CUET Physics Solved Paper-2022

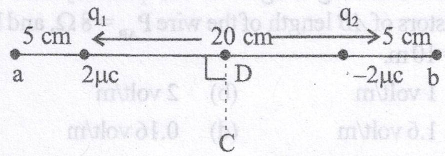
Held on 26 August 2022

1. Magnitude of electric field due to a point charge + Q experienced by a test charge *q* at a distance *r* from the point charge + Q is equal to:
   (a) Magnitude of dielectric force experienced by the point charge/Q
   (b) Magnitude of electric force experienced by the test charge/q
   (c) Magnitude or repulsive force between the point charge and the test charge
   (d) Magnitude of electric force experienced by point charge Q multiplied by the magnitude of charge on the test charge

2. Point A lies at a distance *r* on the axis of q short electric dipole. Electric field at this point is $160\frac{V}{m}$. Now consider another point *P* at a distance 2*r* on its axis. The value of electric field at this point will be
   (a) $160\frac{V}{m}$ (b) $40\frac{V}{m}$
   (c) $20\frac{V}{m}$ (d) $10\frac{V}{m}$

3. A spherical metal body has +Q charge, uniformly distributed over its outer surface. The body has a cavity at its centre. Select proper procedure from those given below which will change the charge on the outer surface of this body from +Q to –Q.
   (a) Charge - 2Q is inserted in the cavity and is kept insulated from the inner surface of the cavity
   (b) Charge - 2Q is brought closer to the body externally and kept at some small distance away from it
   (c) Another metal sphere having total charge - 2Q distributed on its surface is kept in contact with the given spherical body for some time and then the two are separated
   (d) A metal body having charge - Q is inserted in the cavity and kept touching the inner surface of the cavity.

4. Two point charges $q_1 = 2\mu C$ and $q_2 = -2\mu C$ are placed 20 cm apart from each other. Point 'a' is 5 cm away from q, on the line joining q_1 and q_2 on the side opposite to q_2. Point 'b' is 5 cm away from q_2, on the line joining q_1 and q_2, opposite to q_1. Point 'c' is at a perpendicular distance of 10 cm from the centre point *D* of the line joining q_1 and q_2. Identify the correct statement depicting the situation.



   (a) Point C and D are equipotential
   (b) Potential at point a, $V_a < V_b$, potential at point b
   (c) Potential at point a, $V_a < V_c$, potential at point c
   (d) Potential at point *D*, $V_D > V_b$, potential at point b $V_D > V_b$

5. A 300 μF capacitor is charged by 90 volt. Once it is charged battery is removed. Now another uncharged capacitor of capacitance 600 μF is connected across it (in parallel). The value of common potential is
   (a) 30 volt (b) 60 volt
   (c) 120 volt (d) 0 volt

6. Given below are two statements:
   Statement I: Electric potential at every point inside a uniformly charges conducting sphere is equal to that on its surface.
   Statement II: Work done by an electrostatic field in moving a charge from one point to another depends on the length of the path taken to go from one point to the other.
   In the light of the above statements, choose the **most appropriate** answer from the options given below:
   (a) Both **Statement I** and **Statement II** are correct
   (b) Both **Statement I** and **Statement II** are incorrect
   (c) **Statement I** is correct but **Statement II** is incorrect
   (d) **Statement I** is incorrect but **Statement II** is correct

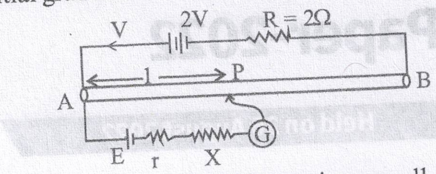
Passage: (Q. No.: 7-11)

Potentiometer has multiple uses. It is based on the principle that when constant current flows through a wire of uniform area of cross-section then potential drop along its length is directly proportional to corresponding length. *i.e.*, $V \propto l$
$V = Kl$

Various uses of potentiometer on:
– To measure potential differences between any two points in an electrical network
– To compare emf of a cell
– To measure emf of a cell
– To measure internal resistance of a cell etc:

Answer the following question related to potentiometer.

7. In the following set up of potentiometer, the value of potential gradient is :



AP is balancing length for the primary cell of emf E, Resistors of AB length of the wire $P_{AB} = 8\ \Omega$, and length AB (L) = 10 m.

(a) 1 volt/m (b) 2 volt/m
(c) 1.6 volt/m (d) 0.16 volt/m

8. Case study-2 based

Potentiometer has multiple uses. It is based on the principle that when constant current flows through a wire of uniform area of cross-section then potential drop along its length is directly proportional to corresponding length. *i.e.*, $V \propto l$

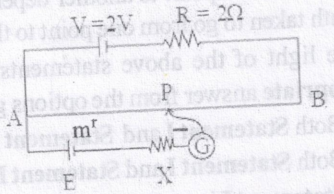
$V = Kl$

Various uses of potentiometer on:

– To measure potential differences between any two points in an electrical network
– To compare emf of a cell
– To measure emf of a cell
– To measure internal resistance of a cell etc:

Answer the following question related to potentiometer.

The length of potentiometer wire AB is 10 m and its resistance is 8 Ω. If balancing length on the potentiometer is 225 cm, the value of emf of the primary cell is:



(a) 0.36 volt (b) 0.16 volt
(c) 36 volt (d) 2 volt

9. Case study-2 based

Potentiometer has multiple uses. It is based on the principle that when constant current flows through a wire of uniform area of cross-section then potential drop along its length is directly proportional to corresponding length. *i.e.*, $V \propto l$

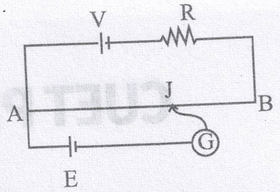
$V = Kl$

Various uses of potentiometer on:

– To measure potential differences between any two points in an electrical network
– To compare emf of a cell
– To measure emf of a cell
– To measure internal resistance of a cell etc:

Answer the following question related to potentiometer.

In the given potentiometer on increasing value of R:



(a) Balancing length will decreases
(b) Balancing length will increases
(c) Balancing length will remain unchanged
(d) Balancing length can be obtained again if polarity of cell E is reversed

10. Case study-2 based

Potentiometer has multiple uses. It is based on the principle that when constant current flows through a wire of uniform area of cross-section then potential drop along its length is directly proportional to corresponding length. *i.e.*, $V \propto l$

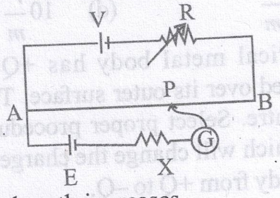
$V = Kl$

Various uses of potentiometer on :

– To measure potential differences between any two points in an electrical network
– To compare emf of a cell
– To measure emf of a cell
– To measure internal resistance of a cell etc:

Answer the following question related to potentiometer.

In the given potentiometer the null point for the primary cell is obtained at P. The effect on the balancing length when resistance X is increased, will be



(a) Balancing length increases
(b) Balancing length remains unchanged
(c) Balancing length decreases
(d) Balancing length first increases and then decreases

11. Case study-2 based

Potentiometer has multiple uses. It is based on the principle that when constant current flows through a wire of uniform area of cross-section then potential drop along its length is directly proportional to corresponding length. *i.e.*, $V \propto l$

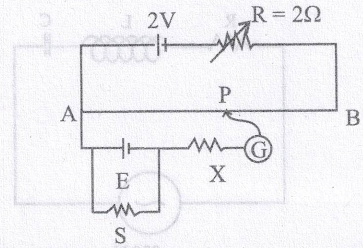
$V = Kl$

Various uses of potentiometer on :

– To measure potential differences between any two points in an electrical network
– To compare emf of a cell
– To measure emf of a cell
– To measure internal resistance of a cell etc:

Answer the following question related to potentiometer.

What happens to the balancing length when resistance S is increased?



(a) Balancing length decreases
(b) Balancing length increases
(c) Balancing length remains unchanged
(d) Balancing length first decreases then increases

12. A charge particle is moving on a helical path in a uniform magnetic field. The correct statement describing the velocity of this charge particle, is:
(1) The particle has non-zero components, of velocity along the parallel as well as perpendicular directions of magnetic field
(2) The particle velocity is in a direction parallel to the direction of magnetic field
(3) The particle velocity is in a direction perpendicular to the direction of magnetic field
(4) The particle is initially at rest while switching the magnetic field on
(a) 1 (b) 2 (c) 3 (d) 4

13. Magnetic flux through any closed surface around magnetic pole is always zero. The correct reason for this fact, is
(a) Magnets always exist in pairs
(b) Magnets are always dipoles
(c) Magnets can exist as monopoles
(d) No magnet exerts force on another magnet

14. In the magnetic meridian at a certain place the horizontal component of earths magnetic field is 32 G and the angle of dip is 60°. The total magnetic field of the earth at this location, is:
(a) 0.52 G (b) 0.64 G
(c) 0.54 G (d) 0.32 G

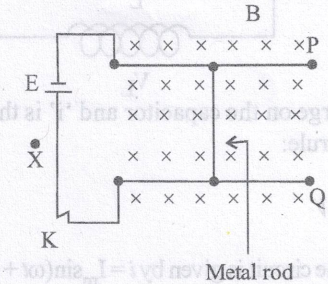
15. Below are mentioned some properties of ferromagnetic substances. Identify the correct ones.
(a) These have strong tendency to move from a region of weak magnetic field to strong magnetic field
(b) In these substances, atomic dipoles align themselves in a common direction over a macroscopic volume called domains
(c) Magnetisation of these materials is inversely, proportional to the absolute temperature

$$M \propto \frac{1}{T} \text{ (Curie's law)}$$

(d) These materials show Meissners effect super conducting magnets which is used in magnetically leviated superfast trains
(e) The temperature of transition from ferromagnetic to paramagnetic to called Curies law

Choose the correct answer from the options given below:
(1) (A), (B), (E) only (2) (B), (C), (D) only
(3) (C), (D), (E) only (4) (B), (D), (E) only
(a) 1 (b) 2 (c) 3 (d) 4

16. Two conducting rails *P* and *Q* are held parallel to each other in the plane of the paper. There is uniform magnetic field 'B' perpendicular to the length of the rails going into the paper. A metal rod is kept touching both the rails and is perpendicular to the rails. A dc source is connected, with switch *K*, to the ends of the rails on one side as shown in the figure. Select the correct statement describing the situation of the metal rod when the switch *K* is closed.



(a) The rod will remain stationary
(b) The rod will oscillate along the length of the rails
(c) The rod will move along the rails from in the direction from X to Y.
(d) The rod will move along the rails from in the direction from Y to X.

17. Match List-I with List-II

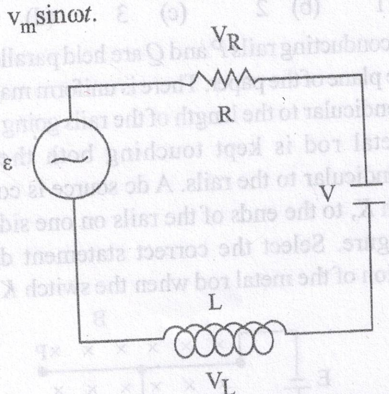
List-I	List-II
(a) Magnetic field	(I) NA^{-2}
(b) Magnetic flux	(II) $NA^{-1}\ m^{-1}$
(c) Magnetic permeability	(III) Am^2
(d) Magnetic moment	(IV) NmA^{-1}

Choose the correct answer from the options given below:
(1) (A) - (II), (B) - (III), (C) - (I), (D) - (IV)
(2) (A) - (IV), (B) - (II), (C) - (III), (D) - (I)
(3) (A) - (II), (B) - (IV), (C) - (I), (D) - (III)
(4) (A) - (III), (B) - (I), (C) - (IV), (D) - (II)
(a) 1 (b) 2
(c) 3 (d) 4

18. A coil of 200 turns, area 0.20 m^2 is rotated in a uniform magnetic field of 0.4 G perpendicular to the axis of the coil at the rate of 7 rps. The maximum emf induced in the coil is
(a) 3.52×10^{-2} V
(b) 4.28×10^{-2} V
(c) 6.24×10^{-2} V
(d) 7.04×10^{-2} V

Passage: (Q. No. 19-23)

A series LCR circuit connected to an AC source with voltage of the source $v = v_m \sin\omega t$.



If 'q' is the charge on the capacitor and 'i' is the current, from Kirchoff's loop rule:

$$L\frac{di}{dt} + iR + \frac{q}{c} = V$$

The current in the circuit is given by $i = I_m \sin(\omega t + \phi)$ where ϕ is the phase difference between the voltage across the source and current in the circuit. We know $V_{Rm} = L_m R$; $V_{Lm} = L_m X_L$; $V_{Cm} = L_m X_C$; and

$$X_L = \omega L; X_c = \frac{1}{\omega C}$$

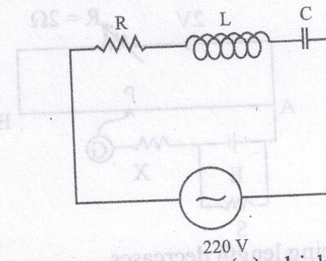
Total impedance in the circuit regulates current. At resonance frequency of the LCR circuit current in the circuit is maximum.

A series LCR circuit has resonant frequency of ω_0. If inductance in the circuit is replaced by another one having the same value of inductance but higher value of internal resistance.

19. Select the statement that explains the change in functioning of the circuit correctly.
(a) Resonant frequency of the circuit will decrease
(b) Amplitude of current at the resonant frequency will increase
(c) Quality factor of the circuit will decrease
(d) Bandwidth of the circuit will decrease

20. Given below are two statements
Statement I : In an LCR series circuit, power dissipated is minimum at resonance.
Statement II : In an LCR circuit, power is dissipated only in the inductor and capacitor.
In the light of the above statements, choose the **most appropriate** answer from the options given below
(a) Both Statement I and Statement II are true
(b) Both Statement I and Statement II are false
(c) Statement I is correct but Statement II is false
(d) Statement I is incorrect but Statement II is true

21. In a series LCR circuit $L = 4$ H, $C = 100$ μF and $R = 25$ Ω. The circuit is connected to a variable frequency 220 V source.



The source angular frequency (ω) which drives the circuit in resonance is
(a) 0.05 rad s^{-1} (b) 2 rad s^{-1}
(c) 314 rad s^{-1} (d) 50 rad s^{-1}

22. In a series LCR circuit if frequency of the ac source is increased from resonance value f_0 to $2f_0$. Choose the statement depicting correct situation in the circuit.
(a) Impedance of the circuit would increase
(b) Potential difference across the resistance would increase
(c) rms value of the current in the circuit will increase
(d) Potential difference across the series combination of L & C will become zero

23. A pure inductor of 0.25 mH, a pure capacitor of 250 μF and a resistor of 350 Ω are connected in series. An ac source of amplitude 210 V is connected across this series combination of L, C and R. The impedance and current amplitude in the circuit at resonance will be:
(a) $Z_{min} = 703$ Ω and $I_{max} = 0.30$ A
(b) $Z_{min} = 350$ Ω and $I_{max} = 0.60$ A
(c) $Z_{min} = 850$ Ω and $I_{max} = 0.25$ A
(d) $Z_{min} = 430$ Ω and $I_{max} = 0.5$ A

24. Which of the following EM waves can be produced by using Klystron or Magnetrons or Gunn diodes?
(a) Gamma rays (b) X rays
(c) Microwaves (d) UV rays

25. Electric and Magnetic fields oscillate sinusoidally in an Electromagnetic Waves. The oscillating electric field cannot be represented in this way, where the symbols have there usual meaning:
(a) $E = E_0 \sin(kz - \omega t)$
(b) $E = E_0 \sin\left[2\pi\left(\frac{z}{\lambda} - \frac{t}{T}\right)\right]$
(c) $E = E_0 \sin\left[\frac{2\pi}{\lambda}(z - vt)\right]$
(d) $E = E_0 \sin\left[\frac{2\pi}{T}(vz - t)\right]$

26. A beam of light converges at a point *M*. Now a concave lens of focal length 32 cm is placed in the path of convergent beam 24 cm from *M*. Now the beam will converge at:
(a) 56 cm from lens (b) 8 cm from lens
(c) +96 cm from lens (d) –32 cm from lens

27. An equiconvex lens of focal length 10 cm is made up of material with refractive index 1.5. The radius of curvature of the each surface is

(a) 10 cm (b) 20 cm

(c) 40 cm (d) 5 cm

28. A compound microscope has an objective lens of focal length $f_o = 1.0$ cm, an eyepiece of focal length 2.2 cm and has tube length 22 cm. The magnification produced compound microscope is

(a) –250 (b) –200

(c) –100 (d) –150

29. The working of an optical fibre can be explained on the basis of

(a) Reflection of light

(b) Refraction of light

(c) Scattering of light

(d) Total internal Reflection of light

30. A light source is kept in air ($n \approx 1$) at a distance of 200 cm from a convex spherical glass surface $\left(n = \frac{3}{2}\right)$ such that light falls on it. If the radius of curvature of the surface is 40 cm, the position of the image is at

(a) –100 cm (b) –200 cm

(c) +200 cm (d) +100 cm

31. For what distance is ray optics a good approximation when the aperture is 2 mm wide and the wavelength is 400 nm?

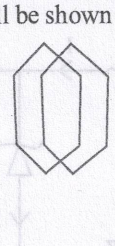
(a) 0.1 m (b) 5×10^{10} m

(c) 5×10^3 (d) 10 m

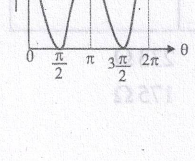
32. In Young's double Slit experiment 3rd maxima (Bright Band) is obtained at a distance d_1 from the central bright fringe when light of wavelength λ_1 is used and at a distance d_2 when light of wavelength λ_2 is used. What will be the ratio of d_1 and d_2?

(a) $\frac{\lambda_1^2}{\lambda_2^2}$ (b) $\frac{\lambda_2}{\lambda_1}$ (c) $\frac{\lambda_1}{\lambda_2}$ (d) $\sqrt{\frac{\lambda_2}{\lambda_1}}$

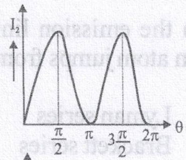
33. Consider the polaroids P_1 and P_2 kept with axis parallel to the other. Now the polaroid P_2 is rotated from 0 to 2π with respect to P_1. The variation of intensity of transmitted light through P_2 will be shown as



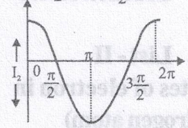
(a)



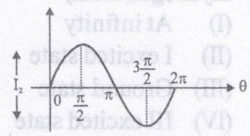
(b)



(c)



(d)



34. The brewster's angle for air to water transition is (Refractive index of water $= \frac{4}{3}$)

(a) $\sin^{-1}\left(\frac{4}{3}\right)$ (b) $\sin^{-1}\left(\frac{3}{4}\right)$

(c) $\tan^{-1}\left(\frac{4}{3}\right)$ (d) $\tan^{-1}\left(\frac{3}{5}\right)$

35. A proton and a triton are accelerated from rest through a potential V. The ratio of their de Broglie wavelength is:

(a) 1 : 1 (b) 1 : 2

(c) $1:\sqrt{2}$ (d) $\sqrt{3}:1$

36. In the experimental study of photoelectric effect, a graph of stopping potential versus frequency of incident radiation for two metals A and B is plotted and identical slopes for both are obtained with different cut off frequencies (VDB > VOA). So

(a) Slope for all metals is same = h/e. Here work function of $A >$ work function of B

(b) Slope for all metals is same = h/e. Here work function of $B >$ work function of A

(c) Slope for all metals is same = h. Here work function of $A >$ work function of B

(d) Slope for all metals is same = h. Here work function of $B >$ work function of A

37. Photoelectric emission occurs only when the incident light has more than a certain minimum

(a) Intensity

(b) Angle of Incidence

(c) Speed

(d) Frequency

38. For a dynamically stable orbit in a hydrogen atom, according to Rutherford's atomic model the relation between the orbit radius (r) and the electron velocity (v) is:

(a) $r = \frac{e}{4\pi\varepsilon_0 mv^2}$ (b) $r = \frac{e^2}{4\pi\varepsilon_0 mv}$

(c) $r = \frac{e^2}{4\pi\varepsilon_0 mv^2}$ (d) $r = \frac{e}{4\pi\varepsilon_0 m^2 v}$

39. The spectral series to which the emission line belongs, when electron in the hydrogen atom jumps from 4th energy state to 2nd energy state, is:

(a) Paschen series (b) Lyman series
(c) Balmer series (d) Brackett series

40. Match List-I with List - II

List - I (Total energy eV)	**List - II (States of electron in Hydrogen atom)**
1. −3.40	(I) At infinity
2. −13.6	(II) I excited state
3. 0	(III) Ground state
4. −0.85	(IV) III excited state

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

(a) (1) - (II), (2) - (III), (3) - (I), (4) - (IV)
(b) (1) - (III), (2) - (I), (3) - (II), (4) - (IV)
(c) (1) - (IV), (2) - (I), (3) - (III), (4) - (II)
(d) (1) - (I), (2) - (II), (3) - (III), (4) - (IV)

41. A particular radioactive sample has a half life of 12 years. The fraction of it that remains undecayed after 48 years, will be:

(a) $\frac{1}{4}^{th}$ of its initial amount

(b) $\frac{1}{8}^{th}$ of its initial amount

(c) $\frac{1}{16}^{th}$ of its initial amount

(d) $\frac{1}{32}^{th}$ of its initial amount

42. Choose the correct statements from the following based on the properties of atomic nucleus.

I. Radius of a nucleus of man no. A depends on its mass number as $R \propto A^3$

II. Radius of nucleus and mass number are related as $R \propto A^{\frac{1}{3}}$

III. Density of nuclei is always a constant

IV. Density of nuclei depends on its mass number A

V. Density of nuclei depends on its size, volume

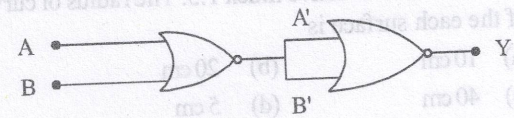
Choose the **correct** answer from the options given below:

(a) I and III only (b) II and III only
(c) II and IV only (d) II and V only

43. The constancy of the binding energy in the range 30 < A < 170 in binding energy curve, is a consequence of the given fact :

(a) Nuclear forces are charge independent
(b) Nuclear forces are short ranged
(c) Nuclear forces are the strongest forces
(d) Nuclear forces are the attractive in nature

44. Identify the logic operation carried out by the given circuit



(a) OR (b) AND
(c) NOT (d) NAND

45. For transistor action, which of the following statements are correct:

(A) The base region must be very thin and lightly doped
(B) Base emitter and collector regions should have same size but different doping concentration
(C) The collector juction is reverse biased and emitter junction is forward biased
(D) Base, emitter and collector regions should have different sizes, but same doping concentration
(E) Both the emitter junction as well as the collector junction are forward biased

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

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

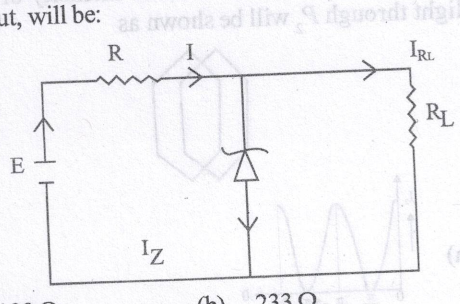
46. The electron and hole concentration in an extrinsic semiconductor in thermal equilibrium is given by:

(a) $n_e \cdot n_h = n_i^2$ (b) $\frac{n_e}{n_n} = n_i^2$

(c) $\frac{n_h}{n_e} = n_i^2$ (d) $n_e \cdot n_h = n_i$

Where n_e = electron density
n_h = hole density
n_i = intrinsic charge density

47. A zener diode having $V_z = 12\ V$ and $Iz_{(max)} = 40$ mA is used in a voltage regular circuit with unregulated power supply giving $E = 19$ V as shown in the circuit diagram shown below. The minimum value of the series resistor R required when the load resistance of 400 Ω is connected across the the zener diode, so that the zener should not burn out, will be:



(a) 100 Ω (b) 233 Ω
(c) 271 Ω (d) 175 Ω

48. Match List-I with List-II

List-I	List-II
(A) Zener diode	(I) Heavily doped operates in forward bias
(B) Photo diode	(II) No external bias required
(C) Solar cell	(III) Heavily doped operates in reverse bias as a voltage regulator
(D) Light emitting diode	(IV) Fabricated with a transparent window to allow light to fall on it

Choose the correct answer from the options given below:

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

49. In satellite communication the preferable range of frequency band for down link is:

(a) 88 – 108 MHz (b) 540 – 1600 KHz
(c) 5.9 – 6.4 GHz (d) 3.7 – 4.2 GHz

50. In the transmission and receiving of amplitude modulation of a signal, following steps are required. Arrange these in correct sequence.

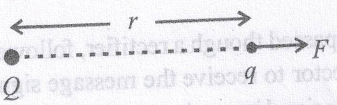
(A) Modulated signal is fed to an antenna after providing necessary power through power amplifier before transmission
(B) The signal is passed though a rectifier, followed by a envelope detector to receive the message signal
(C) The modulating signal is superimposed on high frequency carrier wave
(D) After receiving antenna the received signal is fed to amplifier and then passsed through. If stage where carrier frequency is lowered

Choose the correct answer from the options given below:

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

Hints & Explanations

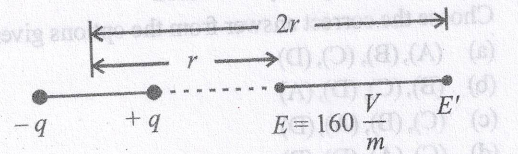
1. **(b)** At 'r' distance from source charge 'Q', if a test charge 'q' experience a force 'F'. Then, electric field at distance 'r' will be given as $\frac{F}{q}$.



i.e., $E = \frac{F}{q}$

So, correct option is (b).

2. **(c)**



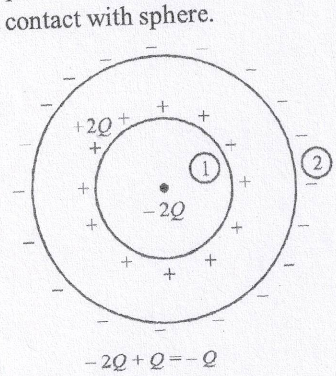
Let electric field at '$2r$' distance be E'.

Then, $E' = k\frac{2P}{(2r)^3}$ and $E = 160 = k\frac{2P}{2r^3}$

So, $\frac{E'}{E} = \frac{r^3}{(2r)^3} = \frac{1}{8}$

$\Rightarrow E' = \frac{E}{8} = \frac{160}{8} = 20$ V/m

3. **(a)** If we place $-2Q$ charge at centre of sphere without making a contact with sphere.



$-2Q + Q = -Q$

Then, charge on surface 1
= charge induced by $-2Q$ charge $= +2Q$
So, charge on surface 2
= charge induced by
$+2Q$ charge present on surface 1 $+ Q$

$= -2Q + Q = -Q$

4. **(a)** Equatorial plane of dipole is an equipotential surface.
So, potential at C = Potential at D
i.e., $V_C = V_D$

5. **(a)** Let V be the common potential. Then,
We have,
$q_i = q_f \Rightarrow 300 \times 10^{-6} \times 90 = (300 \times 10^{-6} + 600 \times 10^{-6})\, V$
$\Rightarrow 300 \times 10^{-6} \times 90 = 300 \times 10^{-6} (1+2)\, V$
$\Rightarrow 90 = 3\, V \Rightarrow V = 30$ volt

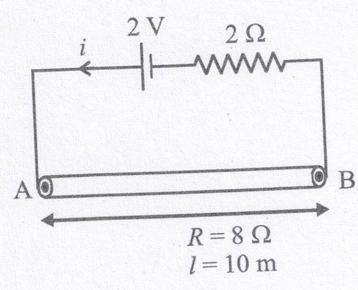
6. **(a)** For conductor having radius 'R', potential is given as

$$V(r) = \frac{KQ}{R}, r < R$$

$$V(r) = \frac{KQ}{R}, r = R$$

So, electric potential inside solid conducting sphere is constant and is equal to value on its surface. Hence, statement I is correct.
Electrostatic force is conservative in nature. It does not depend on the path followed. So, statement II is also correct.

7. **(d)** We will use the figure below as the circuit to find potential gradient.



Potential gradient $= \frac{V_{AB}}{l}$

For the fig,

$i = \frac{2}{2+8} = \frac{2}{10} = 0.2$ A

So, $V_{AB} = 2 - 2 \times i$
$= 2 - 2 \times 0.2 = 1.6$ Volt

So, potential gradient

$= \frac{V_{AB}}{l} = \frac{1.6}{10} = 0.16$ V/m

8. (a) If P is the balancing point, then

$E = V_{AP}$

[$\because V_{AP} = E + ir$ and '$i = 0$' at balancing condition]

$= \frac{V_{AB}}{l} \times AP = 0.16 \times 22.5$

$= 3600 \times 10^{-4}$ Volt $= 0.36$ Volt

9. (b) On increasing 'R', V_{AB} decreases. As V_{AB} decreases, potential gradient decreases. And, as potential gradient decrease, AP (Balancing length) increases.

i.e., E = Potential gradient $\times AP$

$\Rightarrow$ Potential gradient $\propto \frac{1}{AP}$

$\Rightarrow$ Potential gradient $\downarrow\downarrow \Rightarrow AP \uparrow\uparrow$

10. (b) Balancing length, $AP = E \times \frac{l}{V_{AB}}$, is independent of resistance X. So, balancing length remain same.

11. (b) Terminal voltage across 'E' $= E - ir$

$= E - \frac{E}{S + r} r$

So, if S $\uparrow\uparrow \Rightarrow$ Terminal voltage $\uparrow\uparrow$

$\Rightarrow$ Balancing length $\uparrow\uparrow$

12. (a) When charge particle moves in a helical path, it has non-zero component of velocity along the direction of field which helps the charge particle in moving forward direction along the field and it has also velocity perpendicular to direction of field which helps it in moving circular path.

13. (b) As magnets are not monopoles, they are always dipoles.

So, net magnetic flux through any closed surface around magnetic pole is zero.

14. **(None)** We know that

$B_H = B \cos \delta$,

$B = \frac{B_H}{\cos \delta} \Rightarrow B = \frac{32}{\cos 60°} = 64\,G$

where B_H = Horizontal component of magnetic field

δ = Angle of dip

B = Net magnetic field

15. (a) Statement (A), (B) and (E) are basic properties of ferromagnetic substance. So, (A), (B) and (E) are correct for ferromagnetic substance.

$M \propto \frac{1}{T}$ is true for paramagnetic substance only, so (c) is incorrect.

As homogeneous ferromagnetism destroy super-conductivity. So, (d) is wrong.

16. (d) Force on rod $= I(\vec{\ell} \times \vec{B})$

So, by right hand thumb rule, the rod will experience force in direction from Y to X. So rod will move along the rail from in the direction from Y to X.

17. (c) We know that

$F = ILB$

$\Rightarrow$ unit of B = unit of $\frac{F}{IL} = \frac{N}{Am}$

As, $\phi = BA \cos \theta$

$\Rightarrow$ unit of ϕ = unit of $(BA \cos \theta)$

$= \frac{N}{Am} \cdot m^2 = \frac{Nm}{A}$

and, $dB = \frac{\mu_0}{4\pi} \frac{id\ell \sin \theta}{r^2}$

$\Rightarrow$ unit of μ_0 = unit of $\left(\frac{dB \times 4\pi r^2}{id\ell \sin \theta}\right)$

$= \frac{\frac{N}{AM} \times m^2}{Am} = NA^{-2}$

Magnetic moment $= IA$

Unit of magnetic moment = unit of $IA = Am^2$

18. (d) We have

$e_{induced} = NBA\,\omega \cos \omega t$

$(e_{induced})_{max} = NBA\omega$

$= 200 \times 0.4 \times 10^{-4} \times 0.2 \times 2\pi \times 7$

$= 7.04 \times 10^{-2}$ V

19. (c) We have, $\omega_r = \frac{1}{\sqrt{LC}}$

As value of L and C remains same so ω_r will not change. So, (a) is incorrect.

At resonance, $i_0 = \frac{V_0}{R}$. As 'R' got increased so 'i_0' got decreased. So, (b) is incorrect.

As $Q = \frac{1}{R}\sqrt{\frac{L}{C}} \Rightarrow Q \propto \frac{1}{R}$.

Here $R \uparrow\uparrow \Rightarrow Q \downarrow\downarrow$

So, (c) is correct.

B.W. $= \frac{R}{2L}$. Here $R \uparrow\uparrow \Rightarrow$ B.W. $\uparrow\uparrow$

So, (d) is incorrect.

20. **(b)** We have, $P_{avg} = V_{rms} I_{rms} \cos\phi$

at Resonance, $\cos\phi = 1$

So, P_{avg} is maximum at resonance and is equal to $V_{rms} I_{rms}$

Thus, statement (I) is incorrect.

In LCR circuit, power is dissipated only across the resistor.

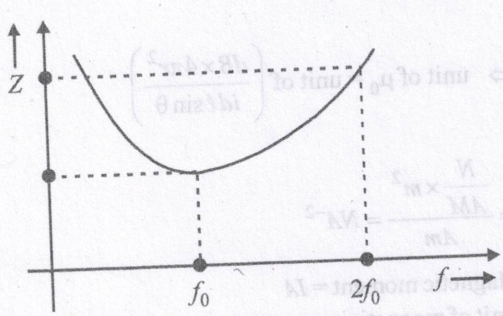
So, statement (II) is incorrect.

21. **(d)** Resonant frequency is given as

$$\omega_r = \frac{1}{\sqrt{LC}} = \frac{1}{\sqrt{4\times100\times10^{-6}}}$$

$$= \frac{1}{2\times10^{-2}} = 50 \text{ rad/sec}$$

22. **(a)** The Z-f curve for alternating current is



So, increasing frequency of AC source, increases impedance as shown in fig. above.

So, (a) is correct.

As $i_{rms} = \frac{V_{rms}}{Z}$. Here Z $\uparrow\uparrow \Rightarrow i_{rms} \downarrow\downarrow$

So, (c) is incorrect.

Potential difference across resistance would decrease as i_{rms} is decreased.

So, (b) is incorrect.

When $f_0 \to 2f_0$, we don't have series resonance condition.

So, $V_C + V_L \neq 0$

So, (d) is incorrect.

23. **(b)** At resonance,

$$Z = Z_{min} = R = 350\,\Omega$$

and, $I = I_{max} = \frac{V}{Z_{min}} = \frac{210}{350} = \frac{3}{5} = 0.6\text{ A}$

24. **(c)** Klystron or Magnetrons or Gunn diodes, all of them produce microwaves.

25. **(d)** $E = E_0 \sin(kz - \omega t)$ is a general equation of EM wave. So, (a) is correct.

$$E = E_0 \sin\left[2\pi\left(\frac{z}{\lambda} - \frac{t}{T}\right)\right]$$

$$\Rightarrow E = E_0 \sin\left[\left(\frac{2\pi}{\lambda}\right)z - \left(\frac{2\pi}{T}\right)t\right]$$

$\Rightarrow E = E_0 \sin[kz - \omega t]$, which is again a general equation of EM wave. So (b) is correct.

$$E = E_0 \sin\left[\frac{2\pi}{\lambda}(z - vt)\right]$$

$$\Rightarrow E = E_0 \sin\left[\frac{2\pi}{\lambda}z - \frac{2\pi}{\frac{\lambda}{V}}t\right]$$

$$\Rightarrow E = E_0 \sin\left[kz - \frac{2\pi}{T}t\right]$$

$\Rightarrow E = E_0 \sin[kz - \omega t]$, which is also a general equation of EM wave. So, (c) is correct.

In $E = E_0 \sin\left[\frac{2\pi}{T}(vz - t)\right]$,

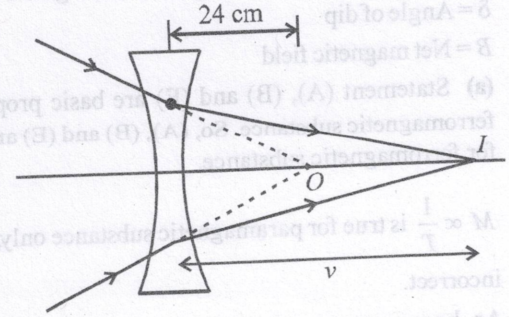
$\left(\frac{2\pi}{T}vz\right)$ is not dimensionless.

So, (d) is incorrect.

26. **(c)** Here, object is virtual and $u = 24$ cm and $f = -32$ cm

So, $\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$

$$\frac{1}{v} = \frac{1}{u} + \frac{1}{f} = \frac{1}{24} + \frac{1}{-32}$$



$$=\frac{1}{24}-\frac{1}{32}=\frac{4-3}{96}=+\frac{1}{96}$$

So, $v=+96$ cm from the lens.

27. **(a)** By lens maker formulae,

$$\frac{1}{f}=(\mu-1)\left(\frac{1}{R_1}-\frac{1}{R_2}\right)$$

$$\frac{1}{10}=(1.5-1)\left(\frac{1}{R}-\frac{1}{-R}\right) \quad [\because f=10 \text{ cm } \& \ \mu=1.5]$$

$$\frac{1}{10}=0.5\times\frac{2}{R}$$

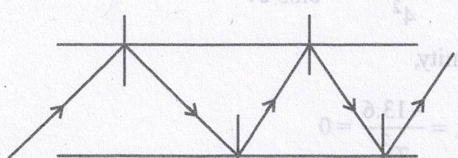
$R=10\times0.5\times2=10$ cm

28. **(a)** The magnification due to compound microscope is given by

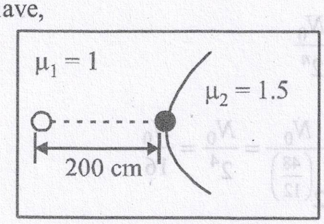
$$\text{M.P.}=\frac{L}{f_0}\cdot\frac{D}{f_e}$$

$$\Rightarrow \text{M.P.}=\frac{-22}{1}\times\frac{25}{2.2}=-250$$

29. **(d)** Optical fibre work on total internal reflection of light.



30. **(c)** We have,



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

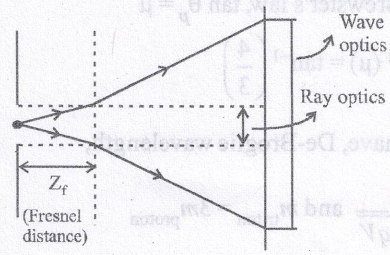
$$\Rightarrow \frac{1.5}{v}-\frac{1}{-200}=\frac{1.5-1}{40}$$

$$\Rightarrow \frac{1.5}{v}=\frac{-1}{200}+\frac{1}{80}$$

$$\Rightarrow \frac{1.5}{v}=\frac{-2+5}{400}$$

$$\Rightarrow v=\frac{600}{3}=200 \text{ cm}$$

31. **(d)** Fresnel distance is the distance between the screen and the slit at which the dispersion of light due to diffraction from the centre of the screen is exactly equal to the size of the slit or fresnel distance is defined as the minimum distance travel by a ray of light along a linear path before diffraction.



Fresnel distance is given as

$$Z_f=\frac{a^2}{\lambda}, \quad a=\text{aperture width}$$

$$=\frac{(2\times10^{-3})^2}{400\times10^{-9}}=10\text{m}$$

32. **(c)** We have, $Y_n=\frac{n\lambda D}{d}$, where Y_n = distance of n^{th} bright fringe from central maxima

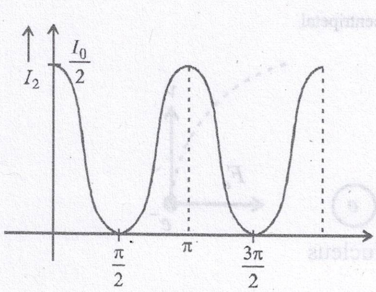
So, $d_1=\frac{3\lambda_1 D}{d}$ and $d_2=\frac{3\lambda_2 D}{d}$

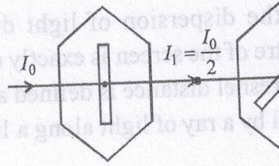
which gives, $\frac{d_1}{d_2}=\frac{\lambda_1}{\lambda_2}$

33. **(a)** Intensity of polarized light is given by

$$I=\frac{I_0}{2}\cos^2\theta$$

So, $I-\theta$ curve will look like





34. **(c)** By Brewster's law, $\tan\theta_p = \mu$

$$\theta_p = \tan^{-1}(\mu) = \tan^{-1}\left(\frac{4}{3}\right)$$

35. **(d)** We have, De-Broglie wavelength,

$$\lambda = \frac{h}{\sqrt{2mqV}} \text{ and } m_{\text{triton}} = 3m_{\text{proton}}$$

$$\Rightarrow \lambda \propto \frac{1}{\sqrt{m}} \Rightarrow \frac{\lambda_P}{\lambda_T} = \frac{\sqrt{m_T}}{\sqrt{m_P}} = \sqrt{\frac{3}{1}} = \sqrt{3}:1$$

36. **(b)** By Einstein photoelectric equation,

$$h\upsilon = h\upsilon_0 + eV_s$$

$$\Rightarrow \upsilon = \upsilon_0 + \left(\frac{e}{h}\right)V_s \Rightarrow V_s = \left(\frac{h}{e}\right)\upsilon - \left(\frac{h}{e}\right)\upsilon_0$$

So, slope $= \frac{h}{e}$. As $\frac{h}{e}$ = constant, therefore slope of all metals will be same.

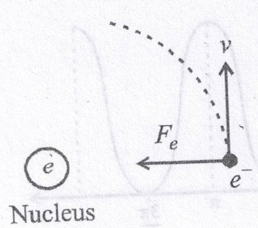
Also, $(\upsilon_0)_B > (\upsilon_0)_A$

$$\Rightarrow (h\upsilon_0)_B > (h\upsilon_0)_A \Rightarrow \phi_B > \phi_A$$

37. **(d)** For photoelectric emission, energy of incident light should be greater than work function.
i.e., $h\upsilon > h\upsilon_0$
i.e., $\upsilon > \upsilon_0$
So, photoelectric emission occurs only when the incident light has frequency more that threshold frequency.

38. **(c)** In hydrogen atom

$$F_{\text{electrostatic}} = F_{\text{centripetal}}$$



$$\Rightarrow \frac{1}{4\pi\varepsilon_0}\frac{e^2}{r^2} = \frac{mv^2}{r}$$

$$\Rightarrow r = \frac{1}{4\pi\varepsilon_0}\frac{e^2}{mv^2}$$

39. **(c)** When an electron jumps to 2nd energy state from any higher energy states. The spectral line corresponds to Balmer series.

40. **(a)** In hydrogen atom,
For ground state,

$$E_1 = \frac{-13.6}{1^2} = -13.6\text{ eV}$$

For Ist excited state,

$$E_2 = \frac{-13.6}{2^2} = -3.4\text{ eV}$$

For IInd excited state,

$$E_3 = \frac{-13.6}{3^2} = -1.51\text{ eV}$$

For IIIrd excited state,

$$E_4 = \frac{-13.6}{4^2} = -0.85\text{ eV}$$

For infinity,

$$E_\infty = \frac{-13.6}{\infty^2} = 0$$

41. **(c)** We have,

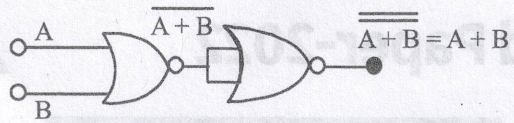
$$N = \frac{N_0}{2^n}$$

$$\Rightarrow N = \frac{N_0}{2^{\left(\frac{48}{12}\right)}} = \frac{N_0}{2^4} = \frac{N_0}{16}$$

42. **(b)** We have, $R = R_0 A^{1/3} \Rightarrow R \propto A^{1/3}$ and, density of nucleus is constant if we ignore isotopic effect.

43. **(b)** For medium and large size nuclei, the distance between nucleons will increase which lead to decrease in nuclear force. As nuclear force will decrease by same amount in nuclei between $A = 30$ and $A = 170$ because of short range of nuclear force. So, binding energy is constant for $30 < A < 170$.

44. (a)



Hence, the logic circuit realizes 'OR' gate.

45. (a) Transistor operate in proper way, when

(a) The emitter should be forward biased and collector should be reverse biased.

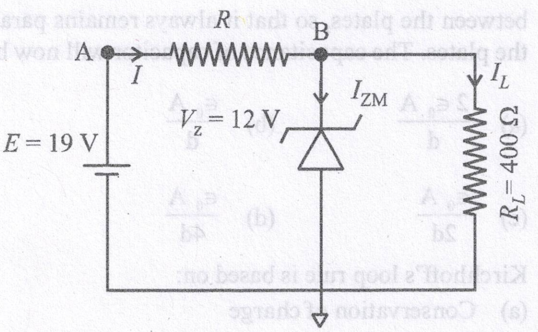
(b) Base in thin and lightly doped.

(c) Emitter size is moderate (larger than base) but slightly smaller than collector (due to heat dissipation from collector region)

46. (a) In thermal equilibrium, the electron-hole concentration is given by

$$n_e n_h = n_i^2$$

47. (a)



Zener diode will burn, when $I_z = I_{zm} = 40$ mA

and, $I_L = \frac{12}{400}$ A $= 30$ mA

Now, $I = I_L + I_{ZM} = (30 + 40)$ mA $= 70$ mA

So, $R = \frac{V_A - V_B}{I} = \frac{19 - 12}{70 \times 10^{-3}} = \frac{7}{7 \times 10^{-2}} = 100\Omega$

48. (d) Zener diode → Heavily doped *p-n* junction and operate in reverse bias.

Photo diode → Fabricated with a transparent window to allow light to fall on it

Solar cell → No external bias required

LED → Heavily doped and operate in forward bias

49. (d) In satellite communication, preferable frequency band as

(5.9 – 6.4) GHz for uplink

and, (3.7 – 4.2) GHz for downlink

50. (d) The correct sequence is

(C) → (A) → (D) → (B)