**HOLY ANGELS MODEL SCHOOL, PATHANAMTHITTA**

**EXAMINATION I**

**Class XII**

**Physics (042)**

**Time allowed: 3 hours. Max. Marks: 70**

**General Instructions :**

*1. All questions are compulsory. There are 37 questions in all.*

*2. This question paper has four sections: Section A, Section B, Section C, and Section D.*

*3. Section A contains 20 questions of one mark each, Section B contains 7 questions of two marks each, Section C contains 7 questions of three marks each, and Section D contains 3 questions of five marks each.*

*4. There is no overall choice. However, an internal choice has been provided in, 2 question of two marks 2 questions of three marks and 3 question of five marks weightage. You have to attempt only one of the choices in such questions.*

*5. You may use the following values of physical constants wherever necessary*

c = $3×10^{8}$ m/s

h = $6.63 x 10^{-34} $Js

e = $1.6 x 10^{-19} $C

μo = $4 x 10^{-7} T m A^{-1}$

$ε$0 = $8.854 x 10^{-12} C^{2} N^{-1} m^{-2}$

$\frac{1}{4πε0}=9 x 10^{9} N m^{2} C^{-2}$

me = $9.1 x 10^{-31} kg$

mass of neutron = $1.675 x 10^{-27} kg$

mass of proton = $1.673 x 10^{-27} kg$

Avogadro’s number = $6.023 x 10^{23} per gram mole $

Boltzmann constant = $1.38 x 10^{-23} JK^{-1}$

**Section A**

1. Write a relation for polarization P of a dielectric material in the presence of an external electric field E
2. Define the term mobility of charge carriers. Write S I unit
3. How does the random motion of free electrons in a conductor get affected when a potential difference is applied across its ends?
4. Sketch the electric field lines for two point charges q1 and q2 for q1 = q2 and q1> q2 separated by a distance d
5. Why do the equipotential surfaces due to a uniform electric field not intersect each other?
6. Define electrical conductivity of a conductor and give its SI unit. On what factors does it depend?
7. Define temperature coefficient of resistivity
8. Name the physical quantity whose SI unit is$JC^{-1}$. Is it a scalar quantity?
9. A point charge +Q is placed in the vicinity of a conducting surface. Draw the electric field lines between the surface and the charge.
10. Nichrome and copper wires of same length and same radius are connected in series. Current I is passed through them. Which wire gets heated up more? Justify your answer
11. Define the intensity of radiation on the basis of photon picture of light. Write its SI unit
12. Write the basic features of photon picture of electromagnetic radiation on which Einstein’s photoelectric equation based.
13. Draw graphs showing variation of photoelectric current with applied voltage for two incident radiations of equal frequency and different intensities. Mark the graph for the radiation of higher intensity.
14. Do electromagnetic waves carry energy and momentum?
15. Name the phenomenon which shows the quantum nature of electromagnetic radiation
16. Four nuclei of an element undergo fusion to form a heavier nucleus, with release of energy. Which of the two  the parent or the daughter nucleus  would have higher binding energy per nucleon?
17. Two particles have equal momenta. What is the ratio of their de-Broglie wavelengths?
18. Monochromatic light of frequency 6.0x 1014 Hz is produced by a laser. What is the energy of photon in the light beam?
19. The photoelectric cutoff voltage in a certain experiment is 1.5V. what is the maximum kinetic energy of the protons emitted?
20. What is the shortest wavelength present in the Paschen series of spectral lines

**Section B**

1. A parallel plate capacitor of capacitance C is charged to a potential V. it is then connected to another uncharged capacitor having the same capacitance. Find out the ratio of energy stored in the combined system to that stored initially in the single capacitor
2. Explain the working of Wheatstone Bridge
3. A network of resistors is connected to a 16 V battery with internal resistance of 1Ώ as shown in the following figure. Compute the equivalent resistance of the network



 OR

A 9 V battery is connected in series with a resistor .The terminal voltage is found to be 8 V. Current through the circuit is measured as 5 A. What is the internal resistance of the battery

1. Assume that there is no repulsive force between the electrons in the atom but the force between positive and negative charges are given by Coulomb’s Law as usual. Under such circumstances, calculate the ground state energy of a He atom
2. Derive an expression for debroglie wavelength of an electron?
3. Light of wavelength 2000 Å falls on an aluminum surface. In aluminum 4.2 eV are required to remove an electron. What is the kinetic energy of (a) fastest (b) the slowest photoelectron?

 OR

An electromagnetic wave of wavelength λ is incident on a photosensitive surface of negligible work function. If the photoelectrons emitted from this surface have deBroglie wavelengthλ1 . Prove that $λ=\left(\frac{2mc}{h}\right)λ1^{2}$

1. Express 16mg mass into equivalent energy in electron volt?

**Section C**

1. Two point charges q1 and q2 are located at r1 and r2 respectively in an external electric field E. Obtain the expression for the total work done in assembling this configuration

 OR

Two closely spaced equipotential surfaces A and B with potentials V and V + ᵟV 'where ᵟV is the change in V) are kept *ᵟl* distance apart as shown in the figure. Deduce the relation between the electric field and the potential gradient between them. Write the two important conclusions concerning the relation between the electric field and electric potentials.

1. Two parallel plate capacitors of capacitance C1 and C2 such that C1 = 2C2 are connected across a battery of V volts a shown in the figure. Initially the key is kept closed to fully charge the capacitors. The key is now thrown open and a dielectric slab of dielectric constant K is inserted in two capacitors to completely fill the gap between the plates. Find the ratio of (i) the net capacitance and (ii) the energies stored in the combination before and after the introduction of the dielectric slab.
2. Describe briefly, with the help of a circuit diagram, how a potentiometer is used to determine the internal resistance of a cell.
3. Determine the value of the de Broglie wavelength associated with the electron orbiting in the ground state of hydrogen atom (Given En =$-(13.6/n^{2})$eV and Bhor radius ro =$0.53Å$). How will the de Broglie wavelength change when it is in the first excited state?
4. A monochromatic radiation of wavelength 975 Å excites the hydrogen atom from its ground state to a higher state. How many different spectral lines are possible in the resulting spectrum? Which transition corresponds to the longest wavelength amongst them?
5. In a given sample, two radioisotopes, A and B, are initially present in the ratio 1:4. The half-lives of A and B are respectively 100 and 50 years. Find the time after which the amounts of A and B became equal?

 OR

How are protons, which are positively charged, held together inside a nucleus? Explain the variation of potential energy of a pair of nucleons as a function of their separation. State the significance of negative potential energy in this

1. Using photon picture of light, show how Einstein’s photoelectric equation can be established. Write two features of photoelectric effect which cannot be explained by wave theory.

**Section D**

1. (a) Define electric dipole moment. Is it a scalar or vector? Derive the expression for the electric field of a dipole at a point on the equatorial plane of the dipole.

b) Draw the equipotential surfaces due to an electric dipole. Locate the points where the potential due to dipole is zero.

 OR

Using Gauss’ law deduce the expression for the electric field due to a uniformly charged spherical conducting shell of radius R at a point i) outside and ii) 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 center of the shell)

1. (a) State the working principle of potentiometer. With the help of circuit diagram, explain how a potentiometer id\s used to compare the emf’s of two primary cells. Obtain the required expression used for comparing the emf’s

(b) Write two possible causes for one sided deflection in a potentiometer experiment

 OR

(a) Write the principle of working of a metre bridge.

(b) In a metre bridge, the balance point is found at a distance *l*1 with

resistances R and S as shown in the figure.



An unknown resistance X is now connected in parallel to the resistance S and the balance point is found at a distance *l*2. Obtain a formula for X in terms of *l*1, *l*2 and S.

(c) At room temperature(27$℃$) the resistance of a heating element is 100Ω. What is the temperature of the element if the resistance is found to be 117Ω, given that the temperature coefficient of the material os $1.70 ×10^{-4}℃^{-1}$

1. (a) State Gauss’ law. Using this law, obtain the expression for the electric field due to an infinitely long straight conductor of linear charge density λ.

(b) A wire AB of length L has linear charge density λ = kx, where x is measured from the end A of the wire. This wire is enclosed by a Gaussian hollow surface. Find the expression for the electric flux through this surface.

 OR

 (a) Derive the expression for the electric potential at any point P, at distance r from the centre of an electric dipole, making angle , with its axis. (b) Two point charges 4 C and +1 C are separated by a distance of 2 m in air. Find the point on the line-joining charges at which the net electric field of the system is zero.