**CBSE Board**
**Class XII Physics**
**Sample Paper - 4**

**Time: Three Hours** **Maximum Marks: 70**

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***General Instructions***

(a) All questions are compulsory.

(b) There are 29 questions in total. Questions 1 to 8 carry one mark each, questions 9 to 16 carry two marks each, questions 17 to 25 carry three marks each and questions 27 to 29 carry five marks each.

(c) Question 26 is a value based question carrying four marks.

(d) There is no overall choice. However, an internal choice has been provided in one question of two marks, one question of three marks and all three questions of five marks each. You have to attempt only one of the given choices in such questions.

(e) Use of calculator is not permitted.

(f) You may use the following physical constants wherever necessary.

$e = 1.6 \times 10^{-19}$ C
$c = 3 \times 10^{8}$ m s$^{-1}$
$h = 6.6 \times 10^{-34}$ J s
$\mu_o = 4\pi \times 10^{-7}$ T ma$^{-1}$
$K_B = 1.38 \times 10^{23}$ J K$^{-1}$
$N_A = 6.023 \times 10^{23}$ /mole
$m_n = 1.6 \times 10^{-27}$ kg

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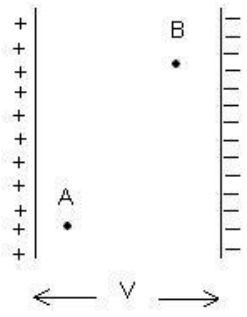
**1.** Suppose one proton A and one electron B are placed between two parallel plates having a potential difference V as shown in the figure.

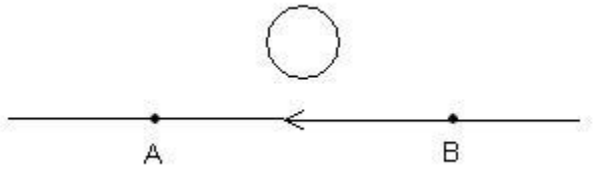



Will A and B experience equal or unequal force? (1)

**2.** An electron and a proton moving with the same speed enter the same magnetic field at right angles to the direction of the field. For which of the two particles will the radius of circular path be smaller? (1)

**3.** For which frequency of light is the human eye most sensitive? (1)

**4.** The electric current in a wire in the direction from B to A is decreasing. What is the direction of induced current in the metallic loop kept above the wire as shown2in the figure? (1)




**5.** A lens of focal length 30 cm is cut vertically as shown in figure. What will be the new focal length? (1)

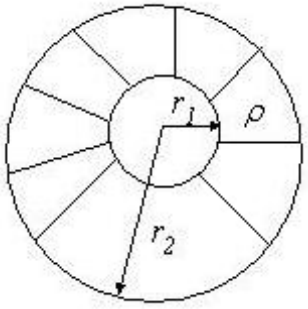
**6.** Are matter waves electromagnetic wave? Write de Broglie wave equation. (1)

**7.** Why a transistor can/cannot be used as a rectifier? (1)

**8.** What will happen if energy of the electron orbiting around nucleus becomes positive? (1)

**9.** Name the dielectric whose molecules have (i) non- zero (ii) zero dipole moment. Define the term 'dielectric constant' for a medium. (2)

**10.** Two hollow spheres of radius $r_1$ and $r_2$ are given. The space between them is filled with material of resistivity $(\rho)$ as shown. Calculate its resistance. (2)




**11.** A current carrying solenoid contracts in length. Why? (2)

**12.** An A.C. voltage $E = E_o \sin wt$ is applied across an inductor L. Obtain an expression for the current I. (2)

**13.** How much work is required to be done to reduce the separation between two like charges of magnitude 100 $\mu C$ each from 20 cm to 10 cm? (2)

**14.** Why is spark produced in the switch, when the light is put off? (2)

**OR**

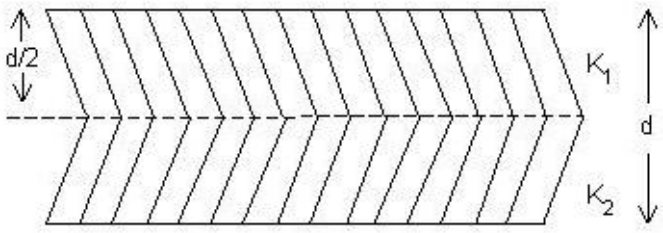
An iron bar falling through a hollow region of a thick cylindrical shell made of copper experiences a retarding force. What can you conclude about the nature of the iron bar? (2)

**15.** Show that only an accelerated charge can produce an electromagnetic wave. (2)

**16.** An eye- piece of a telescope consists of two Plano – convex lenses $L_1$ and $L_2$ each of focal length $f$ separated by a distance of $2f/3$. Where should $L_1$ be placed relative to the focus of the objective lens of the telescope so that the final image through $L_2$ is seen at infinity? (2)

**17.** A tank is filled with water to a height of 12.5 cm. The apparent depth of a needle lying at the bottom of the beaker is measured by a microscope to be 9.4 cm. What is the refractive index of water? If water is replaced by a liquid of refractive index 1.63 up to the same height. By what distance would the microscope have to be moved to focus on the needle again? (3)

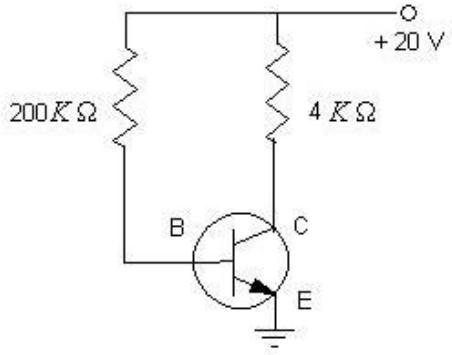
**18.** Calculate capacitance of capacitor as shown below. (3)




**OR**

A conducting slab of thickness 't' is introduced without touching between the plates of a parallel plate capacitor, separated by a distance 'd' (t < d). Derive an expression for the capacitance of the capacitor. (3)

**19.** In the following circuit, the transistor used has a $\beta = 100$. Find $V_{CE}, V_{BE}$, and $V_{BC}$ for $I_c = 2mA$. (3)




**20.** An electron and a photon each have a wavelength of 1 nm. (3)

Find

i) Their momenta

ii) Energy of photon

iii) Kinetic energy of electron

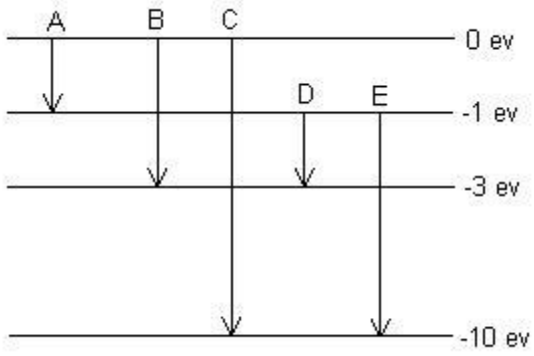
**21.** A potential difference of V volts is applied to a conductor of length L and diameter D. How are the electric field and resistance of the conductor affected when in turn

i) V is halved

ii) L is doubled

iii) D is halved (3)

**22.** The energy levels of an atom of element are shown in the following diagram. Which one of the level transitions will result in the emission of photons of wavelength 620 nm? (3)




**23.** Explain the terms (i) pulse – amplitude modulation (PAM) and (ii) pulse – code modulations (PCM). Which modulation is preferred in transmitting signals and why? (3)

**24.** Show how the following gates can be obtained by using NAND gates only (i) OR gate (ii) AND gate (iii) Not gate (3)

**25.** Derive an expression for the equivalent emf and the equivalent internal resistance of a series combination of n cells in an electric circuit. (3)

**26.** Two best friends John and Jolly are students of IX class. John wants to be an astronaut but he does not know anything about astronomy. So, he shared his desire with his friend Jolly. Jolly asked him to take advice from his teacher.

(i) What would be the suggestion of his teacher?

(ii) An astronaut is looking down on earth's surface from a space shuttle at an altitude of 400 km. Assuming that the astronaut's pupil diameter is 5 mm and the wavelength of visible light is 500 nm. The astronaut will be able to resolve linear objects of about what size? (4)

**27.**

(a) Estimate the average drift speed of conduction electrons in a copper wire of cross – sectional area 1.0 x $10^{-7}$ $m^2$ carrying a current of 1.5 A. Assume that each copper atom contributes roughly one conduction electron. The density of copper is $9.0\times10^3\, kg/m^3$, and its atomic mass is 63.5 $u$.

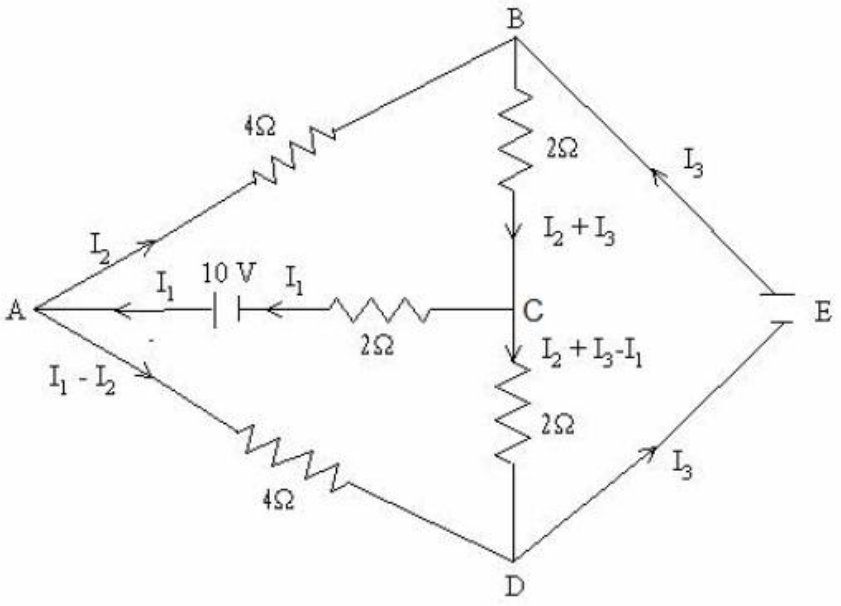
(b) Compare drift speed obtained above with

(i) Thermal speed of copper atoms at ordinary temperatures.

(ii) Speed of propagation of electric field along the conductor which causes the drift motion. (5)

**OR**

Determine the current in each branch of the network shown in figure. (5)




**28.** Explain the principle and working of a cyclotron with the help of a labeled diagram. For a cyclotron having oscillator frequency as $10MHz$, what should be the operating magnetic field for accelerating protons? If the radius of its 'dees' is 60 cm, what is the kinetic energy of the proton beam produced by accelerator? Express your answer in units of MeV. (5)

$\left(e = 1.6 \times 10^{-19} C,\ m_p = 1.67 \times 10^{-27} kg,\ 1MeV = 1.602 \times 10^{-13} J\right)$

**OR**

State Biot–Savart's law. Using Biot – Savart's law, derive an expression for the magnetic field at the centre of circular coil of numbers of turns 'N', radius 'r' and carrying a current ' i'. A semicircular arc of radius 20 cm carries a current of 10A. Calculate the magnitude of the magnetic field at the center of the arc. (5)

**29.** Explain the phenomenon of total internal reflection. State two conditions that must be satisfied for total internal reflection to take place. Derive the relation between the critical angle and the refractive index of the medium. Draw ray diagram to show how a right angled isosceles prism can be used to (i) deviate ray through $180^{o}$ (ii) to invert it.

(5)

**OR**

Prove that $\frac{-\mu_1}{u}+\frac{\mu_2}{v}=\frac{\mu_2-\mu_1}{R}$ when refraction occurs from rarer to denser media at a convex refracting spherical surface. (5)