Class – XII

ubject – PHYSICS

(*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) Two infinite conducting plates separated by a distance *r* meter have equal and opposite charge densities σ. Electric field between the plates is:

(a) $\sigma/\varepsilon_o\, r$ (b) $\sigma/2\varepsilon_o$ (c) σ/ε_o (d) zero

(ii) When electric current is passed through a thermocouple, its two junctions register a difference of temperature. This effect is called

(a) Peltier's effect (b) Seebeck effect (c) Thomson's effect (d) Joule's effect

(iii) The colour of light that travels slowest in glass is :

(a) red (b) green (c) yellow (d) violet

(iv) The momentum of a radiation photon is 3.3×10^{-23} kg m s^{-1}. The frequency of radiation is

(a) 5.0×10^{6} Hz (b) 4.5×10^{21} Hz (c) 4.5×10^{13} Hz (d) 1.5×10^{13} Hz

(v) The ratio of the radii of the nuclei $_{13}Al^{27}$ and $_{52}Te^{125}$ is :

(a) 3:5 (b) 13:52 (c) 27:125 (d) 14:73

B. Answer all questions briefly and to the point: [15]

(i) How will the force between two equal charges change if the charges are halved and distance between them is doubled?

(ii) How does the energy of a parallel plate capacitor change when the area of plates is doubled?

(iii) Differentiate between heating effect produced by Peltier and Joule effects.

(iv) Arrange the three types of magnetic materials in decreasing order of the magnetic susceptibility.

(v) A 0.4 m long straight conductor is moved in a magnetic field of induction 0.9 Wb m^{-2} with a velocity of 7 m s^{-1}. Calculate the maximum emf induced in the conductor.

(vi) Name any two properties which are common to all parts of electromagnetic spectrum.

(vii) In the field of view of Young's experiment using light of wavelength $6600A^{o}$, 60 fringes are observed. How many fringes are observed in the same region when light of $4400A^{o}$ is employed?

(viii) For observing Fraunhofer diffraction from a single slit, what type of wave front should be incident on this slit?

(ix) If the polarising angle for air-glass interface is 56^{o}, what will be the angle of refraction in glass?

(x) Calculate the critical angle for glass and water pair?

(xi) Two thin lenses of powers +15 D and -15D are put in mutual contact. Find the power, focal length and nature of this combination.

(xii) What is natural radioactivity?

(xiii) Find the momentum of the photon of energy 3.0 eV.

(xiv) The energy of an electron in the first Bohr orbit of an atom is -27.2 eV. What will be its energy in third Bohr orbit?

(xv) Why is a NAND gat called as universal gate?

Part – II

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

SECTION - A

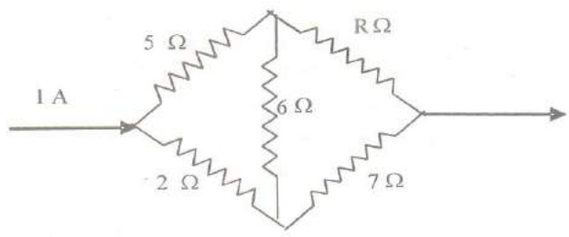
(Answer any two questions)

Question – 2

a) State Gauss theorem in electrostatics. Drive the expression for the electric field at distance r due to an infinite wire having a linear charge density λ C/m. [4]

b) What is dipole moment? What will be the electric field at a point 15 cm on the axis of the dipole having $2x10^{-7}$ Cm as dipole moment. [3]

c) In the following circuit what must be the value of R such that the current in the 6 Ω resistance is zero? What is the current in 7Ω resistor at this value? [2]



Question – 3

a) Two capacitors have capacity 15μF when connected in parallel and 10/3 μF when connected in series. What are the individual capacity of capacitors? [3]

b) Draw a circuit diagram and explain the method for the determination of internal resistance of a cell using potentiometer. Derive the formula to be used. [4]

c) Two identical small magnetic dipoles of magnetic moments 2 Am^2 each are placed at a separation of 2 m with their axes perpendicular to each other. Find the resultant magnetic field at a mid-way between them. [2]

Question – 4

a) Obtain the relation $I=I_o \sin(\omega t +\pi/2)$ and $X_c = 1/C\omega$ for a pure capacitor across which an ac emf $e= E_o \sin \omega t$ is applied. Draw the phasor diagram showing emf E, current I and their phase difference φ [4]

b) An a.c voltage of 200 V is applied on primary and 1400 V is obtained in secondary. Find the ratio of current of secondary to primary of the transformer. [2]

c) An a.c. source of frequency 50 Hz is connected to a 69 mH inductor and a bulb. The bulb glows with some brightness. Calculate the capacitance of the capacitor to be connected in series with the circuit, so that the bulb glows with maximum brightness. [3]

Section – B

(Answer any two questions)

Question – 5

a) Why the amplitude of two sources must be almost equal to observe interference? The ratio of amplitude of two waves is 3:5. What would the ratio of their maximum and minimum intensities? [2]

b) Derive the expression for the point to be bright in Young's double slit experiment [3]

c) Show that the deviation produced by an acute angled prism is $(\mu-1)A$, where A is angle of prism and μ is refractive index of prism material. [3]

Question – 6

a) The focal length of a concave lens is 20 cm. The focal length of a convex lens is 25 cm. These two are placed in contact with each other. What is the power of combination? Is it diverging, converging or undeviating in nature? [3]

b) Draw a neat labeled ray diagram to show how the image of a distant object is formed by an astronomical refracting telescope in normal adjustment. Write (do not derive) an expression for its magnifying power. [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 the eyepiece. [2]

Question – 7

a) Derive Snell's law of refraction on the basis of Huygens principle. [3]

b) A slit of width d is illuminated by light of wavelength 5500 A^o. What will be the value of slit width 'a' when (i) first minimum falls at an angle of diffraction 30^o ?
(ii) first maximum falls at an angle of diffraction 30^o ? [2]

c) State Brewster's law. Prove that reflected ray and refracted ray are perpendicular at Brewster angle. [3]

Section – C

(Answer any two questions)

Question – 8

a) Derive an expression for the radius of n^{th} orbit using Bohr's theory of hydrogen atom. If the radius of the second orbit is 20 nm, what will the radius of 4^{th} orbit? [3]

b) The threshold wavelength of tungsten is 240 nm. It is illuminated with a light of wavelength 160 nm. Find (i) Work Function (ii) Maximum kinetic energy (iii) Stopping potential [3]

c) An electron being accelerated by a potential difference of 100V enters a region of magnetic field of 0.004 T perpendicular to its motion. Calculate the radius of the path of the electron. [2]

Question – 9

a) What are tree main parts of a nuclear reactor? Explain in short functions of each. [3]

b) What is an integrated circuit? What is its main advantage over discrete components? [2]

c) Explain about binding energy and its variation with mass number with graph? [3]

Question – 10

a) (i) In Nuclear Physics, what is the use of a cyclotron ? [2]

(ii) In a nuclear reactor, what is the function of a moderator ?

b) (i) State Mosley's Law. [4]

(ii) What is a neutrino?

(iii) Half life of a certain radio active element is 6 hours. If you start with 32g of this element how much of it would disintegrate in one day?

c) Show how an OR gate can be obtained using NAND gates. [2]

USEFUL CONSTANTS

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