

- i. Please check that this question paper contains 03 printed pages.
- ii. Code number given on the right hand side of the question paper should be written on the title page of the answer –book by the candidate.
- iii. Please check that this question paper contains 26 questions. Please write down the serial no of the question before attempting it.
- iv. 15 minutes time has been allotted to read this question paper.

**Max. Marks: 70**

**PHYSICS– XII SCI.**

**Time allowed: 3 hours**

**General Instructions:-**

- All questions are compulsory.
- There are 26 questions in total. Questions 1 to 5 carry 1 mark each, questions 6 to 10 carry 2 marks each, questions 11 to 22 carry 3 marks each, question 23 is value based question carries 4 marks and questions 24 to 26 carry 5 marks each,
- There is no overall choice. However, internal choice has been provided in one question of two marks, one question of three marks and all the three questions of five marks each. You have to attempt only one of the given choices in such questions.
- Use of calculator is not permitted. However, you may use log table, if necessary,
- You may use the following values of physical constants where ever necessary.

$$C = 3 \times 10^8 \text{ m/s.}$$

$$\mu_0 = 4\pi \times 10^{-7} \text{ TmA}^{-1}$$

$$h = 6.626 \times 10^{-34} \text{ JS}$$

$$m_p = 1.673 \times 10^{-27} \text{ Kg}$$

$$e = 1.602 \times 10^{-19} \text{ C}$$

$$m_e = 9.1 \times 10^{-31} \text{ Kg}$$

$$\frac{1}{4\pi \epsilon_0} = 9 \times 10^9 \text{ Nm}^2\text{C}^{-2}$$

- Q.1 Two point charges  $q_1$  and  $q_2$  are such that  $q_1q_2 > 0$ . What is the nature of force between the two charges?
- Q.2 Two identical cells, each of e.m.f.  $E$ , having negligible internal resistance, are connected in parallel with each other across an external resistance  $R$ . What is the current through this resistance?
- Q.3 A glass lens of refractive index 1.45 placed in a liquid. What must be refractive index of the liquid in order to make the lens disappear?
- Q.4 How would angular separation of interference fringes in young's double slit experiment change when the distance between the slits and screen is doubled?
- Q.5 Welders wear special goggles or face masks with glass windows to protect their eyes from electromagnetic radiations. Name the radiations and write the range of their frequency.
- Q.6 Draw graphs showing the variations of (i) electrostatic potential  $V$  and (ii) electrostatic field  $E$  with distance 'r' from a charge 'q'.
- Q.7 Terminal potential difference is less than the e.m.f. of a cell. Explain why?

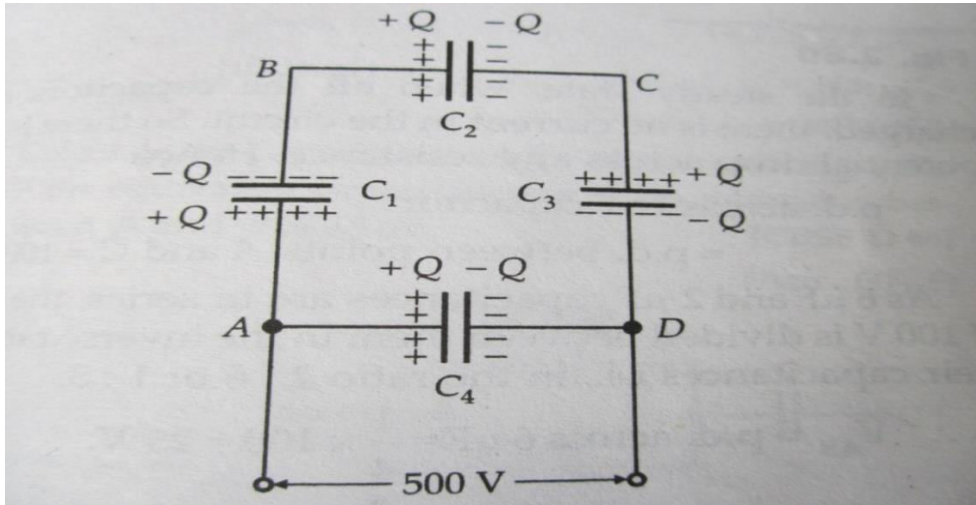
**OR**

- A battery of emf 10V and internal resistance 2 ohm is connected to a resistor. If the current in the circuit is 0.5A, what is the resistance of the resistor? What is the terminal voltage of the battery when the circuit is closed?
- Q.8 A rectangular coil of  $N$  turns and area of cross-section  $A$ , is held in a time varying magnetic field given by  $B = B_0 \sin \omega t$ , with the plane of coil normal to the magnetic field. Deduce an expression for the e.m.f. induced in the coil.
  - Q.9
    - i) What is relation between critical angle and refractive index of a material?
    - ii) Does critical angle depend on the colour of light? Explain.
  - Q.10 How will the resolving power of a compound microscope be affected, when (i) the frequency of light used to illuminate the object is increased, and (ii) the focal length of the objective is increased. Justify your answer in each case.

- Q.11** Using Gauss' theorem, derive an expression for electric field due to a uniformly charged spherical shell of radius  $R$  (i) at a point outside the shell (ii) On the surface of the shell and (iii) at a point inside the shell. Plot a graph showing the variation of electric field as a function of  $r > R$  and  $r < R$ , ( $r$  being the distance from the centre of the shell)
- Q.12** Derive an expression for the energy stored in a capacitor. If 'A' is the plate area and 'd' be the plate separation, then derive expression for energy density of the electric field.

**OR**

A network of four  $10\mu\text{F}$  capacitors is connected to a  $500\text{V}$  supply as shown in the figure. Determine (a) the equivalent capacitance of the network, (b) the charge on each capacitor.



- Q.13** Two cells of e.m.f.  $1.5\text{V}$  and  $2\text{V}$  and internal resistance  $2\ \Omega$  and  $1\ \Omega$  respectively have their negative terminals joined by a wire of  $6\ \Omega$  and positive terminals by a wire of  $4\ \Omega$  resistance. A third resistance wire of  $8\ \Omega$  connects middle points of these wires. Draw the circuit diagram. Using Kirchoff's laws, find potential difference at the ends of this third wire.
- Q.14** A bar magnet of magnetic moment  $1.5\ \text{J/T}$  lies aligned with the direction of a uniform magnetic field of  $0.22\ \text{T}$
- (a) What is the amount of work required to turn the magnet so as to align its magnetic moment
- (i) normal to the field direction (ii) opposite to the field direction?
- (b) What is the torque on the magnet in cases (i) and (ii)?
- Q.15** Derive an expression for the mutual inductance for pair of co-axial solenoids.
- Q.16** The work function of caesium is  $2.14\ \text{eV}$ . Find (a) the threshold frequency for caesium, (b) the wavelength of the incident light, if the photo current is brought to zero by a stopping potential of  $0.60\ \text{eV}$ .
- Q.17** Using Bohr's postulates derive an expression for the energy of an electron in  $n$ th orbit of an atom. What does negative of this energy signify?
- Q.18** Obtain the binding energy (in Mev) of a nitrogen nucleus  ${}^{14}_7\text{N}$ . Given  $m({}^{14}_7\text{N}) = 14.00307\ \text{a.m.u.}$ ,  $m_p = 1.007825\ \text{a.m.u.}$  and  $m_n = 1.008665\ \text{a.m.u.}$
- Q.19** Draw a neat, labelled ray diagram of an astronomical telescope and derive magnifying power when final image is formed at least distance of distinct vision.
- Q.20** In a Young's double slit experiment, the slits are separated by  $0.24\ \text{mm}$  and the screen is kept  $160\text{cm}$  away from the slits. If the fringe width is measured to be  $0.4\text{cm}$ , calculate the wavelength of light used in the experiment.
- Q.21** (a) Write the function of (i) Transducer and (ii) Repeater in a communication system.
- (b) Arrange the following networks in increasing order of the number of computers that may be present in the network.

**Internet , LAN , WAN**

- (c) What is the minimum number of satellites that enables a Global Positioning System (GPS) receiver to determine one's longitude/ latitude position i.e. to make a 2D position fix.

- Q.22** (a) Draw the circuit symbol of n-p-n transistor.  
 (b) The input resistance of a transistor is  $1000\Omega$ . On changing its base current by  $10\mu\text{A}$  the collector current increases by  $2\text{mA}$ . If the load resistance is  $5000\Omega$  is used in the circuit. Calculate the (i) the current gain and (ii) voltage gain of the transistor.

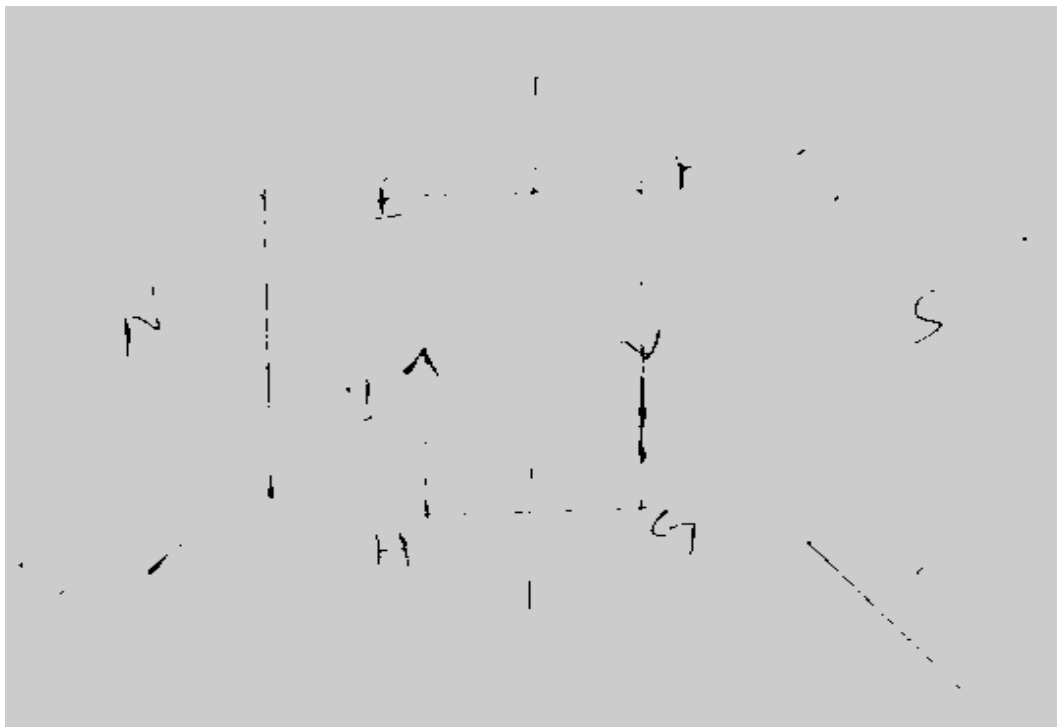
- Q.23** One day Chetan's mother developed severe ache all of a sudden. She was rushed to the doctor, who suggested for an immediate endoscopy test and gave an estimate of expenditure for the same. Chetan immediately contacted his class teacher and shared the information with her. The class teacher arranged for the money and rushed to the hospital. In realising that Chetan belongs to a below average income group family, even the doctor offered concession for the test fee. The test was conducted successfully.

Answer the following questions based on the above information.

- a) Which principle in optics is made use of in endoscopy?  
 b) Briefly explain the values reflected in the action taken by the teacher.  
 c) In what way do you appreciate the response of the doctor on the given situation?
- Q.24** a) With the help of a diagram, explain the principle and working of a moving coil galvanometer.  
 b) What is the importance of a radial magnetic field and how is it produced?

**OR**

- a) A rectangular current carrying loop EFGH is kept in uniform magnetic field as shown in the figure.  
 i) What is the direction of the magnetic moment of the current loop?  
 ii) When is the torque acting on the loop (A) maximum (B) Zero



- b) Two long straight parallel conductors carrying currents  $I_1$  and  $I_2$  in the same direction. Deduce the expression for the force per unit length between them.
- Q.25** Derive expression for (a) instantaneous power and (b) the average power over a complete cycle in case of a circuit containing inductance, resistance and capacitance. What is power factor and watt less current?

**OR**

Draw a schematic diagram of a step-up transformer. Explain its working principle. Deduce the expression for the secondary to primary voltage in terms of the number of turns in the two coils. How is the transformer used in large scale distribution of electrical energy over long distances?

- Q.26** (a) With the help of a ray diagram, show the formation of image of a point object by refraction of light at a convex spherical surface separating two media of refractive indices  $\mu_1$  and  $\mu_2$  ( $\mu_2 > \mu_1$ ) respectively. Using this diagram, derive the relation.

$$\frac{\mu_2}{v} - \frac{\mu_1}{u} = \frac{\mu_2 - \mu_1}{R}$$

(b) Two lenses of powers **10D** and **-5D** placed in contact. (i) Calculate the power of the new lens (ii) Where should an object be held from the lens, so as to obtain a virtual image of magnification 2?

**OR**

- (a) State and derive the lens makers formula. State the assumption and the sign convention used.
- (b) A convex lens of focal length 20 cm is placed coaxially with a convex mirror of radius of curvature of 20cm. The two are kept 15 cm apart. A point object is placed 40cm in front of the convex lens. Find the position of the image formed. Draw the ray diagram showing the image formation.

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