CBSE Physics Set I Delhi Board 2006

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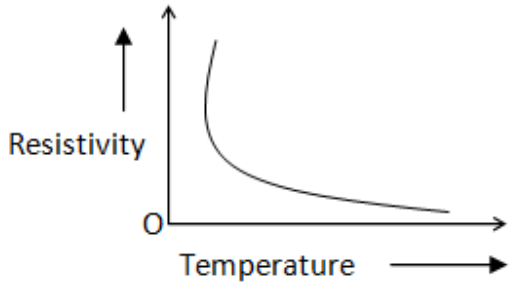
Q1. Define the term 'dielectric constant' of a medium in terms of capacitance of a capacitor.

Answer: We know that Capacitance of capacitor is defined as $C = \frac{\varepsilon_0 \varepsilon_r A}{d}, C_0 = \frac{\varepsilon_0 A}{d}, C = \varepsilon_r C_0, \varepsilon_r = \frac{C}{C_0}$

Therefore **Dielectric constant** of a medium is defined as the ratio of the capacitance of the capacitor with the dielectric as the medium to its capacitance with vacuum between its plates.

Q2. Sketch a graph showing variation of resistivity of carbon with temperature.
Answer: The resistivity of carbon decreases with increasing temperature as shown:



Q3. The vertical component of Earth's magnetic field at a place is $\sqrt{3}$ times the horizontal component. What is the value of angle of dip at this place?

Answer: We know that angle of dip is defined as $\tan\delta = \frac{B_V}{B_H}$

Given: $B_V = \sqrt{3}\, B_H$

$\tan\delta = \frac{\sqrt{3}\, B_H}{B_H} = \sqrt{3}$

∴ Angle of dip, $\delta = 60^\circ$

Q4. With what purpose was famous Davisson-Germer experiment with electrons performed?

Answer: The purpose of Davisson-Germer experiment was to confirm the wave nature of electrons.

Q5. Name the type of communication in which the signal is a discrete and binary coded version of the message or information.

Answer: In Digital communication signal is binary in the form of 0 and 1.

Q6. What are the laws of reflection?

Answer: Two Laws of reflections are

(i) The angle of incidence (i) is equal to the angle of reflection (r) ($\angle i = \angle r$)

(ii) The incident ray, the reflected ray and the normal lie in the same plane.

Q7. Name the physical quantity, whose SI unit is newton coulomb^{-1}.

Answer: It is the unit of electric field intensity (E = F/q).

Q8. State two factors by which the range of transmission of signals by a T.V. tower can be increased.

Answer: (I) By increasing the height of the tower.

(II) By increasing the height of the receiving antenna, so that it may directly intercept the signal from the transmitting antenna.

Q9. The electric field and electric potential at any point due to a point charge kept in air is 20 NC^{-1} and 10 JC^{-1} respectively. Compute the magnitude of this charge.

Answer: Given $\mathrm{E} = \frac{1}{4\pi\varepsilon_0}\frac{\mathrm{q}}{\mathrm{r}^2} = 20\ \mathrm{NC}^{-1}$ and $\mathrm{V} = \frac{1}{4\pi\varepsilon_0}\frac{\mathrm{q}}{\mathrm{r}} = 10\ \mathrm{JC}^{-1}$ therefore E=V/r

$\therefore \mathrm{r} = \frac{\mathrm{V}}{\mathrm{E}} = \frac{10}{20} = 0.5\ \mathrm{m}$

Also Charge, $\mathrm{q} = 4\pi\varepsilon_0 \mathrm{rV} = \frac{0.5\times10}{9\times10^9} = 0.55 \times 10^{-9}\mathrm{C}$ $[\because \mathrm{C} = 4\pi\varepsilon_0\mathrm{r}]$

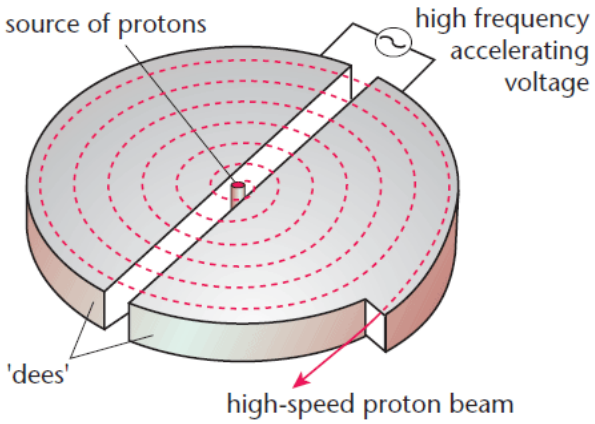
Q10. Write the mathematical relation between mobility and drift velocity of charge carriers in a conductor. Name the mobile charge carriers responsible for conduction of electric current in (I) an electrolyte (II) an ionized gas.

Answer: $\text{Mobility} = \frac{\text{Drift velocity}}{\text{Electric field}}$ or, $\mu = \frac{\mathrm{v_d}}{\mathrm{E}}$

I. The charge carriers in an electrolyte are positive and negative ions.
II. The charge carriers in an ionized gas are electrons and positively charged ions.

Q11. State the principle of working of a cyclotron. Write two uses of this machine.

Answer: **Principle:** Cyclotrons accelerate charged particle beams using a high frequency alternating voltage which is applied between two "D"-shaped electrodes. An additional static magnetic field B is applied in perpendicular direction to the electrode plane. Thus charge particle acquires very high kinetic energy with the help of relative small electric field.



Working: A cyclotron consists of two D-shaped regions known as dees. In each dee there is a magnetic field perpendicular to the plane of the page. In the gap separating the dees there is a uniform electric field pointing from one dee to the other. When a charge is released from rest in the gap it is accelerated by the electric field and carried into one of the dees. The magnetic field in the Dee causes the charge to follow a half-circle that carries it back to the gap.

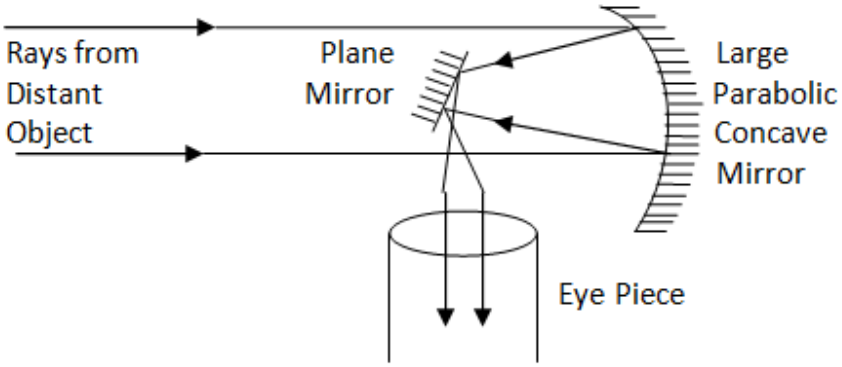
While the charge is in the dee the electric field in the gap is reversed, so the charge is once again accelerated across the gap. The cycle continues with the magnetic field in the dees continually bringing the charge back to the gap. Every time the charge crosses the gap it picks up speed. This causes the half-circles in the dees to increase in radius, and eventually the charge emerges from the cyclotron at high speed.

Uses: (I) Cyclotrons is used in particle therapy to treat cancer.

(II) A cyclotron is used to bombard nuclei with energetic particles and study the resulting nuclear reactions.

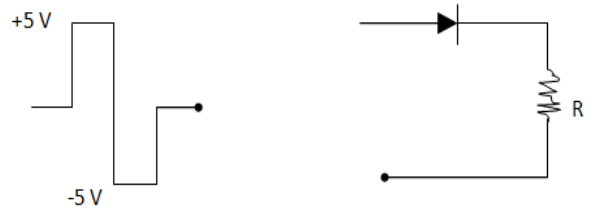
Q12. Draw a labeled ray diagram of a reflective type telescope. Write its one advantage over refracting type telescope.

Answer: The ray diagram of a reflecting type telescope:



Advantage: Objective of reflecting telescope is a mirror (not lens), so the image formed is free from chromatic aberration (which occurs in lens as lens defect because of which image splits/spreads).

Q13. Draw and explain the output waveform across the load resistor R, if the input waveform is as shown in the given figure –



Answer: We know that diode gives output only when Anode (Collector) is at positive voltage and Plate (emitter) is at negative voltage, this we call as forward biased diode. In this given waveform when the input voltage is +5V, the diode gets forward biased, hence output across R is +5V will be obtained however during the next cycle of input waveform it clearly shows input voltage is -5V, the diode gets reversed biased so no output will be obtained across R.

Output across resistance R is as shown