

Class – XII
Subject – PHYSICS

Marks:70

Time: 3 Hours

*(Candidates are allowed additional 15 minutes for **only** reading the paper.*

*They must **NOT** start writing during this time)*

*Answer **all** questions in **Part I** and **six** questions from **Part II**, choosing **two** questions from **each** of the Sections **A, B** and **C**.*

All working, including rough work, should be done on the same sheet as, and adjacent to, the rest of the answer.

The intended marks for questions or parts of questions are given in brackets [].

(Material to be supplied: Log tables including Trigonometric functions)

A list of useful physical constants is given at the end of this paper.

Part – I
(Compulsory)

Question – 1

A. Choose the correct alternative (a),(b), (c) or (d) for each of the questions given below: [5]

- (i) A dipole placed in a uniform electric field experiences
- (a) only a net force (b) only a torque
(c) both a net force and a torque (d) neither a force nor a torque
- (ii) The force on a charged particle moving in a magnetic field is maximum when the angle between direction of motion and field is
- (a) zero (b) 45° (c) 90° (d) 180°
- (iii) An important component of Michelson's method to determine speed of light is:
- (a) A Nicol prism (b) A bi prism (c) a grating (d) an octagonal mirror
- (iv) In a sample of radioactive material what percentage of material will decay in one half life ?
- (a) 50% (b) 37% (c) 69.3% (d) 63%
- (v) The kinetic energy of a photon depends upon.....of radiation
- (a) intensity (b) frequency (c) velocity (d) direction

B. Answer all questions briefly and to the point:

[15]

- (i) State Coulomb's law in electrostatics.
- (ii) Which conservation principle is involved in Kirchoff's second law?
- (iii) What is specific resistance?
- (iv) What is the internationally accepted value of velocity of light in vacuum? (All nine digits).
- (v) Alternating current I flowing through a device lags behind the potential difference V across it by 90° or $\pi/2$ radian. Is this electrical device a resistor, an inductor or a capacitor?
- (vi) What kind of source produces a cylindrical wave front?
- (vii) On which factors does the deviation produced by a thin prism depend?
- (viii) A convex lens forms a virtual image of an object. Where is the object? Answer in terms of focal length.
- (ix) In which state, a substance emits a line spectrum?
- (x) Write down the relation between mean life τ of a radioactive substance and its half life $T_{1/2}$.
- (xi) What is rectification?
- (xii) What is an analogue circuit? Give examples.
- (xiii) According to the modern view, matter and energy are inter-convertible. Give one example where energy is converted to matter.
- (xiv) Write down the truth table of an AND gate.
- (xv) What is meant by doping?

Part – II

Answer six questions in this part, choosing two question from each of the section A, B and C.

SECTION - A

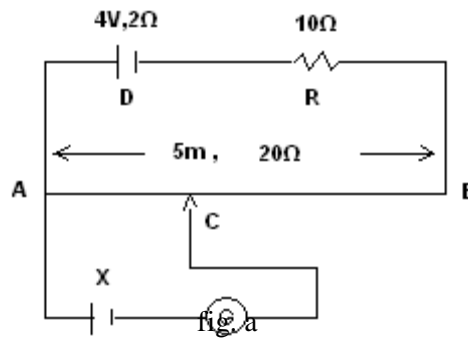
(Answer any two questions)

Question – 2

- a) What is an electric dipole? Obtain an expression for electric field at a point along the equatorial line of an electric dipole. [4]
- b) Using Gauss' Theorem, calculate intensity of electric field at a point at a radial distance of 3 cm from an infinite line charge having linear charge density of $5 \times 10^{-6} \text{ C m}^{-1}$ [2]
- c) Explain the phenomenon of induction for the electrification of a conductor [3]

Question – 3

- a) Draw a labeled diagram of a balanced wheat stone bridge. Using either Ohm's law or Kirchoff's law obtain the relation between four resistors forming the bridge. [3]
- b) Figure (a) below shows a potentiometer circuit. when the jockey is pressed on the slide wire **AB** at a point **C** such that $AC=2.9$ m the galvanometer '**G**' shows no deflection. Find the emf of the cell **X**. [3]



- c) Obtain an expression for the drift velocity in terms of relaxation time and discuss the consequences based on the value of relaxation time. [3]

Question – 4

- a) Using Ampere's Circuital Law and with the help of a labelled diagram, show that magnetic flux density '**B**' at a distance r from a long straight conductor is given by : $B = \mu_0 I / 2 r$, where the terms have their usual meaning. [3]
- b) Define 'time constant' of an LR circuit. What is its MKS unit? [2]
- c) Explain an alternating current circuit with capacitor alone. [3]

Section – B

(Answer any two questions)

Question – 5

- a) How are the electric vector **E** and magnetic vector **B** and velocity vector **C** oriented in an electromagnetic wave? [2]
- b) The distance between the first and sixth bright fringes formed in Young's double slit experiment is found to be 12.5 mm. The separation between the slit is 0.12 mm and the distance of the screen from the slits is 60 cm. Calculate (i) the fringe width, (ii) the wavelength of light used (in mm) [3]
- c) What is a Polaroid? What is meant by (i) plane polarizing light and (ii) polarizing angle? [3]

Question – 6

- a) Derive Lens Maker's Formula. [4]
- b) A glass lens is immersed in water. Will its power increase or decrease? [1]
- c) When two thin lengths f_1 and f_2 are kept in contact, prove that their combined focal length f is given by $1/f = 1/f_1 + 1/f_2$. [3]

Question – 7

- a) Explain the phenomenon of total internal reflection with neat ray diagrams. [3]
- b) Derive the condition for two thin lenses placed coaxially in contact so as to form an achromatic combination. Why are lenses of opposite nature used to form an achromatic lens combination? [3]
- c) An astronomical telescope is adjusted to form the final image at infinity. The separation between the lenses is 80 cm. The angular magnification is 15. Calculate the focal lengths of the objective lens and eyepiece. [2]

Section – C
(Answer any two questions)

Question – 8

- a) In a cathode ray-tube, an electron passes through a field, where electric field E and the magnetic field B are uniform and mutually perpendicular. Derive an expression for velocity at which the electron reaches the screen undeflected. [3]
- b) Calculate the energy and momentum of a photon of wavelength 10000 \AA . [2]
- c) State the laws of photoelectric emission. [3]

Question – 9

- a) The activity of a radioactive material drops to $1/16^{\text{th}}$ of its initial value in 24 hours. Calculate its half life and decay constant. [3]
- b) The wavelength of a yellow line of sodium is 5896 \AA . Give its wave number. [2]
- c) What is meant by hard and soft X-rays? How can the intensity and penetrating power of X-rays be controlled? [3]

Question – 10

- a) What is meant by average life of a radioactive substance? [2]
- b) Draw a labelled circuit diagram of a simple common-emitter amplifier, what is the phase angle between input and output voltages? [3]
- c) Explain energy generation in stars. [3]

USEFUL CONSTANTS

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|--|---|--|
| 1. Speed of light in vacuum | : | $c = 3 \times 10^8 \text{ ms}^{-1}$ |
| 2. Planck's constant | : | $h = 6.6 \times 10^{-34} \text{ Js}$ |
| 3. Constant of proportionality for Coulomb's Law | : | $1/4\pi\epsilon_0 = 9 \times 10^9 \text{ mF}^{-1}$ |
| 4. Bohr radius | : | $a_0 = 5.3 \times 10^{-11} \text{ m}$ |
| 5. Charge of a proton | : | $e = 1.6 \times 10^{-19} \text{ C}$ |
| 6. Constant of proportionality for Biot Savart Law | : | $\mu_0 / 4\pi = 10^{-7} \text{ Hm}^{-1}$ |