# CBSE
# Class XII Physics
# Sample Paper1– Solution

## Section A

**1.** Downwards.
The force is given by $\vec{F} = q\vec{V} \times \vec{B}$ .

**OR**

parallel currents attract and anti parallel currents repel.

**2.** $Li^{+}$

**3.** Both wave and particle phenomena

**OR**

Light travels from denser to rarer medium.

**4.** Constant phase difference

**OR**

$\pi$

**5.** $n_p = n_e$

**6.** From nside to pside

**OR**

depletion region

**7.** (d) n=2 to n=1.
For this transition, energy change is maximum and $E \propto \frac{1}{\lambda}$.

**8.**

$\frac{nh}{2\pi}$

**9.** Zero
As both charges are equal in magnitude but opposite in polarity.

**10.** May increase or decrease
It depends on the polarity of charges. In case of same polarity, potential energy decreases with separation, whereas in case of opposite polarity, it increases with separation.

**11.** D : Assertion is false and Reason is also false

As the temperature increases, energy exchange increases causing more valence electron to cross the energy gap and hence increasing the electron- hole pair. In semiconductor the conduction mainly occurs due to electron –hole pairs, therefore conductivity increases with increase in temperature and resistivity decreases with increase in temperature.

**12.** A: Both Assertion and Reason are true and R is the correct explanation of A

$$E = \frac{-13.6}{n^2}$$

$$E = \frac{-13.6}{2^2}$$

$$E = -3.4\,eV$$

**13.** c)A is true but R is false

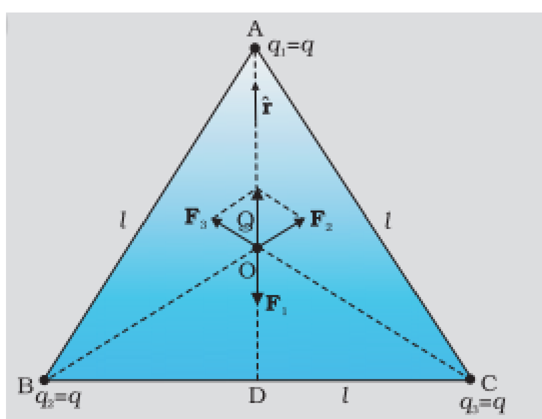
Light shows the phenomenon of interference, diffraction and Polarisation because of the wave nature of light.

**14.** D) Assertion is false and Reason is also false:

Electric potential of a charged conductor depends not only on the amount of charge and volume but also on the shape of the conductor. Hence if their shapes are different, they may have different electric potential.

## Section B

**15.**




a) i. Zero. As Q is present on the centroid hence the force exerted by all the charges are equal and due to symmetry the force will cancel out each other and the resultant force would become zero.

b) ii. $F_R = \frac{kqQ}{\left(\frac{1}{\sqrt{3}}\right)^2}$. The distance between A and O is $\frac{2}{3}(AD) \Rightarrow \frac{2}{3}\left(\frac{\sqrt{3}}{2}l\right) \Rightarrow \frac{1}{\sqrt{3}}$

c) ii. The magnitude and direction of force experienced by the charge Q due the charge present on the vertex C of the triangle is $F = \frac{kqQ}{\left(\frac{1}{\sqrt{3}}\right)^2}$ Along CO

d) i. Upwards.

e) i. Zero. As Q is present on the centroid hence the force exerted by all the charges are equal and due to symmetry the force will cancel out each other and the resultant force would become zero.

**16.** a) i. Separation of fringes increases.

b) ii. Separation of fringes decreases.

c) ii. Separation of fringes decreases.

d) iii. Separation of fringes remains constant. Thus, as S decreases (i.e., the source slit is brought closer), the interference pattern gets less and less sharp, and when the source is brought too close for this condition to be valid, the fringes disappear. Till this happens, the fringe separation remains fixed.

e) iii. Separation of fringes remain constant. Same as in (d). As the source slit width increases, fringe pattern gets less and less sharp. When the source slit is so wide that the condition $s/S \leq \lambda/d$ is not satisfied, the interference pattern disappears.

## Section C

**17.** de Broglie wavelength:

$$\lambda = \frac{h}{p} = \frac{h}{\sqrt{2mK}}$$

For the same kinetic energy, de Broglie wavelength depends on the mass of the particle.

As the alpha particle is the most massive of the three, its de Broglie wavelength will be the shortest.

**18.** Yes, because the potentiometer does not draw any current from the circuit, but it still measures the potential difference.

An ideal voltmeter has infinite resistance, and hence, it does not draw any current from the circuit.

**OR**

$R_0 = 5\ \Omega$ $R_{100} = 5.23\ \Omega$ and $R_t = 5.795\ \Omega$

$$t = \frac{R_t - R_0}{R_{100} - R_0} \times 100$$

$$t = \frac{5.795 - 5}{5.23 - 5} \times 100$$

$$t = \frac{0.795}{0.23} \times 100 = 345.65\ ^{\circ}C$$

**19.** The n-type semiconductor is neutral, i.e. uncharged, because the atoms of every substance are neutral. The pentavalent impurity atoms are neutral even though their electronic structure provides excess of electrons when mixed in a pure semiconductor.

**20.** TV signals have a frequency between 100 and 200 MHz, so they are not reflected by the ionosphere. Thus, their transmission via sky waves is not possible.
The range can be increased by using (i) taller antennaand (ii) geostationary satellites.

**21.** Ohm's law is not obeyed when the
(i) Temperature is not constant.
(ii) Conductor is not ohmic.

**OR**

$$I_{max} = \frac{E}{r}$$

$E = 12\ V$ and $r = 0.4\ \Omega$

$$\therefore I_{max} = \frac{12}{0.4} = 30\ A$$

**22.** Energy of electrons

$E = 30keV = 30 \times 10^3 \times 1.6 \times 10^{-19}$ joule

From Einstein equation,

$E = h\nu$

$$\nu = \frac{E}{h} = \frac{30 \times 10^3 \times 1.6 \times 10^{-19}}{6.6 \times 10^{-34}} = 7.27 \times 10^{18}\ Hz \quad (1)$$

$$\lambda = \frac{v}{\nu} = \frac{c}{\nu} = \frac{3.0 \times 10^8}{7.27 \times 10^{18}} = 0.0413\ nm \quad (1)$$

**23.** (a) $v = 30$ MHz $= 30 \times 10^6$ Hz

$$\lambda = \frac{c}{v} = \frac{3 \times 10^8}{30 \times 10^6} = 10\ m$$

$$l = \frac{\lambda}{2} = \frac{10}{2} = 5\ m$$

(b) $v = 300$ MHz $= 3 \times 10^8$ Hz

$$\lambda = \frac{c}{v} = \frac{3\times10^8}{3\times10^8} = 1 \text{ m}$$

$$l = \frac{\lambda}{2} = \frac{1}{2} = 0.5 \text{ m}$$

Thus, we observe that the length of the dipole antenna decreases as the frequency of transmission increases.

**24.**

Kinetic energy of a particle $E = \frac{1}{2}mv^2$

$mv = \sqrt{2mE}$

de-broglie wavelength associated with the particle is

$$\lambda = \frac{h}{mv} = \frac{h}{\sqrt{2mE}}$$

For a given value of E, $\lambda = \frac{h}{\sqrt{m}}$

Mass of electron < mass of proton

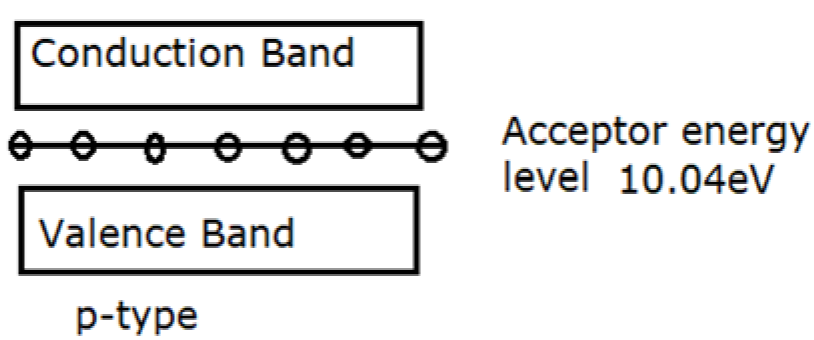
So, electron has greater de-broglie wavelength

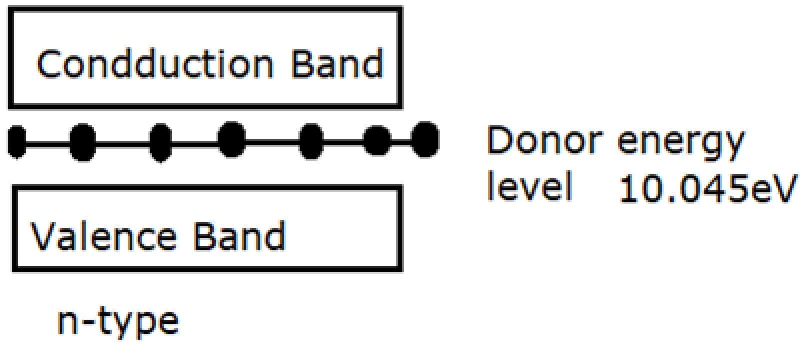
**25.**

| Forward bias | Reverse bias |
|---|---|
| Positive terminal of battery is connected to p-type and negative terminal is connected to n-type semiconductor. | Positive terminal of battery is connected to n-type and negative terminal is connected to p-type semiconductor. |
| Depletion layer is very thin. | Depletion layer is thick |
| p-n junction offers very low resistance | p-n junction offers very high resistance. |
| An ideal diode have zero resistance | An ideal diode have infinite resistance. |

**OR**

The required energy band diagram is shown below:

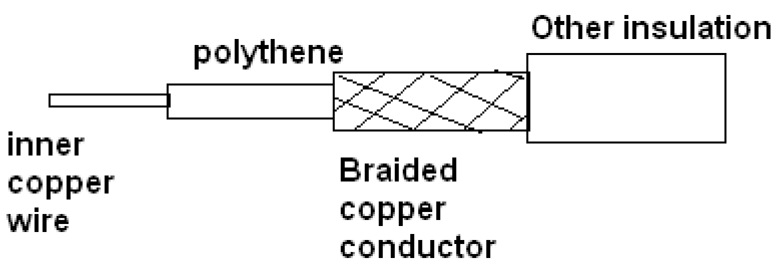





## Section D

**26.** (i) Each free electron accelerates due to the force that acts on it. This increases its drift speed until it collides with a positive ion of the metal. It loses some energy after each collision, but it again accelerates and then collides and once again loses some energy. This sequence of events continues. Hence, on an average, the electrons acquire only a drift speed, but they are not able to accelerate.
(ii)In the presence of an electric field, the path of the electrons is generally curved rather than straight.

**27.**




a. A coaxial cable is as shown in the figure above. It consists of an inner conductor that is made of a copper wire, and the outer conductor can be either a solid or braided mesh of fine wires. The outer conductor is externally covered with a polymer jacket for protection.
b. The upper limit of the frequency that can be used is 20MHz.

**28.** A is a capacitor and B is an inductor.
On decreasing the frequency of the applied voltage, the inductive reactance decreases, so the current through the inductor will increase.
For this change in the frequency, the capacitive reactance increases, so the current through the capacitor decreases.

**OR**

$E = E_0 \sin \omega t$

$$E - L\frac{dI}{dt} = 0$$

$$\frac{dI}{dt} = \frac{E}{L} = \frac{E_0}{L}\sin\omega t$$

$$I = \frac{E_0}{L}\int \sin\omega t$$

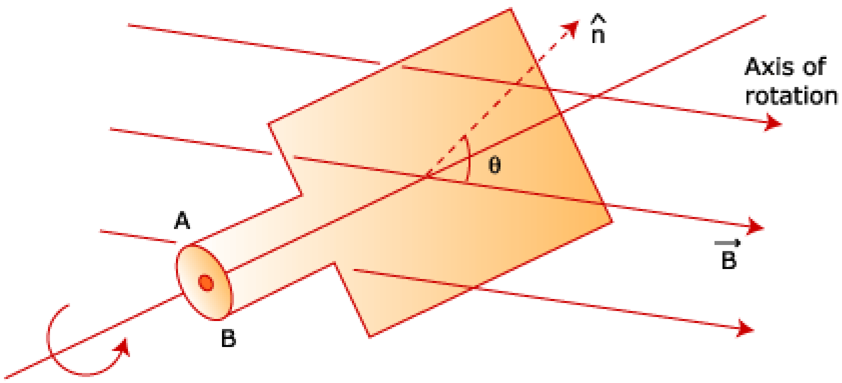
$$= -\left(\frac{E_0}{\omega L}\right)\cos\omega t = -I_0\cos\omega t$$

$$\text{where } I_0 = \frac{E_0}{\omega L}$$

$$\text{or,}\quad I = I_0\sin\left(\omega t - \frac{\pi}{2}\right)$$

Hence, current lags behind the voltage by a phase angle of $\frac{\pi}{2}$.

**29.** A wire loop of area A is free to rotate about an axis which is perpendicular to a uniform magnetic field B.




If the normal to the loop $n$ makes an angle $\theta$ with $\vec{B}$, then the flux through the loop is $\Phi = BA\cos\theta$.

If this loop rotates with a constant angular velocity $\omega = \frac{d\theta}{dt}$, then the flux through it changes at the rate

$$\frac{d\Phi}{dt} = -BA\sin\theta\frac{d\theta}{dt} = -BA\omega\sin(\omega t + C_0)$$

where $C_0$ is a constant.

$\therefore$ emf is induced between ends A and B and is given by

$$\varepsilon = BA\omega\sin(\omega t + Co)$$

$$\varepsilon = V_m\sin(\omega t + Co)$$

$V_m = BA\omega$ = Peak value of emf generated.

**OR**

The coil P should be moved quickly towards or away from the coil S. The laws involved here are Faraday's law of electromagnetic induction.

On the basis of his experiment, faraday gave the following two laws.

First law: Whenever magnetic flux linked with a circuit changes, an emf is induced in it which lasts, so long as change in flux continuous

Second law: The emf induced in loop or closed circuit is directly proportional o the rate of change of magnetic flux linked with the loop

$e = \frac{-d\phi}{dt}$ or $e = -N\frac{-d\phi}{dt}$

Where, N=number of turns in the coil. Negative sign indicates lenz's law.

**30.** (i) Photons travel in a straight line with the speed of light.

(ii) Rest mass of a photon is zero or a photon cannot exist at rest.

(iii) The equivalent mass of a photon is

$E = h\nu = mc^2$

$m = h\nu/c^2$

(iv) Due to the change in wavelength, photons travel with different speeds in different media.

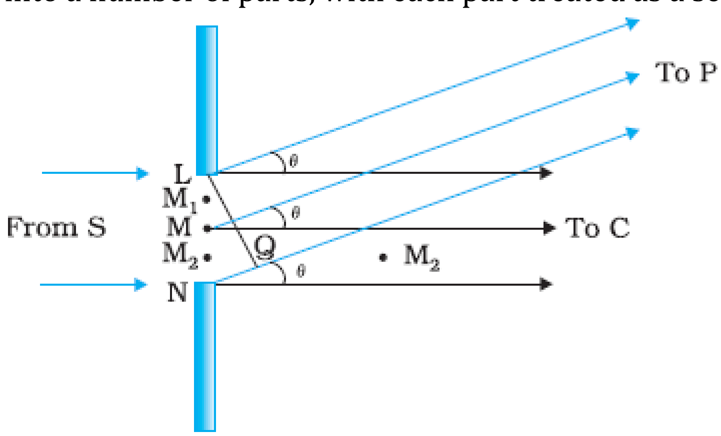
(v) Momentum of photon is

$p = h/\lambda$

## Section E

**31.** Condition: Size of the obstacle or aperture should be comparable with the wavelength of incident light.

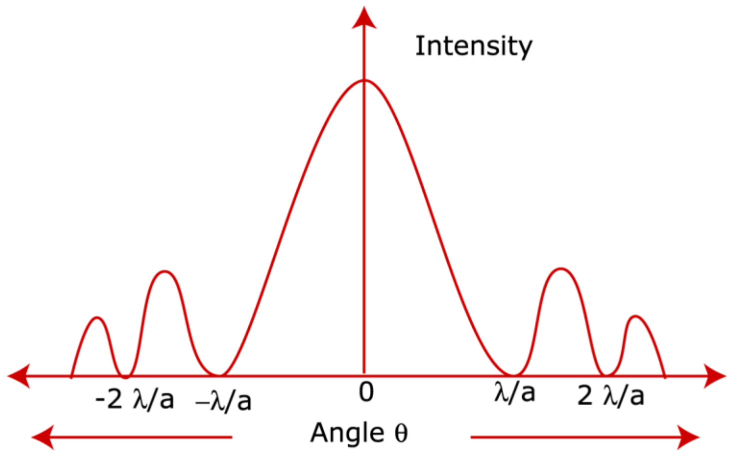
Let a plane wave front incident on slit LM be of width 'a'. To consider diffraction effects at any point P, directed an angle θ to the incident ray, the wave front is divided into a number of parts, with each part treated as a secondary wave front.




Path difference between secondary wave front from L and M = $a \sin\theta$

For minima, $a \sin\theta = n\lambda$

For maxima, $a \sin\theta = (2n+1)\frac{\lambda}{2}$




**OR**

Coherent sources of light: Two sources with the same frequencies having a time-independents table phase difference or zero phase difference.

If the phase difference is variable, the interference term averages to zero. In case of a stable phase difference between coherent sources, the intensity at each point will vary and so sustained interference will be observed.

Difference between interference and diffraction pattern formed due to a single slit:

| **Interference** | **Diffraction** |
|---|---|
| All bright and dark fringes are of equal width. | Width of secondary maxima keeps on decreasing. |
| At $\theta = \lambda / a$, a bright fringe is formed. | At $\theta = \lambda / a$, a dark fringe is formed. |
| Pattern is formed due to the superposition of two different wave fronts. | Pattern is formed due to the superposition of wavelets of the same wave front. |

**32.** According to the Biot–Savart law, the magnetic field dB due to an element dl carrying a steady current I at a point P at a distance r from the current element is

$$dB = \frac{\mu_0}{4\pi} I \frac{d\ell \times r}{r^3}$$

By taking a circuit element, we can write the magnetic field due to this segment. Then integrate to find the magnetic field due to the circular current loop, which comes out to be

$$B = \frac{\mu_0 I a^2}{2(a^2 + x^2)^{3/2}}$$

The magnetic field at the centre of the coil is found by putting $x = 0$

$$B_1 = \frac{\mu_0 I}{2a}$$

Magnetic field at an axial point for $x = \sqrt{3}a$ is

$$B_2 = \frac{\mu_0 I}{16a}$$

$$\frac{B_1}{B_2} = 8:1$$

**OR**

A)

Let the magnetic field acting on the loop be B and length of the rod PQ be l

The induced e.m.f. ε = Blv

i) Current in the loop $i = \frac{\varepsilon}{r} = \frac{Blv}{r}$

ii) Force $F = ilB = \frac{Blv}{r} \times lB \Rightarrow F = \frac{B^2 l^2 v}{r}$

iii) Power required to move the arm PQ $P = \varepsilon i = \frac{B^2 l^2 v^2}{r}$

B)τ (Torque on the loop) = MB sin θ

As $\vec{M}$ and $\vec{B}$ are parallel hence torque will be zero

Force acting on the loop

$$= \frac{\mu_0 I_1 I_2}{2\pi} l \left( \frac{1}{r_1} - \frac{1}{r_2} \right)$$

$$= 2 \times 10^{-7} \times 4 \times 1 \times 5 \times 10^{-2} \left( \frac{1}{10^{-2}} - \frac{1}{3 \times 10^{-2}} \right)$$

$$= 2.67 \times 10^{-6}\ N$$

**33.** (a)

$$\beta = \frac{\Delta I_C}{\Delta I_B} = \frac{2\ mA}{20\ \mu A} = 100$$

(b)Input resistance $R_{BE} = \frac{\Delta V_{BE}}{\Delta I_B} = \frac{20\ mV}{20\ \mu A} = 1\ k\Omega$

(c)Transconductance = $\frac{\Delta I_C}{\Delta V_{BE}} = \frac{2\ mA}{20\ mV} = 0.1\ mho$

(d) Change in input voltage is $R_L \Delta I_C = (5\ k\Omega)(2\ mA) = 10\ V$

The applied signal voltage = 20 mV

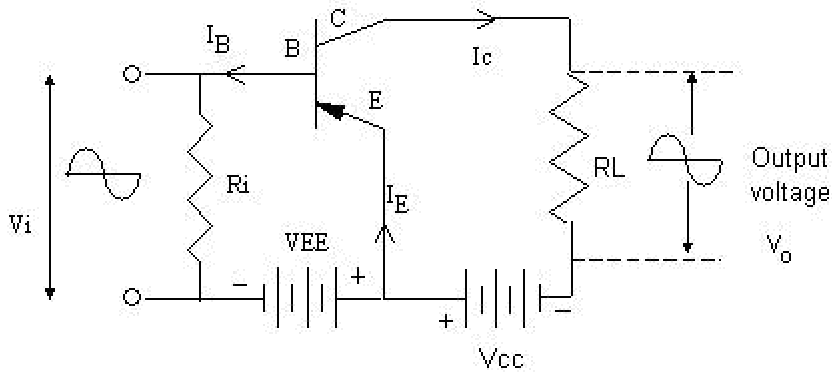
Thus, voltage gain

$$= \frac{10\ V}{20\ mV} = 500 \quad (1)$$

**OR**

<u>**Commonemitter transistor amplifier:**</u> Thecommonemitter transistor amplifier gives the highest gain, and hence, it is the most commonly employed circuit. The figure depicts the circuit for a PNP transistor.

In this circuit, the emitter is common to both input (emitter–base) and output (collector–emitter) circuits and is grounded. The emitter–base circuit is forward biased and the base–collector circuit is reverse biased.




**Working principle**: In a common emitter circuit, the collector current is controlled by the base current rather than the emitter current. Since in a transistor, a large collector current corresponds to a very small base current, when the input signal is applied to the base, a very small change in the base current provides a much larger change in the collector current, and thus, extremely large current gains are possible.

**Current gain:** The ratio of the change in collector current to the change in base current is defined as the alternating current gain denoted by $\beta$ . Thus,

$$\beta(ac) = \frac{\Delta I_c}{\Delta I_b}$$

$\beta$ has positive values and is generally greater than 20.

**Voltage gain**:

The voltage gain of the commonemitter transistor amplifier is given by

$$A_v = \frac{\Delta V_{out}}{\Delta V_{in}} = \frac{R_L \, \Delta I_c}{R_i \, \Delta I_b} = \frac{\Delta I_c}{\Delta I_b} \cdot \frac{R_L}{R_i}$$

$$\Rightarrow A_v = \beta \frac{R_L}{R_i}$$