CUET Physics Solved Paper-2023

Held on 22 May 2023 (Shift-I)

1. Krichhoff's First Law, $\Sigma I = 0$ at a junction deals with conservation of :
   (a) Charge (b) Energy
   (c) Momentum (d) Angular Momentum

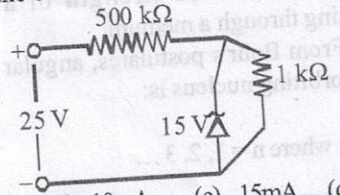
2. Match **List - I** with **List-II.**

List-I	List-II
(A) Microwave	(I) Radar System for Aircraft Navigation
(B) UV Rays	(II) To study crystal structure
(C) X-Rays	(III) Radioactive decay of Nucleus
(D) Gamma-Rays	(IV) Lasik eye surgery

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

3. What is the approximate earth's dipole moment, if the earth's magnetic field at the Equator is approximately 0.5 G and diameter is 15.0×10^6m ?
   (a) $1.05\times10^8\ Am^2$ (b) $6.5\times10^{30}\ Am^2$
   (c) $2.1\times10^{23}\ Am^2$ (d) $1.05\times10^{23}\ Am^2$

4. A Zener diode is used in a voltage regulator circuit as shown below. Its breakdown voltage is 15V.
   What is the current following through the zener diode?



   (a) 5mA (b) 10mA (c) 15mA (d) 20mA

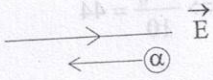
5. Which of the following statement is NOT true, when two capacitors charged to different potential are connected in parallel by a conducting wire ?
   (a) Some energy is lost
   (b) The charge lost by one is equal to the charge gained by the other
   (c) Both the capacitors acquire a common potential
   (d) The potential lost by one is equal to the potential gained by the other

6. The force between two electric charges is expressed by the equation :

$$F = \frac{k\,q_1q_2}{r^2}$$

   Which of the following is a correct statement?
   (a) The equation applies to point charges
   (b) k is Boltzmann's constant
   (c) r is the radius of the spheres on which the two charges are placed
   (d) The equation can only be applied to uniform electric fields

7. In the figure, an α- particle moves a distance l in a uniform electric field $\vec{E}$ as shown. Does the Electric Field do a positive or a negative work on the α -particle ? Does the electric potential energy of the α-particle increase or decrease ?



   (a) Negative, increases (b) Positive, decreases
   (c) Negative, decreases (d) Positive, increases

8. A25μF capacitor, a 0.10 H inductor a 25Ω resistor are connected in series with an ac source of emf $\varepsilon = 310$ sin 314 t. What is the frequency of AC source?
   (a) 314Hz (b) 100Hz
   (c) 50HZ (d) 310Hz

9. A uniformly charged conducting sphere of radius 1.3 m has a surface charge density of $70\mu C\ m^{-2}$. What is the total electric flux leaving the surface of the sphere?
   (a) $5.9\times10^8\ N\,m^2\,C^{-1}$ (b) $1.7\times10^{-8}\ N\,m^2\,C^{-1}$
   (c) $1.7\times10^{-8}\ N\,m^2\,C^{-1}$ (d) $6.4\times10^{-8}\ N\,m^2\,C^{-1}$

10. Match List -I with List - II

List-I	List-II
(A) Range	(I) Range of frequencies over which communication system works
(B) Band width	(II) The largest distance between transmitter and receiver
(C) Attenuation	(III) A device that has input in electrical form or provides output in electrical form
(D) Transducer	(IV) Loss of strength of a signal during propagation

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

11. In an AC genertor when the plane of the armature is perpendicular to the magnetic field, what will the magnitude of the magnetic flux passing through the coil and the emf induced in the coil be ?
(a) Both the magnetic flux and the induced emf are maximum
(b) Both the magnetic flux and the induced emf are zero
(c) The magnetic flux is zero and the induced emf is maximum
(d) The magnetic flux is maximum and the induced emf is zero

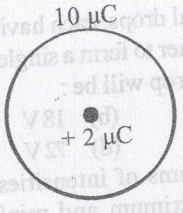
12. The objective of a reflecting telescope is a :
(a) Convex lens (b) Concave mirror
(c) Concave lens (d) Prism

13. Energy of a photon corresponding to a wavelength of 600 nm is 2.08 eV. The energy of a photon of wavelength 400 nm will be :
(a) 1.39 eV (b) 3.12 eV
(c) 4.68 eV (d) 0.92 eV

14. Two coils of self inductances L_1 and L_2 are kept close to each other so that the effective flux in one is completely linked with the other. What is the mutual inductance M between them?
(a) L_1L_2 (b) $L_1L_2^{-1}$
(c) $(L_1L_2)^2$ (d) $(L_1L_2)^{1/2}$

15. Which of the following spectral series is found in the visible region of the hydrogen spectrum?
(a) Lyman (b) Balmer
(c) Paschen (d) Pfund

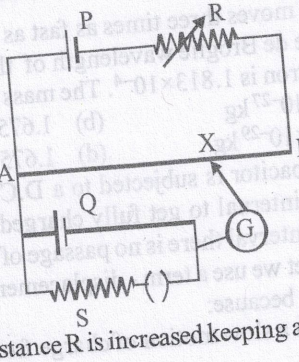
16. A thin metallic spherical shell contains a charge + 10 μC on it. A point charge +2 μC is placed at the centre of the shell and an other charge +5 μC is placed outside it as shown. The force on the charge +2 μC at the centre is :



(a) Towards the left (b) Towards the Right
(c) Upwards (d) zero

17. Under the influence of a uniform magnetic field, a charged particle moves with a constant speed v in a circle of radius r. The time period of the revolution of the particle :
(a) depends on v and not on r
(b) is independent of both v and r
(c) depends on r and not on v
(d) depends on both v and r

18. In the potentiometer circuit the balance point is at x. The balance point will be shifted right towards B when :



(A) Resistance R is increased keeping all other parameters constant
(B) Resistance S is increased keeping all other parameters constant
(C) Cell P is replaced by another cell whose emf is lower than Q
(D) The polarity of Q is reversed
Choose the **correct** answer from the options given below:
(a) (A) only (b) (B) and (D) only
(c) (A), (B) only (d) (B) and (C) only

19. A square shaped wire loop of side L is carrying a current I. What is the magnetic field at the point of intersection of diagonals of the square wire loop ?
(a) $\frac{\mu_0 I}{\pi L\sqrt{2}}$ (b) $\frac{2\sqrt{2}\mu_0 I}{\pi L}$
(c) $\frac{\sqrt{2\mu_0 I}}{\pi L}$ (d) $\frac{\sqrt{2\mu_0 I}}{\pi L}$

20. Match **List-I** with **List-II.**

List-I	List-II
(a) Minimum magnetic moment associated with orbital motion of electron is 1st orbit is	(I) greater than one
(b) Paramagnetic materials have relative permeability	(II) Meissner's effect
(c) Magnetic moment per unit volume of the material is called	(III) Bohr Magneton
(d) Perfect diamagnetism of superconductors	(IV) Intensity of Magnetisation

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

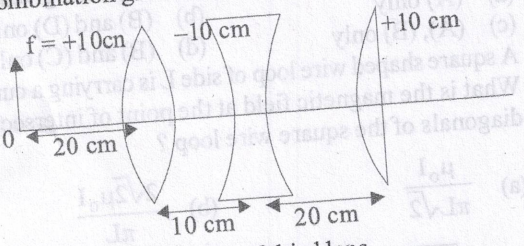
21. During the p-n junction formation, when an electron diffuses from n → p, it leaves behind an :
(a) ionised acceptor on n-side
(b) ionised donor on n-side
(c) ionised donor on p-side
(d) ionised donor on n-side and p-side both

22. In Bohr's atomic model , the radius of the first orbit is r_o. The radius of the third orbit will be:
(a) $3r_o$ (b) $9r_o$
(c) r_o (d) $r_o/3$

23. A particle moves three times as fast as an electron . The ratio of the de Broglie wavelength of the particle to that of the electron is 1.813×10^{-4}. The mass of the particle is.
(a) 1.67×10^{-27} kg (b) 1.675×10^{-31} kg
(c) 1.675×10^{-29} kg (d) 1.675×10^{-30} kg

24. When a capacitor is subjected to a D.C. source it takes small time internal to get fully charged up.During this small time interval there is no passage of charge through dielectric, yet we use a term - displacement current . This term is used because:
(a) There is a slow motion of charge from one plate to another
(b) There is a continues change of electric field between plates and hence electric flux
(c) The electric charge from battery stops moving
(d) There is temporary breakdown of dielectric

25. What would be the position of image formed by the lens combination given in the figure below?



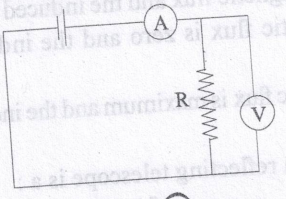
(a) 10 cm to the right of third lens
(b) 7 cm to the right of third lens
(c) 7cm to the left of third lens
(d) at ∞ to right of third lens

26. A ray of light passes through an equilateral glass prism in such a manner that the angle of incidence is equal to the angle of emergence and each of these angles is equal to $\left(\frac{3}{4}\right)^{th}$ of the angles of prism.
The angle of deviation is :
(a) 45° (b) 70°
(c) 39° (d) 30°

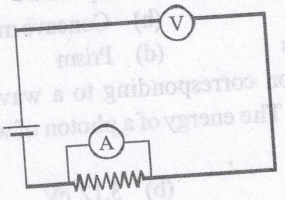
27. Electrostatics deals with the study of forces, fields and potential arising from static carges. Which of the following statements are correct?
(A) Electrostatic force is a conservative force
(B) Charge is quantized because only integral number of electrons can be transferred from one body to the other.
(C) In a uniform electric field E, an electric dipole experiences a torque τ and a net force F.
(D) The electric field lines start from positive charges and end at negative charges . If there is a single charge, these may start or end at infintity.
(E) If the uniform surface charfe density of an infinite plane sheet is positive, the electirc field is directed away from the palte.
Choose the **correct** answer from the options given below:
(a) (B), (C), and (E) only
(b) (A), (C), and (D) only
(c) (A), (B), (D) and (E) only
(d) (A), (B), and (C) only

28. A magnet suspended freely at he Equator will set itself ____ to the surface of Earth, while one suspended at pole will stand ____.
(a) vertical, parallel (b) parallel , parallel
(c) parallel , vertical (d) vertical , vertical

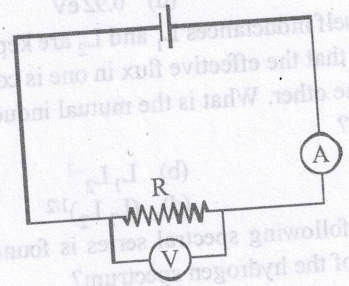
29. Which of the following circuits can not be used to measure the resistance of resistor R?
(a)



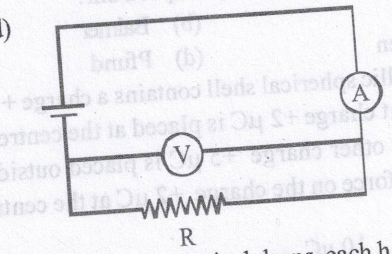
(b)



(c)



(d)



30. Eight identical spherical drops, each having a potential of 9 V are combined together to form a single large drop. The potential of this large drop will be :
(a) 4.5 V (b) 18 V
(c) 36 V (d) 72 V

31. Two coherent light beams of intensities I and 4 I are superimposed. The maximum and minimum possible intensities in the resulting pattern are :
(a) 5 I and 3 I (b) 5 I and I
(c) 9 I and I (d) 9 I and 3 I

32. The same current is flowing in two AC circuits. The first circuit contains a pure inductor and the second, a capacitor. If the frequency of the AC is increased, then the current will.
(a) increase in the first but decrease in the second
(b) increase in both
(c) decrease in both
(d) decrease in the first and increase in the second

33. The magnitude of a magnetic force on a current carrying conductor is given by :

(a) $q\frac{dV}{dx}$ (b) $qvB\sin\theta$

(c) $ilB\sin\theta$ (d) $q(E+VB\sin\theta)$

34. A transformer has an efficiency of 80%. It works at 3 kW and 120 V . If the secondary voltage is 240 V, what will be the secondary current ?

(a) 2.5 A (b) 12.5 A

(c) 25 A (d) 10 A

35. The half life if a radioactive substance is 10 days. How many days will it take to disintegrate3/4 of its initial value?

(a) 5 days (b) 10 days

(c) 20 days (d) 15 days

36. Which of the following is an example of nuclear fusion ?

(a) Formation of $^{144}_{56}Ba$ and $^{89}_{36}Kr$ from $^{235}_{92}U$

(b) Formation of $^{235}_{94}Pu$ from $^{235}_{92}U$

(c) Formation of $^{4}_{2}He$ from $^{2}_{1}H$

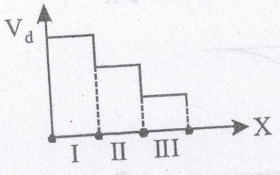
(d) Formation of water from hydrogen and oxygen

37. A boat is moving due east in a region where the Earth's magnetic field is 5.0×10^{-5} $NA^{-1}m^{-1}$ due north and horizontal. The boat carries a vertical aerial 2m long. If the speed of the boats is 1.5 ms^{-1}, the magnitude of the induced emf is:

(a) 0.50 mV (b) 0.15 mV

(c) 1.00 mV (d) 0.75 mV

38. Figure shows drift speed V_d of conduction electrons in a copper wire versus position (X) for the three sections, Then,



(A) Radius of III > Radius of II > Radius of I

(B) Electric Field in III > Electric Field in II> Electric Field in I

(C) Radius of wire is same in all sections

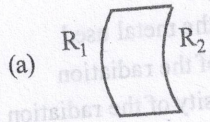
(D) Conductivity is same in all sections

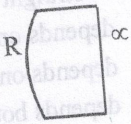
Choose the **correct** answer from the options given below:

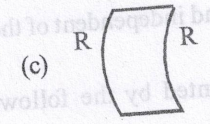
(a) (D)only (b) (B) and (D) only

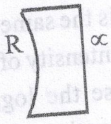
(c) (A) and (D) only (d) (B) and (C) only

39. Which of the following spherical lenses does not exhibit dispersion ? The radii of curvature of the surfaces of the lenses are given in diagrams.

(a) 

(b) 

(c) 

(d) 

40. If the 8^{th} bright band of wavelength λ_1 coincides with 9^{th} bright band of wavelength λ_2 in a Young's double slits experiment then the possible wavelength of two lights are:

(a) λ_1 =450 nm, λ_2= 400nm

(b) λ_1 =400 nm, λ_2= 450nm

(c) λ_1 =425 nm, λ_2= 450nm

(d) λ_1 =400 nm, λ_2= 425nm

41. Which of the following change is observed when light travels from air to glass ?

(a) speed of light only

(b) frequency of light only

(c) wavelength of light only

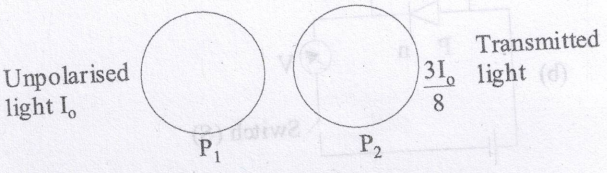
(d) wavelength and speed of light only

42. The temp at which the resistance of a conductor becomes 30% more than that of its resistence at 47°C will be : (given the value of temperature coefficient of ressistance of the conductor is $2\times10^{-4}K^{-1}$.)

(a) 1847 K (b) 1820 K

(c) 1547 K (d) 1500 K

43. P_1 and P_2 are two polaroids



The intensity of the unpolarised is I_o and intensity of the transmitted height is $\frac{3I_o}{8}$. The angle between axis of P_1 and P_2 is:

(a) 30° (b) 90°

(c) 45° (d) 60°

44. According to Einstein's photoelectric equation, the plot of the Kinetic Energy of the emitted photoelectrons from a metal versus the frequency of the incident radiation gives a straight line whose slope:

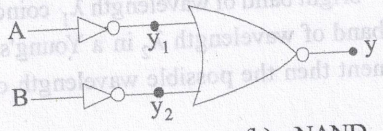
(a) depends on the nature of the metal used

(b) depends on the intensity of the radiation

(c) depends both on the intensity of the radiation and the metal used

(d) is the same for all metals and independent of the intensity of the radiation

45. Choose the logic gate represented by the following combination of logic gates.



(a) NOR (b) NAND

(c) AND (d) OR

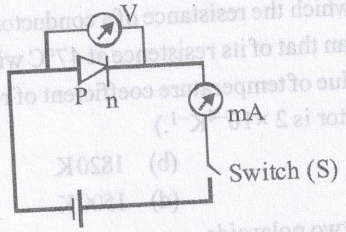
46. If a match box of size 5 cm × 4 cm × 1 cm is filled with nuclear matter, what will be its expected mass? The density of the nuclear matter is approximately 2.3×10^{17} kg m^{-3}.

(a) 4.6×10^{12} mg (b) 4.6×10^{12} µg

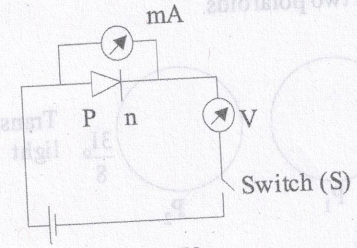
(c) 4.6×10^{12} g (d) 4.6×10^{12} kg

47. Choose the correct experimental circuit arrangement for studying V-I characteristics a p-n junction diode in forward bias:

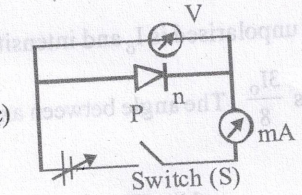
(a)



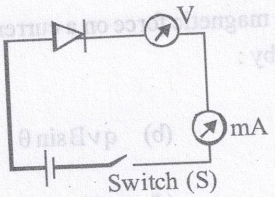
(b)



(c)



(d)



48. A carrier wave of peak voltage 14 V is used to transmit a message. What should be the peak voltage of the modulating signal in order to have a modulation index of 70%?

(a) 20.0 V (b) 2.0 V

(c) 9.8 V (d) 4.2 V

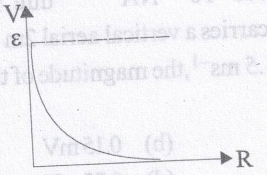
49. A plane electromagnetic wave of frequency 50 MHz travels in free space along the x- direction. At a particular point in space and time $\vec{E} = 9.3\ \hat{j}$ V m^{-1}. What is $\vec{B}$ at this point?

(a) $(3.1\times10^{-8}\ \hat{k})$T (b) $(3.1\times10^{-8}\ \hat{i})$T

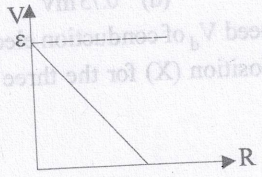
(c) $(3.1\times10^{-8}\ \hat{k})$T (d) $(3.1\times10^{-8}\ \hat{j})$T

50. Cell having an emf E and internal resistance r is connected across a variable external resistance R. As the resistance R is increased, the plot of potential difference V across R is given by:

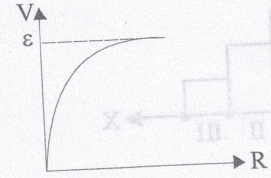
(a)



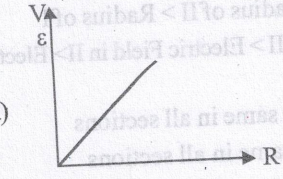
(b)



(c)



(d)



Hints & Explanations

1. **(a)** Kirchhoff's first law, $\Sigma I = 0$ based on conservation of charge.

2. **(a)** Microwave used in radar system for aircraft navigation.
UV-rays used for lasik eye surgery.
X-ray used for determine the crystal structure.
In radioactive decay of nucleus gamma-rays are released.

3. **(c)** The magnetic field is given by

$$B = \frac{\mu_0}{4\pi}\frac{m}{r^3}$$

$$\text{Dipole moment, } m = \frac{4\pi r^3 B}{\mu_0}$$

$$= \frac{4\pi \times (7.5\times10^{6})^3 \times 0.5\times10^{-4}}{4\pi\times10^{-7}}$$

$$= 210.3\times10^{21} = 2.1\times10^{23}\ \text{Am}^2$$

4. **(a)** The voltage drop in a parallel connection is always the same.

$$i_1 = \frac{25\ \text{V}}{1\ \text{k}\Omega} = 25\ \text{mA} = 0.025\ \text{A}$$

$$i_2 = \frac{(25-15)\ \text{V}}{500\ \Omega} = \frac{10}{500} = 0.02\ \text{A}$$

The circuit flowing through the zener diode is

$$i_z = i_1 - i_2 = 0.025 - 0.02 = 0.005 = 5\ \text{mA}$$

5. **(d)** Charge flows from a capacitor at higher potential to the capacitor at lower potential.
The equal potential of both the capacitor is known as common potential.
Total charge on both the capacitor before sharing
$q = C_1V_1 + C_2V_2$
Total charge on both the capacitor after sharing
$q = C_1V_1 + C_2V_2 = (C_1 + C_2)V$
So, charge is conserved

$$C_1V_1 + C_2V_2 = (C_1 + C_2)V$$

$$\Rightarrow V = \frac{C_1V_1 + C_2V_2}{C_1 + C_2}$$

6. **(a)** The force between two electric charged is expressed as

$$F = \frac{kq_1q_2}{r^2}$$

Here r is the distance between two point charges.

$$\text{Here } k = \frac{1}{4\pi\varepsilon_0}$$

It is equation applies to point charges.

7. **(a)** Force acting on alpha particle due to electric field
$F = qE$ (Rightward direction)
But the displacement is in leftward direction
Work, $W = Fd\cos\theta$
Here, $\theta = 180 = Fd\cos180 = -Fd$
$\Rightarrow W < 0$
Since, the potential decreases in the direction of electric field.

$$E = -\frac{dV}{dr}$$

$\therefore$ Potential will increase in opposite direction of electric field.
We have,
$U = qV$
Since, V is increase then U will be increase.
$\Delta U > 0$

8. **(c)** $\varepsilon = 310\sin 314t$
Compare with
$\varepsilon = V_0\sin\omega t$
$\omega = 314$
$2\pi f = 314$

$$f = \frac{314}{2\times3.14} = 50\ \text{Hz}$$

9. **(c)** Total electric flux leaving the surface is given by

$$\phi = \frac{q}{\epsilon_0} = \frac{\sigma\times4\pi r^2}{\epsilon_0} = \frac{70\times10^{-6}\times4\times3.14\times(1.3)^2}{8.86\times10^{-12}}$$

$$= 1.7\times10^{8}\ \text{Nm}^2\text{C}^{-1}$$

10. **(b)** (A) Range : The largest distance between transmitter and receiver.
(B) Bandwidth : Range of frequencies over which communication system works.
(C) Attenuation : Loss of strength in a signal during propagation.
(D) Transducer : A device that has an input in electrical form or provide output in electrical form.

11. **(b)** Magnetic flux is given by
$\phi = NBA\cos90° = 0$
Induced emf, $\varepsilon = BA\cos\theta$
$= BA\cos90$
$= 0$
Hence, both the magnetic flux and the induced emf are zero.

12. **(b)** In a reflecting telescope, only a concave mirror is used instead of the objective lens because it helps to gather large amount of light coming from the object.

13. **(b)** $E_1 = 2.08$ eV and $\lambda_1 = 600$ nm
$\lambda_2 = 400$ nm

$\because E = \frac{hc}{\lambda}$

$\frac{E_2}{E_1} = \frac{\lambda_1}{\lambda_2} = \frac{600}{400}$

$\Rightarrow E_2 = \frac{3}{2} \times 2.08 = 3.12\ eV$

14. (d) Magnetic flux, $\phi = MI$

Induced emf, $\varepsilon = -\frac{d\phi}{dt} = -M\frac{dI}{dt}$

$\Rightarrow M = \frac{-\varepsilon}{\frac{dI}{dt}}$ ...(1)

$\varepsilon_1 = -L_1\frac{dI_1}{dt}$ and $\varepsilon_2 = -L_2\frac{dI_2}{dt}$

Putting this value in equation (1)

$M = \frac{\varepsilon_1}{\varepsilon_1 / L_1}$ and $M = \frac{\varepsilon_2}{\varepsilon_2 / L_2}$

$\because M^2 = L_1L_2 \Rightarrow M = \sqrt{L_1L_2}$

15. (b) All of the wavelengths (400 nm to 740 nm) in the Balmer series are in visible region of the electromagnetic spectrum.

16. (d) The force on the charge + 2μc at the center is zero due to electrostatic shielding. The metallic spherical shell acts as a sheild and do not allow the electric field due to outside charges to penetrate through it.

17. (b) Time period is given by $T = \frac{2\pi r}{v}$

Under the uniform magnetic field, a charged particle moves

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

$\Rightarrow r = \frac{mv}{qB}$

$\Rightarrow T = \frac{2\pi}{v} \times \frac{mv}{qB} = \frac{2\pi B}{qB}$

So, the time period of the revolution of the particle is independent of both r and v.

18. (c) (i) $R_{AB} \propto R$

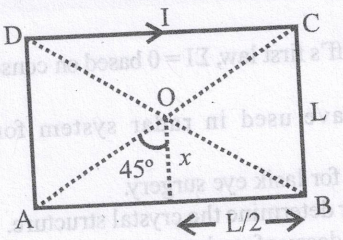
If resistance R is increased and all the other parameters are unchanged. So, the resistance of the wire AB increases. Hence the current flow in the wire will decrease and the potential drop per unit lenght of the wire also decrease. So a greater length of wire is required to find a null point. Thus, the null point will shift towards the point B.

(ii) As, $S \propto \frac{1}{R_{AB}}$

In this case S is increased keeping R constant. When the resistance S is increased the resistance of wire AB will decrease so as a result the terminal potential difference of the cell will decrease.

Hence, the balance point will be shorter distance and it will shift towards the point A.

19. (b)



Magnetic field at point O due to wire AB is B_o

$= \frac{\mu_0 I}{4\pi x}(\sin 45 + \sin 45)\left(\because x = \frac{L}{2}\right) = \frac{\mu_0 I}{4\pi \times \frac{L}{2}}\left[\frac{1}{\sqrt{2}} + \frac{1}{\sqrt{2}}\right]$

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

The net magnetic field at the point of intersection of diagonals of the square wire loop is $B = 4B_o = 4 \times \frac{\mu_0 I}{\sqrt{2}\pi L}$

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

20. (d)

21. (b) When an electron diffuses from the n to p, an ionised doner is left behind on the n-side, which is immobile. As, the process goes on a layer of positive charge is developed on the n-side of the junction.

22. (b) The radius of the first orbit is r_0.

$r_{n=3} = n^2 r_0$

$= 3^2 r_0 = 9r_0$

23. (a) Given, $v_p = 3v_e$

$\lambda = \frac{h}{p} = \frac{h}{mv}$

$\frac{\lambda_p}{\lambda_e} = \frac{h}{m_p v_p} \times \frac{m_e v_e}{h}$

$1.813 \times 10^{-4} = \frac{m_e v_e}{m_p \times 3v_e}$

$m_p = \frac{9.1 \times 10^{-31}}{1.813 \times 10^{-4} \times 3} = 1.67 \times 10^{-27}\ kg$

24. (b) Displacement current is the current in the insulated region due to changing the electric flux.

$i_d = \frac{dQ}{dt} = \epsilon_0 \frac{d\phi_E}{dt}$ $\left(\because Q = \epsilon_0 \phi_E\right)$

$i_d = \epsilon_0 A\frac{dE}{dt}$ $\because \phi_E = E.A$

25. (a) For first lens

$u_1 = -20\text{ cm}\ f_1 = 10\text{ cm}$

$$\frac{1}{f_1} = \frac{1}{v_1} - \frac{1}{u_1}$$

$$\frac{1}{v_1} = \frac{1}{f_1} + \frac{1}{u_1}$$

$$= \frac{1}{10} - \frac{1}{20}$$

$$= \frac{2-1}{20}$$

$v_1 = 20\text{ cm}$

The image formed by first lens is at a distance of 20 cm to the right of first lens. This image serves as a virtual object for second lens.

For second lens

$f_2 = -10\text{ cm}, u_2 = 20 - 10 = 10\text{ cm}$

$$\frac{1}{v_2} = \frac{1}{f_2} + \frac{1}{u_2}$$

$$= \frac{-1}{10} + \frac{1}{10}$$

$v_2 = \infty$

The real image formed by second lens at infinite distance. This acts as an object for third lens.

For third lens

$f_3 = 10\text{ cm}\ u_3 = \infty$

$$\frac{1}{v_3} = \frac{1}{f_3} + \frac{1}{u_3}$$

$$= \frac{1}{10} + \frac{1}{\infty}$$

$\Rightarrow v_3 = 10\text{ cm}$

The final image is formed at a distance 10 cm to the right lens.

26. (d) Angle of incident, i = Angle of emergence $= \frac{3}{4}A$

Here, angle of prism = A

Since, prism is equilateral A = 60

$$i = e = \frac{3}{4} \times 60 = 45°$$

Now, angle of deviation will be

$\delta = i + e - A$

$= 45 + 45 - 60$

$= 30°$

27. (c) In a uniform electric field, electric dipole experience a torque. Therefore the magnitude of force are equal. Hence, net force is always zero.

28. (c)

29. (c)

30. (c) Volume of large drop = 8 × volume of small drop

$$\frac{4}{3}\pi R^3 = 8 \times \frac{4}{3}\pi r^3$$

$R = 2r$

The potential of this large drop

$$V' = \frac{KQ}{R}$$

$$= \frac{K8q}{2r} \quad (\because Q = 8q)$$

$$= \frac{4Kq}{r} = 4 \times 9 = 36\text{V}$$

31. (c) $\frac{I_1}{I_2} = \left(\frac{a_1}{a_2}\right)^2 = \frac{I}{4I} = \frac{1}{4}$

$$\frac{a_1}{a_2} = \frac{1}{2} \Rightarrow a_2 = 2a_1$$

$$\frac{I_{max}}{I_{min}} = \frac{(a_1 + a_2)^2}{(a_1 - a_2)^2} = \frac{(a_1 + 2a_1)^2}{(a_1 - 2a_1)^2} = \frac{9a_1}{a_1} = \frac{9}{1}$$

Hence, the required possible intensities will be 9I and I.

32. (d) Let the frequency of AC be ν.

$\omega = 2\pi\nu$

Reactance of the capacitor

$$X_C = \frac{1}{\omega c} = \frac{1}{2\pi\nu C}$$

Reactance of the inductance

$X_L = \omega L = 2\pi\nu L$

Current in the circuit, $I = \frac{\nu}{X}$

When the frequency of the AC is increased then X_C will decrease whereas X_L will get increased. Hence for the same input AC voltage. Current in the inductor circuit will decrease and in the capacitor will increase.

33. (c) The magnitude of a magnetic force on a current carrying conductor is given by

$F = i\left(\vec{L} \times \vec{B}\right)$

$= i\,LB\sin\theta$

34. (d) Efficiency, $\eta = 80\%$

Input power, $P_{in} = 3\text{kW} = 3000\text{ W}$

Input voltage, $V_{in} = 120\text{ V}$

Secondary voltage, $V_s = 240\text{ V}$

$$\eta = \frac{P_{out}}{P_{in}}$$

$$\frac{80}{100} = \frac{V_s I_s}{3000}$$

$\Rightarrow I_s = 3000 \times \frac{80}{100} \times \frac{1}{240}$

Secondary current, $I_S = 10$ A

35. (c) Half life of a radioactive substance

$t_{1/2} = 10$ days

Remain radioactive substance $= 1 - \frac{3}{4} = \frac{1}{4}$

$N = N_0 e^{-\lambda t}$

$\frac{N_0}{4} = N_0 e^{-\lambda t}$

$4 = e^{\lambda t}$

$2\ln 2 = \lambda t$

$t = \frac{2\ln 2}{\lambda}$

$= \frac{2\ln 2}{0.693} \times t_{1/2} = 2 \times 10 = 20$ days

36. (c) The nuclear fusion reaction is

$${}_1^2H + {}_1^3H \rightarrow {}_2^4He + {}_0^1n$$

37. (b) The magnitude of emf is given by

$\varepsilon = Blv$

$= 5 \times 10^{-5} \times 2 \times 1.5$

$= 15 \times 10^{-5}$

$= 0.15$ mv

38. (c) Drift velocity is given by

$I = neAv_d$

$v_d = \frac{I}{neA} = \frac{I}{ne\pi r^2}$

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

from the graph

$v_{d_I} > v_{d_{II}} > v_{d_{III}}$

So, $r_{III} > r_{II} > r_I$

$J = \sigma E$

$\frac{I}{A} = \sigma E$

$\Rightarrow E = \frac{I}{\sigma \pi r^2}$

So, $E_I > E_{II} > E_{III}$

When current flows through conductor then value of current remain always constant in every section of wire. So conductivity is same in all sections.

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

For no dispersion, $\frac{1}{f} = 0$

$0 = \frac{1}{R_1} - \frac{1}{R_2} \quad \Rightarrow R_1 = R_2 = R$

40. (a) Position of n^{th} bright band from centre of screen given by $= \frac{n\lambda D}{d}$

$\frac{8\lambda_1 D}{d} = \frac{9\lambda_2 D}{d}$

$\frac{\lambda_1}{\lambda_2} = \frac{9}{8}$

If $\lambda_1 = 450$ nm, $\lambda_2 = 400$ nm

41. (d) When light travel from air to glass, it change only wavelength and speed of light.

42. (b) $R' = R + \frac{30R}{100} = 1.3R$

$T = 47 + 273 = 320$ K

$R' = R_0(1 + \alpha(T' - T)$

$1.3R_0 = R_0[1 + \alpha(T' - 320)]$

$0.3 = 2 \times 10^{-4}(T' - 320)$

$\Rightarrow T' = \frac{0.3}{2 \times 10^{-4}} + 320$

$= 1820$ K

43. (a) By malus's law

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

$\frac{3I_0}{8} = \frac{I_0}{2}\cos^2\theta$

$\cos^2\theta = \frac{3}{4}$

$\theta = 30°$

44. (d) Einstein photoelectric equation is

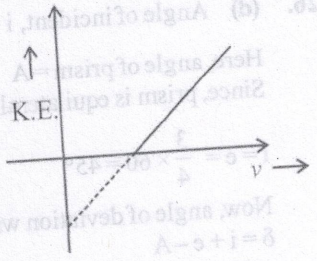
$KE_{max} = hc - \phi$

Compair with

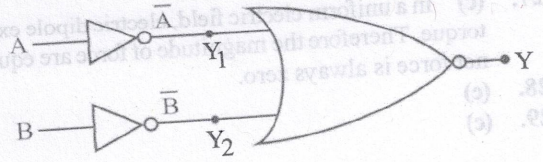
$y = mx + c$

$m = h;\ c = -\phi$

Therefore, slope of the plot is equal to planck's constant. Hence, the plot is same for all metals and independent of the intensity of the radiation.



45. (c)



$Y = \overline{\bar{A} + \bar{B}} = \bar{\bar{A}} \cdot \bar{\bar{B}} = A \cdot B$

It represent a AND gates.

46. **(d)** Density of the nuclear matter, $\rho = 2.3 \times 10^{17}\ \text{Kg m}^{-3}$

Volume, $V = 5 \times 4 \times 1 \times 10^{-6}$

$= 20 \times 10^{-6}\ \text{m}^3$

Mass, $m = \rho . V$

$= 2.3 \times 10^{17} \times 20 \times 10^{-6}$

$= 46 \times 10^{11}$

$= 4.6 \times 10^{12}\ \text{Kg}$

47. **(c)**

48. **(c)** Modulation index $= \dfrac{V_m}{V_c}$

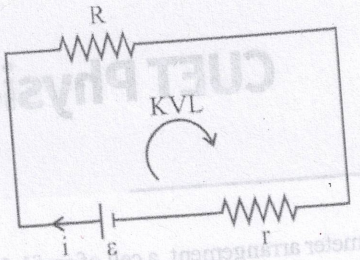
$$0.7 = \frac{V_m}{14}$$

$$\Rightarrow V_m = 14 \times 0.7 = 9.8\ \text{V}$$

49. **(d)** $C = \dfrac{E}{B}$

$$\Rightarrow B = \frac{E}{C} = \frac{9.3}{3 \times 10^8} = 3.1 \times 10^{-8}\,\hat{j}\ \text{T}$$

50. **(c)**



Apply the KVL

$-\varepsilon + ir + iR = 0$

$$\Rightarrow i = \frac{\varepsilon}{R + r}$$

$V = iR$

$$V = \frac{\varepsilon R}{R + r} = \frac{\varepsilon}{1 + \dfrac{r}{R}}$$

If $R = 0$ then $V = 0$

and $R = \infty$ then $V = \varepsilon$