IV (d) A-II, B-III, C-IV, D-I

21. Dimensional formula of Planck constant is:

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

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

- (a) $175\hat{k}$ Nm (b) $150\hat{k}$ Nm
(c) $75\hat{k}$ Nm (d) $25\sqrt{37}\hat{k}$ 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:

- (a) A, D, E only (b) B, C, D only
(c) A, C, E only (d) A, B only

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

- (a) Radiowaves (b) Infra-red rays
(c) Visible light (d) Micro waves

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?

- (a) Frequency (b) Amplitude
(c) Speed in vacuum (d) Wave number

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.

- (a) A-IV, B-II, C-III, D-I (b) A-I, B-II, C-IV, D-III
(c) A-III, B-I, C-II, D-IV (d) A-II, B-III, C-IV, D-I

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

- (a) 4F (b) 8F (c) $\frac{F}{8}$ (d) $\frac{F}{4}$

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

- (a) 9 W (b) 1 W (c) 81 W (d) 27 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:

- (a) 95° (b) 45° (c) 30° (d) 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 space, where the sheets are kept)

- (a) $\frac{\sigma}{2\epsilon_0}$ (b) $\frac{-\sigma}{\epsilon_0}$ (c) $\frac{\sigma}{\epsilon_0}$ (d) Zero

31. In which of the following interference is possible?

- (a) Sound waves only
(b) Light waves only
(c) Both light and sound waves
(d) Neither sound nor light 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:

- (a) A and B only (b) A, B and C only
(c) D and C only (d) A and D only

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

- (a) $\frac{1}{8}$ (b) $\frac{1}{16}$ (c) $\frac{1}{4}$ (d) $\frac{1}{32}$

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

- (a) $n\lambda$ (b) $(n+1)\frac{\lambda}{2}$
(c) $(2n+1)\frac{\lambda}{2}$ (d) $(n+1)\lambda$

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

- (a) $\frac{27}{128}$ (b) $\frac{81}{256}$ (c) $\frac{81}{512}$ (d) $\frac{27}{64}$

36. Match List-I with List-II

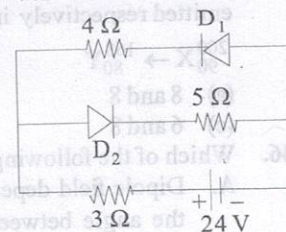
List-I	List-II
A. Charge on an electron	I. 1.6×10^{-19} C
B. Electric permittivity of free space	II. $8.85 \times 10^{-12} \text{ C}^2 \text{ N}^{-1} \text{ m}^{-2}$
C. Number of lines of force from 1C of charge in free space	III. 1.13×10^{11}
D. Dielectric constant of vacuum	IV. 1.13×10^{11}

Choose the correct answer from the options given below.

- (a) A-II, B-III, C-IV, D-I (b) A-III, B-II, C-I, D-IV
(c) A-II, B-IV, C-III, D-I (d) A-IV, B-III, C-II, D-I

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

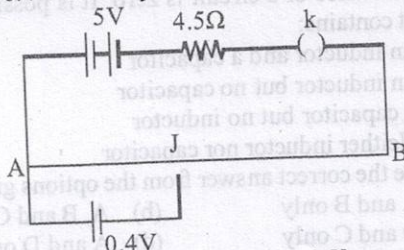
- (a) 2 A
(b) 4.59 A
(c) 4.9 A
(d) 3 A



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

(a) 4 cm (b) 40 cm
(c) 440 cm (d) 44 cm

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



- (a) 4m (b) 1.52m
(c) 0.8m (d) 0.4m
40. A coil of inductance 0.50 H and resistance 100Ω is connected to 240 V, 50 Hz supply. The maximum current in the coil is

(a) 1.72 A (b) 1.62 A
(c) 1.82 A (d) 1.92 A

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

(a) Cylindrical (b) Spherical
(c) Plane (d) Elliptical

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

(a) Ground waves (b) Surface waves
(c) Space waves (d) Sky waves

43. Match List I with List II

LIST-I
A. The standard resistance coil
B. The connecting wire
C. The heating wire
D. The fuse wire

LIST-II
I. Nickel-chromium alloy
II. Tin-lead alloy
III. Copper metal
IV. Copper manganese nickel alloy

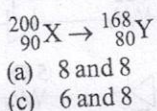
Choose the correct answer from the options given below:

(a) A-II, B-IV, C-III, D-I (b) A-I, B-II, C-III, D-IV
(c) A-IV, B-III, C-I, D-II (d) A-IV, B-II, C-III, D-I

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

(a) Paramagnetic (b) Ferromagnetic
(c) Diamagnetic (d) Electromagnetic

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



(a) 8 and 8 (b) 8 and 6
(c) 6 and 8 (d) 6 and 6

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:

(a) A, B and D only (b) B, C and E only
(c) C, D and E only (d) A, D and E only

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?

(a) Converging, 10 cm
(b) Diverging, 60 cm
(c) Plane sheet of glass, infinite
(d) Diverging, 40 cm

48. Match List I with List II

List I
A. Bandwidth

List II
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:

(a) A-IV, B-III, C-I, D-II (b) A-III, B-IV, C-I, D-II
(c) A-II, B-III, C-IV, D-I (d) A-I, B-II, C-III, D-IV

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 loses 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:

(a) A, C and D only (b) B, C and D only
(c) A, B and D only (d) A, B and C only

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

(a) $n = 2$ to $n = 1$ (b) $n = 3$ to $n = 2$
(c) $n = 4$ to $n = 3$ (d) $n = 5$ to $n = 4$

Hints & Explanations

1. (b) Equivalent capacitance of $2\mu\text{F}$ two capacitors of capacitances and $2\mu\text{F}$ in parallel, and in series $12\mu\text{F}$ then capacitances $2\mu\text{F}$ is in parallel

$$C_1 = 2 + 2 = 4\mu\text{F}$$

$$C_2 = 12\mu\text{F}$$

$$C_{PQ} = \frac{C_1 C_2}{C_1 + C_2} + 2$$

$$C_{PQ} = \frac{4 \times 12}{4 + 12} + 2$$

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

$$= 3 + 2 = 5\mu\text{F}$$

2. (a) For long straight current carrying wire, for $r < a$

$$I_{\text{enc}} = \frac{1}{\pi a^2} \times \pi \left(\frac{a}{4}\right)^2 = \left(\frac{1}{16}\right)$$

By Ampere's circuital law

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

$$B_1 \times 2\pi a$$

$$\frac{a}{4} = \frac{\mu_0 I}{16}$$

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

$$B_2 \times 2\pi \times 3a = \mu_0 I \quad B_2 = \left(\frac{\mu_0 I}{6\pi a}\right)$$

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

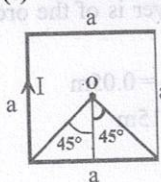
3. (b) The magnetic field of a light wave at given time $B = B_m \sin(kz - \omega t)$
Plane progressive wave is moving in positive z direction.

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

$$\hat{k} = \hat{n} \times \hat{j} \Rightarrow \hat{n} = (\hat{i})$$

$\therefore$ Electric field will be along x -axis and moving in z direction.

4. (c) For wire X, which is bent into form a square



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

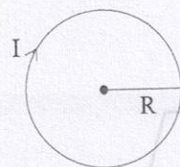
The magnetic field at the Centre of the square will be

$$B_x = \left[\frac{\mu_0 I}{4\pi d} [\sin 45^\circ + \sin 45^\circ] \times 4 \right]$$

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

$$= \frac{8\sqrt{2}\mu_0 I}{\pi L} \quad (\because d = \frac{a}{2} = \frac{L}{8})$$

For wire Y, which is bent into form a circle



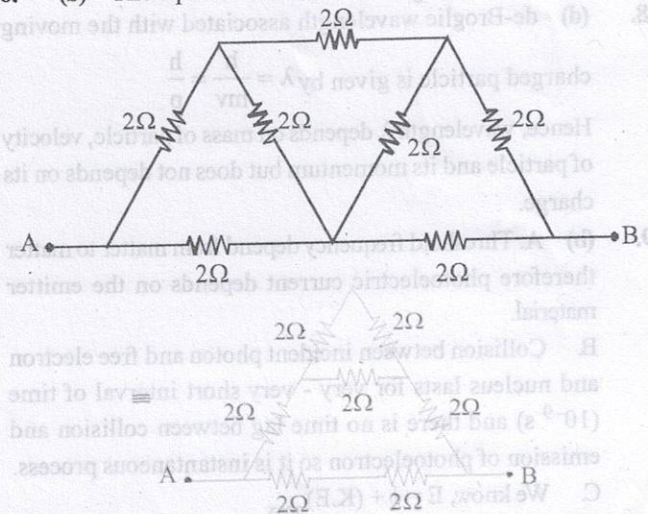
$$2\pi R = L \Rightarrow R = \left(\frac{L}{2\pi}\right)$$

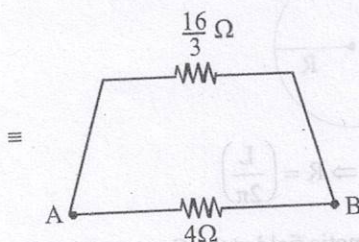
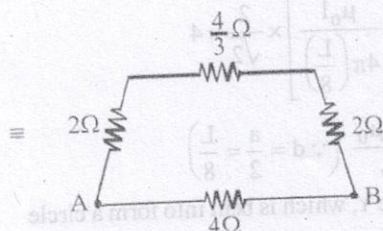
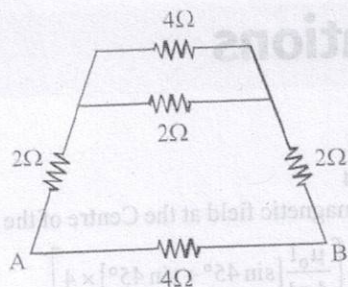
The magnetic field at the Centre of the circle will be

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

$$\text{Ratio} = \frac{B_x}{B_y} = \frac{8\sqrt{2} / \mu_0}{\pi L} = \frac{8\sqrt{2}}{\pi^2} \frac{\mu_0 I \times \pi}{L}$$

5. (d) A metal plate can be heated when a DC or AC current passing through it and it is placed in time varying magnetic field.
6. (b) The equivalent network will be





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

7. (b) From the photoelectric equation

$$E = \phi_0 + eV_0$$

$$hf = hf_0 + eV_0 \Rightarrow V_0 = \frac{h}{e}f - \frac{h}{e}f_0$$

$y = mx + c$ compare with

$$\therefore \text{slope}(m) = \frac{h}{e}$$

8. (d) de-Broglie wavelength associated with the moving

$$\text{charged particle is given by } \lambda = \frac{h}{mv} = \frac{h}{p}$$

Hence, wavelength λ depends on mass of particle, velocity of particle and its momentum but does not depend on its charge.

9. (b) A. Threshold frequency depend 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 $E = \phi + eV_0$

$\therefore$ 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 $E = mc^2$, $E = h\nu$

$$\Rightarrow mc^2 = h\nu \text{ \& } \nu = c/\lambda \Rightarrow \lambda = h/mv$$

10. (b) From the wheat stone bridge in part cbd

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

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

... (i)

In part cad

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

$$\text{from equation (a) we have } \frac{V_c + V_d}{2} = V_a$$

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

11. (d) Centripetal force on ion, $F_c = \frac{mv^2}{r}$

Magnetic force on ion, $F_m = qvB$

$$F_c = F_m$$

$$\frac{mv^2}{r} = qvB \Rightarrow v = \frac{qBr}{m}$$

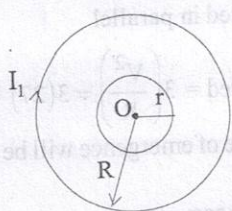
$$v = r\omega$$

$$\Rightarrow \omega = \frac{qB}{m}$$

$\therefore$ Angular velocity is independent of radius of circle and speed of ion.

12. (b) (A) Yes, the process of generation of conduction electrons and holes and process of recombination is simultaneous.
(B) When a small amount impurity is added to a pure semiconductor is increased manifold.
(C) In extrinsic semiconductors doped with trivalent impurity, electrons become minority carriers and hole become 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. (c) Radius of inner circular loop, $r_1 = 0.05\text{m}$
Radius of outer circular loop, $R = 0.15\text{m}$



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

Magnetic flux, $\phi = BA$

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

By definition of mutual inductance

$$\phi = M I_1 = \frac{\mu_0 \pi r^2}{2R} I_1$$

$$M = \frac{\mu_0 \pi r^2}{2R} = \frac{4\pi \times 10^{-7} \times 3.14 \times (0.05)^2}{2 \times (0.15)} = 0.32 \times 10^{-7} \text{ H}$$

$$\frac{dI_1}{dt} = 10 \text{ A/ms} = 10 \times 10^3 \text{ A/S}$$

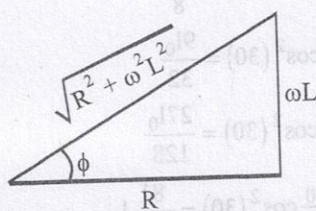
$\Rightarrow$ The e.m.f induced in the inner loop

$$\varepsilon = -\frac{M dI_1}{dt} = -(0.32 \times 10^{-7} \times 10^4) = -3.29 \times 10^{-4} \text{ V}$$

14. (b) The work done in deflecting the dipole is given by
 $W = -PE \cos \theta$

$$W = W_{180} - W_0 = -PE \cos 180^\circ - (-PE \cos 0^\circ) = PE + PE = 2PE$$

15. (d) $\tan \phi = \frac{\omega L}{R}$



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

$$= \frac{R}{\sqrt{R^2 + \omega^2 L^2}}$$

16. (b) A. C Generator – Nicola Tesla
 Polarity of induced emf – Heinrich Friedrich Lenz

Electromagnetic induction – Michael Faraday

Eddy current – Foucault

17. (b) A. Photodiode $\rightarrow$ IV

B. Junction diode $\rightarrow$ I

C. Zener diode $\rightarrow$ II

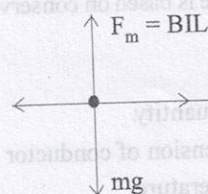
D. Solar cell $\rightarrow$ III

18. (d) Mass of Straight

wire, $m = 200 \text{ g}$

$$= 200 \times 10^{-3} \text{ kg}$$

$$BIL = mg$$



$$B = \frac{mg}{IL} = \frac{200 \times 10^{-3} \times 10}{2 \times 1.5} \text{ T} = 0.67 \text{ T}$$

19. (a) $V = I_g (G + R_1)$

$$\frac{V}{3} = I_g (G + R_2)$$

$$3V = I_g (G + R_3)$$

from (i) and (ii)

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

$$2G = R_1 - 3R_2$$

using (i) and (iii)

$$3(G + R_1) = G + R_3$$

$$3G + 3R_1 = G + R_3$$

$$2G = R_3 - 3R_1$$

from (iv) and (v)

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

20. (a) 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. (d) $\Delta E = hf$ (Energy of photon)

$$\Delta E = Mc^2$$

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

Where f is frequency of wave

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

22. (b) The torque acting on it is $(\hat{j} \times \hat{j} = \hat{k})$

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

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

$$= 150\hat{k} \text{ Nm}$$

23. (c) $\rightarrow$ Kirchhoff's junction rule is based on conservation of charge.

$\rightarrow$ Current is a scalar quantity.

$\rightarrow$ Current density is a vector quantity.

$\rightarrow$ Resistance depends on dimension of conductor

$\rightarrow$ Resistivity depends on temperature

24. (b) Infrared rays is used as heat energy.

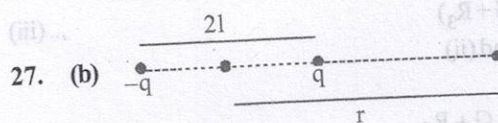
25. (c) Speed in vacuum is same for all types of electromagnetic waves.

26. (a) Size of nucleus $\approx 10^{-15} \text{ m}$

Number of proton in ${}_Z^AX^A = Z$

Size of atom $\approx 10^{-10} \text{ m}$

Number of neutrons in ${}_Z^AX^A = A - Z$



27. (b)

$$\because r \gg 2l$$

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

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

$$\text{Here, } r = \frac{r}{2} \text{ then } F' = \frac{1}{\left(\frac{r}{2}\right)^3} = 8F$$

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

28. (c) When connected in series

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

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

When connected in parallel

$$\text{Power dissipated} = 3 \left(\frac{V^2}{R} \right) = 3(27) = 81 \text{ W}$$

29. (d) The angle of emergence will be

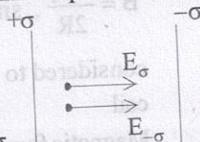
$$e = (A + D) - i$$

$$= (60^\circ + 40^\circ) - (50^\circ) = 50^\circ$$

30. (c) Electric field due to single thin infinite plate is given

$$\text{by } E = \frac{\sigma}{2\epsilon_0}$$

$$\vec{E}_{\text{net}} = \vec{E}_{+\sigma} + \vec{E}_{-\sigma} = \frac{\sigma}{2\epsilon_0} + \frac{\sigma}{2\epsilon_0} = \frac{\sigma}{\epsilon_0}$$



31. (c) Interference is possible for light as well as sound waves.

32. (d) 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. (b) Half - life period

$$T_{1/2} = 20 \text{ hours. and } T = 80 \text{ hours}$$

$$\text{Activity remain after time } t \text{ is } A = \frac{A_0}{(2)^{t/T_{1/2}}} \left(\because n = \frac{t}{T_{1/2}} \right)$$

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

34. (c) Path difference for destructive interference is given by

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

35. (c) Intensity after passing through first polariser $I_1 = \frac{I_0}{2}$

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

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

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

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

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

B. Electric permittivity of free space

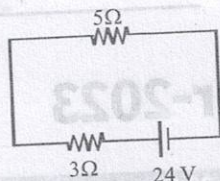
$$\epsilon_0 = 8.85 \times 10^{-12} \text{ C}^2 \text{ N}^{-1} \text{ m}^{-2}$$

C. Number of lines of force from 1C of charge in free space $= 1.13 \times 10^{11}$

D. Di-electric constant of vacuum $= 1$

37. (d) D_1 is reverse biased while D_2 is forward biased.
 D_1 act as open circuit and D_2 act as short circuit

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$$\therefore I = \frac{V}{R_{\text{net}}} = \frac{24}{5+3} = 3A$$

38. (b) For telescope,

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

$$\therefore \frac{f_0}{f_e} = 10 \quad \dots(i)$$

$$\text{length, } L = |f_0| + |f_e| = 44 \quad \dots(ii)$$

From (i) and (ii) we get

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

$$\therefore f_0 + \frac{f_0}{10} = 44 \Rightarrow \frac{11f_0}{10} = 44$$

$$\therefore f_0 = 40 \text{ cm}$$

39. (b) $\varepsilon = IR_L$ (where, R_L is resistance of balancing length)

$$0.4 = \left[\frac{5}{(4.5) + 5} \right] R_L$$

$$R_L = \frac{0.4 \times 9.5}{5} = 0.76 \Omega$$

Now, length of 5Ω of wire = 10 m

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

40. (c) Here, $Z = \sqrt{(X_L)^2 + R^2} = \sqrt{(2\pi fL)^2 + R^2}$

$$Z = \sqrt{[(100\pi)(0.5)]^2 + (100)^2} \quad Z = 100\sqrt{3.5}$$

$$I = \frac{V}{Z} = \left(\frac{240}{100\sqrt{3.5}} \right)$$

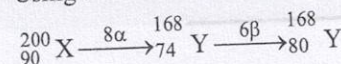
$$I = I\sqrt{2} = \left(\frac{240}{100\sqrt{3.5}} \right) \sqrt{2} = 1.82A$$

41. (c) For Fraunhofer diffraction the wavefront incident should be 'plane'.
Here, the most appropriate answer should be (c).
42. (c) 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. (c) 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.
 $\therefore$ Option (c) is the correct answer.

44. (c) Magnetic susceptibility is negative for diamagnetic materials.

45. (b) 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



46. (a) • 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. (b) Power of a lens (P) = $\frac{1}{\text{focal length (in metre)}}$

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

$$P_2 = \frac{1}{-f_1} = \frac{-100}{20}$$

Net power of the lens system will be

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

$$P_{\text{eff}} = \frac{-100}{60} = \frac{1}{f_{\text{eff}}} \therefore f_{\text{eff}} = 60 \text{ cm}$$

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

48. (b) 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. (d) • From Bohr's postulates, angular momentum of electron orbiting nucleus is:

$$L = \frac{nh}{2\pi}, \text{ where } n = 1, 2, 3 \dots$$

$\therefore$ Angular momentum of electron is quantised.

• Electrons move in stationary states around the nucleus, hence even though they are accelerated they don't lose their energy and go inside the nucleus.

50. (a) 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.

$$E = hc$$

$$= h c_R \left[\frac{1}{n_1^2} - \frac{1}{n_2^2} \right]$$

$$= hc \left(1 - \frac{1}{4} \right) = \frac{3}{4} hc$$