

CUET Physics Solved Paper-2023

Held on 21 May 2023 (Shift-I)

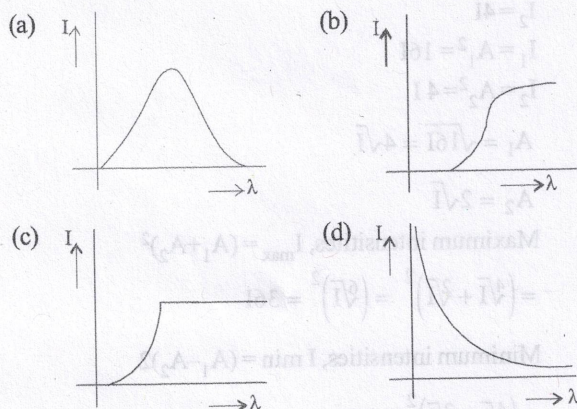
1. A ray is incident normally on the face of an equilateral prism of refracting angle of 60° . The refractive index of the prism is $\frac{2}{\sqrt{3}}$. The angle of deviation will be:

- (a) 60° (b) 30°
(c) 45° (d) 90°

2. If charge is moving parallel to uniform magnetic field, its path will be:

- (a) straight line (b) circular
(c) helical (d) elliptical

3. The anode voltage of a photocell is kept fixed. The wavelength, λ of light falling on the cathode is gradually changed. The plate current I of the photocell varies as follows.



4. Arrange the following EM waves in increasing order of their frequency?

- (A) Ultraviolet rays (B) Gamma rays
(C) Radio Waves (D) Infrared waves
(E) X-rays

Choose the correct answer from the options given below:

- (a) $C < E < A < D < B$ (b) $B < E < A < D < C$
(c) $C < D < A < E < B$ (d) $B < A < C < D < E$

5. Match List I List II

List-I

- (A) Electric field outside a uniformly charged thin spherical shell.

List-II

- I. zero

(B) Electric field inside the uniformly charged thin spherical shell.

(C) Electric field due to an infinitely long straight uniformly charged wire.

(D) Electric field due to an uniformly charged infinite plane sheet

Choose the correct answer from the options given below:

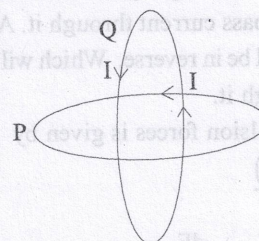
(a) A-IV, B-I, C-II, D-III

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

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

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

6. Two identical circular wires P and Q each of radius R and carrying current I are kept in perpendicular planes such that they have a common center as shown in figure. Find the magnitude and direction of the net magnetic field at the common center of the two coils

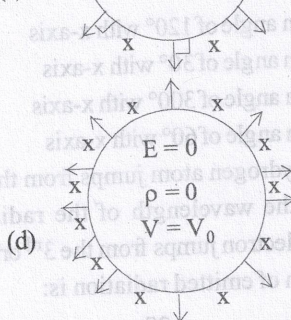
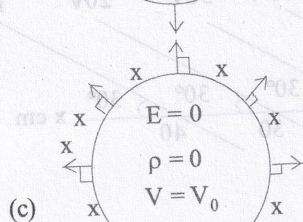
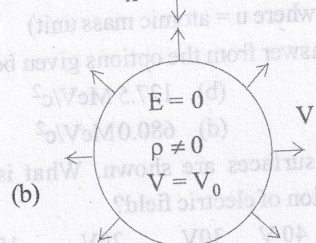
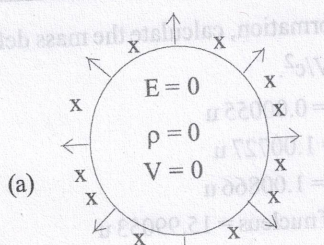


- (a) zero (b) $\frac{\sqrt{3} \mu_0 I}{2 R}, \beta = 60^\circ$

- (c) $\frac{\mu_0 I}{\sqrt{2} R}, \beta = 45^\circ$ (d) $1, \beta = 90^\circ$

7. Which of the following diagram correctly shows the electrostatic properties of a charged conductor. (Given V_0 = potential on the surface of conductor, p = Volume charge density.)

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8. Which of the following frequency would be suitable for the beyond the horizon communication using sky waves?
- (a) 1000 GHz (b) 1 GHz
(c) 10 MHz (d) 10 kHz
9. Current carrying wire produces:
- (a) Electric field only
(b) Magnetic field only
(c) Both Electric and Magnetic field
(d) Electric flux only
10. A message signal of peak value 2 V is used to modulate a carrier wave of peak value 10 V. The modulation index of the amplitude modulated wave is:
- (a) 0.2 (b) 5
(c) 0.66 (d) 1.5
11. A dentist has a small mirror of focal length 1.6 cm. He observes the cavity in the tooth of a patient by holding the mirror at a distance of 8 mm. from the cavity. The magnification is:
- (a) 1 (b) 1.5
(c) 2 (d) 3

12. The bottom of a container is a 6 cm thick glass ($\mu = 1.5$) slab. The container contains a thick layer of water ($\mu_w = 1.33$), 4 cm on top of the glass. What is the apparent position of a scratch on the outer surface of the bottom of the glass slab when viewed through the container?
- (a) 1 cm (b) 2 cm
(c) 3.5 cm (d) 3 cm

13. Which of the following statements are correct:
- (A) In semiconductor diodes carriers are generated by photo - excitation.
(B) When the photo diode is illuminated with light with energy (E) > Energy gap (E_g) of the semiconductor, then electron - hole pairs are generated.
(C) Photovoltaic devices convert electricity into optical radiation.
(D) Photodiode can be used as a photodetector to detect optical signal.
(E) Zener diode specification should be taken as per the required output voltage.

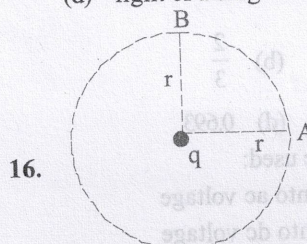
Choose the correct answer from the following options given below:

- (a) A, B and C only (b) B, C and E only
(c) A, B, D and E only (d) A, C and D only
14. Young's double slit experiment is performed using a source of white light.

- (A) The center fringe will be white.
(B) The fringe next to the center fringe will be violet.
(C) The fringe next to the center fringe will be red.
(D) There will be no completely dark fringe.
(E) The center fringe will be of no colour.

Choose the correct answer from the options given below:

- (a) C, D, E only (b) A, B, D only
(c) A, C, and D only (d) B, C, D only
15. A monochromatic visible light consists of
- (a) light of a single wavelength with all the colours of spectrum of white light.
(b) light of many wavelengths with a single colour.
(c) light of many wavelengths with all the colours of spectrum of white light
(d) light of a single colour and single wavelength



16.

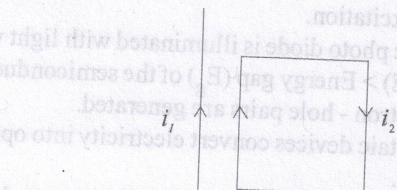
What is the work done in moving a δq charge from A to B?

- (a) 0 (b) $\frac{kq\delta q}{r}$
(c) $\frac{kq\delta q}{\sqrt{2}r}$ (d) $\frac{2kq}{r}$

17. The amplitude of the magnetic field of a harmonic electromagnetic wave in vacuum is $B_0 = 610$ nT. The amplitude of the electric field of the wave is:

(a) $5 \times 10^{14} \text{ NC}^{-1}$ (b) $203 \times 10^{-17} \text{ NC}^{-1}$
(c) 183 NC^{-1} (d) 610 NC^{-1}

18. In the situation shown in the figure, the straight wire is fixed but the loop can move under magnetic force. The loop will:



(a) remains stationary
(b) moves towards the wire
(c) moves away from the wire
(d) rotates about the wire

19. A potential difference of 3V is applied across a conductor of resistance 1.5Ω . The number of electrons flowing through it in one second would be:

(a) 16×10^{19} (b) 4.5×10^{19}
(c) 1.25×10^{19} (d) 4.8×10^{19}

20. In a p-n junction under equilibrium:

(a) Diffusion current dominates (b) Drift current dominates
(c) No net current flows (d) Depending upon the semiconductor either diffusion current or drift current dominates.

21. The half lives of 2 radioactive specimen are $T_1 = 5$ years, and $T_2 = 7.5$ years. The ratio of their disintegration constant λ_1 and λ_2 is:

(a) $\frac{3}{2}$ (b) $\frac{2}{3}$
(c) 1:1 (d) 0.693

22. A p-n junction diode can be used:

(a) to convert dc voltage into ac voltage
(b) to convert ac voltage into dc voltage
(c) to decrease the amplitude of ac voltage
(d) to decrease the frequency of ac voltage

23. Magnetic susceptibility χ of a given material is -0.5 . Identify the magnetic material.

(a) Paramagnetic (b) Diamagnetic
(c) Ferromagnetic (d) Diamagnetic and Ferromagnetic both

24. Using the given information, calculate the mass defect of $^{16}_8\text{O}$ nucleus in MeV/c^2 .

mass of electron, $m_e = 0.00055 \text{ u}$

mass of proton, $m_p = 1.00727 \text{ u}$

mass of neutron, $m_n = 1.00866 \text{ u}$

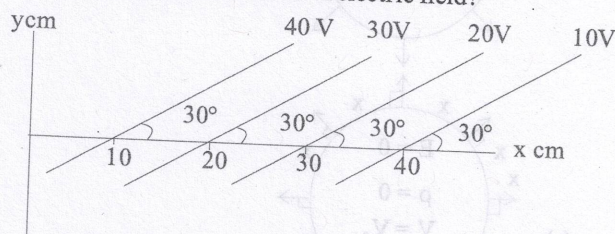
experimental mass of nucleus = 15.99053 u

$1 \text{ u} = 931.5 \text{ MeV}/c^2$ (where u = atomic mass unit)

Choose the correct answer from the options given below:

(a) $150.5 \text{ MeV}/c^2$ (b) $127.5 \text{ MeV}/c^2$
(c) $107.5 \text{ MeV}/c^2$ (d) $680.0 \text{ MeV}/c^2$

25. Some equipotential surfaces are shown. What is the magnitude and direction of electric field?



(a) 200 V/m making an angle of 120° with x-axis
(b) 100 V/m making an angle of 30° with x-axis
(c) 200 V/m making an angle of 300° with x-axis
(d) 100 V/m making an angle of 60° with x-axis

26. When the electron in hydrogen atom jumps from the 2nd orbit to the 1st orbit, the wavelength of the radiation emitted is λ . When the electron jumps from the 3rd orbit to 1st orbit, the wavelength of emitted radiation is:

(a) $\frac{27}{32} \lambda$ (b) $\frac{27}{5} \lambda$
(c) $\frac{4}{5} \lambda$ (d) $\frac{2}{3} \lambda$

27. Which of the following statements are correct?

(A) The relative motion between a magnet and a coil is responsible for induction of electric current in the coil.
(B) Magnetic flux is a vector quantity.
(C) In a closed coil, the magnitude of emf induced is equal to the time rate of change of magnetic flux.
(D) Eddy currents oppose the magnetic braking effect in trains.
(E) Lenz's law gives the polarity of the induced emf clearly.

Choose the correct answer from the options given below:

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

28. Which of the following is NOT a property of charges?

(a) Quantisation (b) Scalar
(c) Additive (d) affected by frames of reference

29. A telescope has an objective of focal length 30 cm and an eyepiece of focal length 3.0 cm. It is focused on a scale distant 2.0 m. For seeing with relaxed eye, the separation between the objective and eyepiece would be:
- (a) 35.3 cm (b) 38.3 cm
(c) 37 cm (d) 30 cm
30. If U_E = electric field energy density and U_m = magnetic field energy density. Then,
- (a) $\frac{U_E}{U_m} > 1$ (b) $\frac{U_E}{U_m} = 1$
(c) $\frac{U_E}{U_m} < 1$ (d) $\frac{U_E}{U_m}$ is variable
31. If the frequency of light in a photoelectric experiment is doubled the stopping potential will be:
- (a) be doubled (b) be halved
(c) becomes more than the double (d) becomes less than the double
32. The capacitance of a capacitor becomes $\frac{7}{6}$ times its original value if a dielectric slab of thickness $t = \frac{2}{3}d$ is introduced in between the plates, where d is the separation between the plates. The dielectric constant of the slab is:
- (a) $\frac{11}{7}$ (b) $\frac{7}{11}$
(c) $\frac{11}{14}$ (d) $\frac{14}{11}$
33. Match List I with List II
- | List I | List II |
|---|---|
| A. Impedance of a series RLC circuit at resonance | I. Voltage across L & C are 180° out of phase. |
| B. For a series LC circuit | II. Current in L & C are 180° out of phase |
| C. For a parallel LC circuit | III. Minimum |
| D. Reactance of a capacitor in a DC circuit | IV. Infinite |
- Choose the correct answer from the options given below:
- (a) A-III, B-I, C-II, D-IV (b) A-III, B-II, C-I, D-IV
(c) A-IV, B-I, C-II, D-III (d) A-IV, B-II, C-I, D-III
34. Which of the following pair of nuclides are Isobars?
- (a) ${}^2_1\text{H}$, ${}^3_1\text{H}$ (b) ${}^3_1\text{H}$, ${}^3_2\text{He}$
(c) ${}^{198}_{80}\text{Hg}$, ${}^{197}_{79}\text{Au}$ (d) ${}^1_1\text{H}$, ${}^3_1\text{H}$
35. Transverse nature of electromagnetic waves are/is evident by:
- A. Interference B. Dispersion
C. Polarisation D. Diffraction
- Choose the correct answer from the options given below:
- (a) A only (b) C and D only
(c) A and B only (d) C only
36. The kinetic energy of an electron in the ground state of hydrogen atom is 13.6 eV. the potential energy (P.E) and total energy (E) of electron in this state is:
- (a) P.E = -13.6 eV, E = 27.2 eV
(b) P.E = +13.6 eV, E = -27.2 eV
(c) P.E = +27.2 eV, E = -13.6 eV
(d) P.E = -27.2 eV, E = -13.6 eV
37. The magnetic flux (Φ) is:
- (a) Scalar quantity and its SI unit is Wb/m^2 .
(b) Vector quantity and its SI unit is Tm^2 .
(c) Scalar quantity and its SI unit is Tm^2 .
(d) Vector quantity and its SI unit is Wb/m^2 .
38. Which quantity is increased in a step down transformer?
- (a) Power (b) Current
(c) Frequency (d) Voltage
39. What should be the size of an obstacle to observe diffraction?
- (a) has no relation with the wavelength
(b) should be exactly half of the wavelength
(c) should be of the same order as wavelength
(d) should be much larger than the wavelength
40. Two lenses of power 3D and -1D are kept in contacts. The focal length of the combined lens would be:
- (a) 50 cm (b) 200 cm
(c) 100 cm (d) 400 cm
41. Choose the correct statements:
- A. Diamagnetic substances have non zero resultant magnetic moment.
B. The magnetisation of a paramagnetic material is inversely proportional to the absolute temperature T.
C. At high enough temperature, a ferromagnet becomes a paramagnet.
D. Magnetic permeability of ferromagnets, $\mu \gg 1$
E. Susceptibility of Diamagnetic $\chi \gg 1$
- (a) A & C only (b) A, C & D only
(c) D & E only (d) B, C & D only
42. The colour of the third band of a colour coded carbon resistor of resistance $2.3 \times 10^2 \Omega$ would be:
- (a) Red (b) Yellow
(c) Blue (d) Brown

43. A molecule of a substance has a permanent electric dipole moment of magnitude 10^{-31} cm. A mole of this substance is 100% polarised by applying a strong electrostatic field of magnitude 10^8 Vm $^{-1}$. The direction of field is suddenly changed by an angle of 60° . Find the heat released by substance in aligning its dipoles along the new direction of the field.

[Take 1 mole = 6×10^{23} molecules]

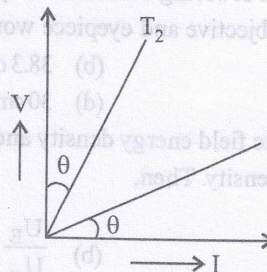
- (a) -9 J (b) -3 J
(c) 9 J (d) 3 J
44. Choose the correct statement(s)
- In photo electric effect, the minimum negative potential to the plate A for which photocurrent is zero is called saturation potential.
 - Maximum kinetic energy of photoelectrons is directly proportional to intensity of incident radiation.
 - $K_{\max} = eV_0$.
 - Photocurrent becomes zero at stopping potential.
 - For different intensities of light, stopping potential is different.

Choose the correct answer from the options given below:

- (a) C & D only (b) B and E only
(c) D and E only (d) C, D & E only
45. An electric dipole of dipole moment $\vec{p}$ is rotated in an electric field of magnitude E from the most stable orientation to most unstable orientation. The work done is the process is:
- (a) pE (b) $2pE$
(c) $-2pE$ (d) $-pE$
46. The increased resistance of a wire if its length is doubled and original cross sectional area is halved will be:
(Given R = original resistance of wire)

- (a) $\left(\frac{3}{4}\right)R$ (b) $\left(\frac{R}{4}\right)$
(c) $4R$ (d) $3R$

47. V-I graph for a platinum wire at temperatures T_1 and T_2 is shown in the given figure. The temperature difference ($T_2 - T_1$) is proportional to:



- (a) $\sin 2\theta$ (b) $\cos 2\theta$
(c) $\tan 2\theta$ (d) $\cot 2\theta$
48. The depletion layer has large electrical resistance because:
- It contains few ions as charge carriers.
 - It has few holes as charge carriers.
 - It has no charge carriers.
 - It contains few electrons as charge carriers.
49. The sensitivity of a potentiometer can be increased by:
- Decreasing the length of potentiometer wire only.
 - Increasing the potential gradient of the potentiometer wire of fixed length.
 - Decreasing the potential gradient of the potentiometer wire of fixed length.
 - Increasing the current in the potentiometer wire circuit.
50. An a.c voltage is applied to a resistor of resistance 5Ω and an inductor having inductive reactance of 5Ω connected in series. The phase difference between applied voltage and the current in the circuit is:

- (a) $\frac{\pi}{3}$ (b) $\frac{\pi}{4}$
(c) $\frac{\pi}{2}$ (d) Zero

Hints & Explanations

1. (a) Apply the Snell's law

$$n_1 \sin \theta_1 = n_2 \sin \theta_2$$

$$\Rightarrow 1 \times \sin 90^\circ = \frac{2}{\sqrt{3}} \times \sin \theta_2$$

$$\Rightarrow \sin \theta_2 = \frac{\sqrt{3}}{2} = \sin 60^\circ$$

$$\Rightarrow \theta_2 = 60^\circ$$

$$\text{Angle of deviation, } \delta = 180 - 60 - 60 = 60^\circ$$

2. (a) It's path will be straight line.

$$\vec{F} = q(\vec{v} \times \vec{B})$$

$$= qvB \sin 0^\circ = 0$$

3. (d) Intensity is proportional to incident photons and energy of each photon

$$I \propto E \quad \left(\because E = \frac{hc}{\lambda} \right)$$

$$I \propto \frac{1}{\lambda}$$

4. (c) Gamma rays > X-rays > Ultraviolet rays > Infrared waves > Radio waves

5. (a) Electric field outside a uniformly charged thin spherical shell

$$E = \frac{kq}{r^2} \hat{r}$$

Electric field inside the uniformly charged thin spherical shell

$$E = \text{zero}$$

Electric field due to an infinitely long straight uniformly charged wire.

$$E = \frac{\lambda}{2\pi\epsilon_0 r} \hat{n}$$

Electric field due to a uniformly charged infinite plane sheet

$$E = \frac{\sigma}{2\epsilon_0} \hat{n}$$

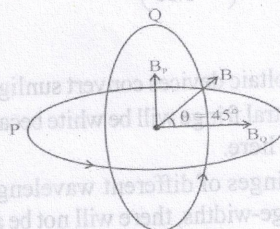
6. (c) The resultant magnetic field is given by

$$B = \sqrt{B_P^2 + B_Q^2}$$

$$\text{Here, } B_P = B_Q = \frac{\mu_0 I}{2R}$$

$$B = \sqrt{2} B_P$$

$$= \sqrt{2} \times \frac{\mu_0 I}{2R} = \frac{\mu_0 I}{\sqrt{2} R}$$



Direction of magnetic field is given by

$$\tan \theta = \frac{B_P}{B_Q} = 1$$

$$\Rightarrow \tan \theta = \tan 45^\circ$$

$$\Rightarrow \theta = 45^\circ$$

7. (c) There is no charge inside the conductor. So, electric field is zero inside a conductor.

$$\nabla \cdot E = \frac{\rho}{\epsilon_0}$$

$$E = 0 \Rightarrow \rho = 0$$

Potential will constant throughout a conductor.

8. (c) 10 MHz is suitable for sky wave communication.
9. (b) Scientist Oersted observed that if current is flowing through a wire a magnetic field is created outside wire.

Current carrying wire doesn't produce an electric field because wire is basically neutral because of the existence of the same number of protons and electrons.

10. (a) The modulation index is the ratio of modulating signal voltage to the carrier wave peak voltage.

$$m = \frac{V_m}{V_C} = \frac{2}{10} = 0.2$$

11. (c) Concave mirror is used by dentist.

We have

$$\text{focal length, } f = -1.6 \text{ cm} = -16 \text{ mm}$$

$$\text{Distance, } u = -8 \text{ mm}$$

$$\frac{1}{f} = \frac{1}{u} + \frac{1}{v}$$

$$\Rightarrow \frac{1}{v} = \frac{1}{f} - \frac{1}{u} = \frac{1}{-16} - \frac{1}{(-8)} = \frac{-1+2}{16}$$

$$\Rightarrow v = 16 \text{ mm}$$

$$\text{So, magnification, } m = \frac{-v}{u} = \frac{-16}{-8} = 2$$

12. (c) The apparent position is given by

$$S = h_1 \left(1 - \frac{1}{\mu_1} \right) + h_2 \left(1 - \frac{1}{\mu_2} \right)$$

$$= 6 \left(1 - \frac{1}{1.5} \right) + 4 \left(1 - \frac{1}{1.33} \right)$$

$$\approx 3.5 \text{ cm}$$

13. (c) Photovoltaic devices convert sunlight into electricity.

14. (b) The central fringe will be white because all the colours superimpose here.

Since, the fringes of different wavelengths of light have different fringe-widths, there will not be a completely dark fringe. The fringe next to the centre fringe will be violet, because the violet end of the spectrum has the shortest wavelength.

15. (c) A monochromatic visible light consists of light of many wavelengths with the colour of spectrum of white light.

16. (a) Here potential in A will be equal to potential in B

Work done = Charge $\times$ Change in potential

The work done in moving a δq charge from A to B is zero.

17. (c) $c = \frac{E_0}{B_0}$

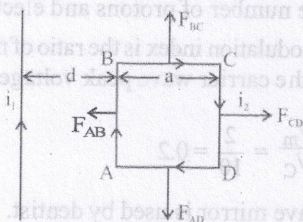
Here, E_0 is amplitude of electric field.

$$\Rightarrow E_0 = CB_0$$

$$= 3 \times 10^8 \times 610 \times 10^{-9} = 183 \text{ NC}^{-1}$$

18. (b) Force acting on the wire per unit length of current carrying (i_1) wire due to another wire carrying current (i_2) at a distance d is

$$F = \frac{\mu_0 i_1 i_2}{2\pi d}$$



Here,

$$|F_{AB}| = \frac{\mu_0 i_1 i_2}{2\pi d} \quad (\text{toward the wire})$$

$$|F_{CD}| = \frac{\mu_0 i_1 i_2}{2\pi(d+a)} \quad (\text{away from the wire})$$

Since, $F_{AB} > F_{CD}$

$|F_{BC}| = |F_{AD}|$, as they are equally away from the wire but the direction is opposite. Thus net force is towards the wire. Hence the loop will move towards the wire.

19. (c) Potential difference, $V = 3 \text{ V}$

Resistance of conductor, $R = 1.5 \Omega$

from Ohm's law

$$I = \frac{V}{R} = \frac{3}{1.5} = 2 \text{ A}$$

Charge, $q = It = ne$

$$\text{Number of electron, } n = \frac{It}{e} = \frac{2 \times 1}{1.6 \times 10^{-19}}$$

$$= 1.25 \times 10^{19}$$

20. (c) In a p-n junction under equilibrium no net current flows.

At equilibrium, the p-n junction has the same number of majority and minority carriers moving in opposite direction. So the net current will be zero as diffusion and drift current are equal and opposite.

21. (a) $\lambda_1 = \frac{0.693}{T_1} = \frac{0.693}{5} \quad \dots(1)$

$$\lambda_2 = \frac{0.693}{T_2} = \frac{0.693}{7.5} \quad \dots(2)$$

$$\text{Ratio} = \frac{\lambda_1}{\lambda_2} = \frac{0.693}{5} \times \frac{7.5}{0.693} = 1.5$$

22. (b) A p-n junction diode can be used as rectification, which convert ac voltage to dc voltage.

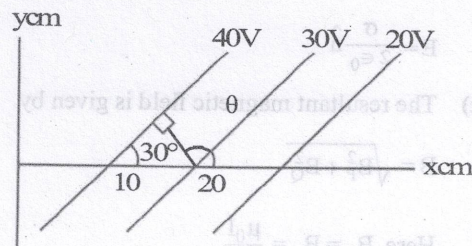
23. (b) When magnetic susceptibility χ is $\chi > 0$ then material is paramagnetic.

When magnetic susceptibility χ is $\chi >> 0$ then material is ferromagnetic.

When magnetic susceptibility χ is $\chi < 0$ then material is diamagnetic.

24. (b) Mass defect, $\Delta m = [Zm_p + (A - Z)m_n - m]$
 $= 8 \times 1.00727 + (16 - 8) \times 1.00866 - 15.99053$
 $= 8.05816 + 8.06928 - 15.99053$
 $= 0.13691 \times 931.5$
 $= 127.5 \text{ MeV}/c^2$

25. (a)



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$$dV = -E \cdot dL$$

$$dV = -EdL \cos \theta$$

$$E = \frac{(V_2 - V_1)}{(L_2 - L_1) \cos \theta}$$

$$= \frac{(30 - 40)}{10^{-2} \times (20 - 10) \cos 120^\circ}$$

$$= \frac{10}{10^{-2} \times 10 \times \sin 30^\circ} = 200 \text{ V/m}$$

Direction of electric field making an angle of 120° with x-axis.

$$26. (a) \frac{1}{\lambda} = R \left[1 - \frac{1}{2^2} \right] = \frac{3R}{4} \quad \dots(1)$$

$$\frac{1}{\lambda'} = R \left[1 - \frac{1}{3^2} \right] = \frac{8R}{9} \quad \dots(2)$$

Divide equation (1) by (2), we have

$$\frac{\lambda'}{\lambda} = \frac{3R}{4} \times \frac{9}{8R}$$

$$\Rightarrow \lambda' = \frac{27\lambda}{32}$$

27. (d) According to the Faraday law of induction, the magnitude of induced emf is product of the number of turns and the rate of change of flux.

Magnetic flux is a scalar quantity.

$$\phi = \vec{B} \cdot d\vec{A}$$

28. (d) Charges is not affected by frames of reference.

29. (b) Here, $u = -2\text{m} = -200 \text{ cm}$

$$f_0 = 30 \text{ cm}$$

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

$$\frac{1}{30} = \frac{1}{v} - \frac{1}{(-200)}$$

$$\frac{1}{v} = \frac{1}{30} - \frac{1}{200} = \frac{20-3}{600} = \frac{17}{600}$$

$$\Rightarrow v = \frac{600}{17} = 35.3 \text{ cm}$$

Distance between the objective and eyepiece will be

$$= v + f_e$$

$$= 35.3 + 3 = 38.3 \text{ cm}$$

30. (b) Average energy density of magnetic field, $U_B = \frac{B_0^2}{2\mu_0}$

$$\text{Average energy density of electric field, } U_m = \frac{1}{2} \epsilon_0 E_0^2$$

$$U_E = \frac{1}{2} \epsilon_0 E_0^2$$

$$= \frac{1}{2} \epsilon_0 \times C^2 B_0^2 \quad \left(C = \frac{E_0}{B_0} \right)$$

$$= \frac{1}{2} \epsilon_0 \times \frac{1}{\epsilon_0 \mu_0} \times B_0^2$$

$$= \frac{B_0^2}{2\mu_0} = U_m$$

$$U_E = U_m$$

31. (a) The photoelectric equation given as,

$$CV = hv - W$$

$$V = \frac{hv}{e} - \frac{W}{e}$$

When the frequency is doubled

$$V' = \frac{2hv}{e} - \frac{W}{e}$$

$$= \frac{2hv}{e} - \frac{2W}{e} + \frac{W}{e}$$

$$V' = 2V + \frac{W}{e}$$

Hence, stopping potential will be doubled.

32. (d) Capacitance is given as

$$C = \frac{\epsilon_0 A}{d}$$

When dielectric slab of thickness $t = \frac{2}{3}d$ introduced in between the plates.

$$C' = \frac{\epsilon_0 A}{d - t \left(1 - \frac{1}{k} \right)}$$

$$= \frac{\epsilon_0 A}{d - \frac{2}{3}d \left(1 - \frac{1}{k} \right)}$$

$$= \frac{\epsilon_0 A}{d - \frac{2}{3}d + \frac{2d}{3k}} = \frac{\epsilon_0 A}{\frac{d}{3} + \frac{2d}{3k}}$$

$$\frac{7}{6}C = \frac{C}{\frac{1}{3} + \frac{2}{3k}}$$

$$\frac{1}{3} + \frac{2}{3k} = \frac{6}{7}$$

$$\frac{2}{3k} = \frac{6}{7} - \frac{1}{3} = \frac{18-7}{21} = \frac{11}{21}$$

$$\frac{2}{3k} = \frac{11}{21} \Rightarrow \frac{2}{k} = \frac{11}{7} \Rightarrow k = \frac{14}{11}$$

33. (a)

34. (b) Isobars, ${}^3_1\text{H}$, ${}^3_2\text{He}$ both have same atomic mass number but have different atomic number.
35. (d) Polarization is defined as a phenomenon caused due to the transverse nature of electromagnetic radiation.
36. (c) Ground state kinetic energy of hydrogen atom, $\text{KE} = 13.6 \text{ eV}$
 total energy, $\text{TE} = -\text{KE}$
 $= -13.6 \text{ eV}$
 Potential energy, $\text{PE} = -2 \times \text{K.E}$
 $= -2 \times 13.6$
 $= -27.2 \text{ eV}$
37. (c) The magnetic flux (ϕ) is scalar quantity and its SI unit is Tm^2 .
38. (b) In a step down transformer, high voltage convert to low voltage but the power remain constant.
 from $P = VI$ relation
 current will increased.
39. (c) Diffraction is basically the bending of waves. The bending occurs due to obstacles. It occurs only when the wavelength is comparable to the size of aperture.
40. (a) Given, $P_1 = 3\text{D}$ and $P_2 = -1\text{D}$
 $P = P_1 + P_2$
 $= 3 - 1$
 $= 2\text{D}$
 $f = \frac{100}{P} = \frac{100}{2} = 50 \text{ cm}$
41. (d) Diamagnetic substance have zero resultant magnetic moment.
 Magnetic susceptibility of diamagnetic is $\chi < 0$, which means it is always a negative value for diamagnetic material.
42. (d) Resistance of resistor
 $R = 2.3 \times 10^2 \Omega = 23 \times 10^1 \Omega$
 Therefore, the colour of third band of a colour coded resistor will be related to number 1 i.e. brown.
43. (d) Dipole moment, $p = 10^{-31} \text{ cm}$
 Electric field, $E = 10^8 \text{ Vm}^{-1}$
 Heat released by substance,
 $H = npE (\cos 0^\circ - \cos 60^\circ)$
 $= 6 \times 10^{23} \times 10^{-31} \times 10^8 \left(1 - \frac{1}{2}\right) = 3\text{J}$
44. (a) The stopping potential does not depend on the intensity nor the number of photons.
45. (c) For stable orientation is parallel to $\vec{E}$
 $\theta = 0^\circ$

For unstable orientation is antiparallel to $\vec{E}$
 $\theta = 180^\circ$

The work done in the process is
 $W = pE [\cos 180^\circ - \cos 0^\circ]$
 $= -2pE$

46. (c) $R = \frac{\rho \ell}{A}$

Here $\ell' = 2\ell$ and $A' = \frac{A}{2}$

$$R' = \frac{\rho \ell'}{A'} = \frac{\rho \times 2\ell \times 2}{\frac{A}{2}} = 4R$$

47. (d) From the Ohm's Law

$$R_1 = \frac{V_1}{I_1} = \tan \theta$$

$$R_2 = \frac{V_2}{I_2} = \tan (90^\circ - \theta) = \cot \theta$$

Temperature dependence of resistance is given by

$$R_1 = R_0 (1 + \alpha T_1)$$

$$R_2 = R_0 (1 + \alpha T_2)$$

Subtracting above equations

$$R_2 - R_1 = 2(T_2 - T_1)$$

$$\Rightarrow T_2 - T_1 \propto R_2 - R_1 \propto \cot \theta - \tan \theta$$

$$\propto \frac{\cos \theta}{\sin \theta} - \frac{\sin \theta}{\cos \theta}$$

$$T_2 - T_1 \propto \frac{\cos^2 \theta - \sin^2 \theta}{\sin \theta \cos \theta}$$

$$\propto \frac{2 \cos 2\theta}{\sin 2\theta}$$

$$T_2 - T_1 \propto \cot 2\theta$$

48. (c) The depletion layer has large electrical resistance because it has no charge carriers because depletion layer consists of mainly stationary ions.

49. (b) Sensitivity of potentiometer can be increased by increasing the length of the potentiometer wire and by reducing the current and in decreasing the potential gradient of the potentiometer wire of fixed length.

50. (b) $X_L = 5\Omega$ and $R = 5\Omega$

The phase difference between applied voltage and the current in the circuit is

$$\theta = \tan^{-1} \left(\frac{X_L}{R} \right) = \tan^{-1} \left(\frac{5}{5} \right) = \frac{\pi}{4}$$