PRE BOARD EXAMINATION JANUARY 2020

Class: XII **PHYSICS** **Max.Marks: 70**

Date: 12/01/2020 **Time: 3 hrs**

General Instructions:

i. All questions are compulsory. There are 37 questions in total.
ii. This question paper has four sections.
iii. Section A contains twenty questions of 1 mark each, Section B contains seven questions of 2 marks each, Section C contains seven questions of 3 marks each and section D contains three questions of 5 marks each.
iv. There is no overall choice. However an internal choice has been provided in one question of one mark, one question of two marks, one question of three marks and all questions of five marks. You have to attempt only one of the choices in such questions.
v. You may use the following values of physical constants wherever necessary:

$C = 3\times10^{8}$ m/s $h = 6.63\times10^{-34}$ Js $e = 1.6\times10^{-19}$C $\mu_0 = 4\pi\times10^{-7}$ T m A^{-1}

$\varepsilon_0 = 8.854\times10^{-12}\ C^2N^{-1}m^{-2}$ $\frac{1}{4\pi\varepsilon_0} = 9\times10^{9}\ Nm^2C^{-2}$ Mass of electron= 9.1×10^{-31} kg

Mass of neutron= 1.675×10^{-27} kg Mass of proton= 1.673×10^{-27} kg

Avogadro's number=6.023×10^{23}/g mol Boltzmann constant = 1.38×10^{-23} JK^{-1}

SECTION -A

1. A radioactive nucleus (initial mass number A and atomic number Z) emits three α particles and two positrons. The ratio of number of neutrons to that of protons in the final nucleus will be

a) $\frac{A-Z-4}{Z-2}$ b) $\frac{A-Z-8}{Z-4}$ c) $\frac{A-Z-4}{Z-8}$ d) $\frac{A-Z-12}{Z-4}$

2. The magnetic field in a plane electromagnetic field is given by

$B_y = 2\times10^{-7}$ Sin $(0.5\times10^{3}\ z + 1.5\times10^{11}t)$ T. Then the electric field will be

a) $E_y = 2\times10^{-7}$ Sin $(0.5\times10^{3}\ z+1.5\times10^{11}t)$ v/m b) $E_x = 2\times10^{-7}$ Sin $(0.5\times10^{3}\ z+1.5\times10^{11}t)$ v/m

c) $E_y = 60$ Sin $(0.5\times10^{3}\ z+1.5\times10^{11}t)$ v/m d) $E_x = 60$ Sin $(0.5\times10^{3}\ z+1.5\times10^{11}t)$ v/m

3. If an electron and proton have the same de-Broglie wavelength, then the kinetic energy of the electron (Ee) is:

a) Zero b) <Ep c) = Ep d) >Ep

4. An electric dipole is placed at an angle of 30° with an electric field of intensity 2×10^{5} N/C. It experiences a torque of 4 Nm. Find the charge on the dipole if the dipole length is 2cm.

a) 4mC b) 2 mC c) 8mC d) 1 mC

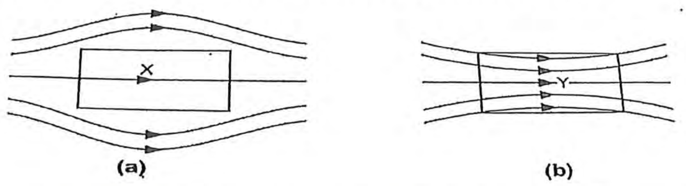
5. Which wavelength belongs to visible region of hydrogen atom spectrum?

a) 698 A^0 b) 1293 A^0 c) 970 A^0 d) 824 A^0

6. A moving electron enters a uniform and perpendicular magnetic field. Inside the magnetic field, the electron travels along:

a) a straight line b) a parabola c) a circle d) a hyperbola

7. A uniform magnetic field gets modified as shown below, when two specimens X and Y are placed in it. Choose the correct answer



a) X is paramagnetic, Y is diamagnetic b) X is para magnetic, Y is ferromagnetic

c) X is diamagnetic, Y is paramagnetic d) X is diamagnetic, Y is ferromagnetic

8. The frequency of gamma rays, X rays and ultraviolet rays are p, q and r respectively. Then

a) $p>q>r$ b) $p<q<r$ c) $p=q=r$ d) $p>r>q$

9. The physical quantity which has its unit joule coulomb^{-1} is

a) electric field intensity b) electric potential

c) electric dipole moment d) charge density

10. A square of side L meters lies in the x y plane in a region where the magnetic field is given by $B=B_0\,(2i+3j+4k)$ Tesla, where B_0 is constant. The magnitude of flux passing through the square is

a) $2B_0L^2$ Wb b) $3B_0L^2$ Wb c) $4B_0L^2$ Wb d) $\sqrt{29}\,B_0L^2$ Wb

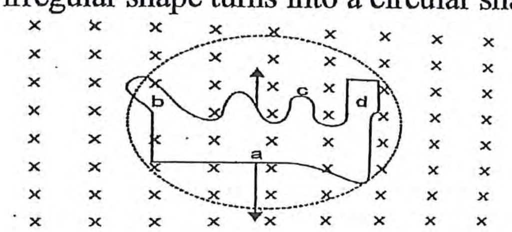
11. ——— type semiconductor is formed when Germanium is doped with Indium.

12. The power of a convex lens is found using red and violet light. The power is less in case of ——————— light.

13. The distance of the field point on the equatorial plane of a small electric dipole is halved. The electric field due to the dipole will becomes ——— times initial value.

14. Two lenses of powers -15 D and +5 D are in contact with each other. The focal length of combination is ———————.

15. If a wire of irregular shape turns into a circular shape as shown in the diagram.



The direction of induced current will be ——————.

16. Half-life of a radioactive substance is 12.5 h and its mass is 256 g. After what time, the amount of remaining substance is 1 g?

17. Two insulated charged copper spheres A and B of identical size have charges q_A and $-3q_A$ respectively. When they are brought in contact with each other and then separated, what are the new charges on them?

18. Three photo diodes D1, D2 and D3 are made of semiconductors having band gaps of 2.5 ev, 2ev and 3ev respectively. Which ones will be able to detect light of wavelength 6000 A^0.

19. A photosensitive surface emits photoelectrons when red light falls on it. Will the surface emit photoelectrons when blue light is incident on it?

20. Identify the electromagnetic wave whose wavelength vary as 10^{-12} m<λ<10^{-8}m. Write any one use of this wave.

OR

Why did Maxwell introduce the concept of displacement current? Explain.

SECTION B

21. Derive an expression for the law of radioactive decay of a given sample having initially N_0 nuclei decaying to the number N present at any subsequent time t.

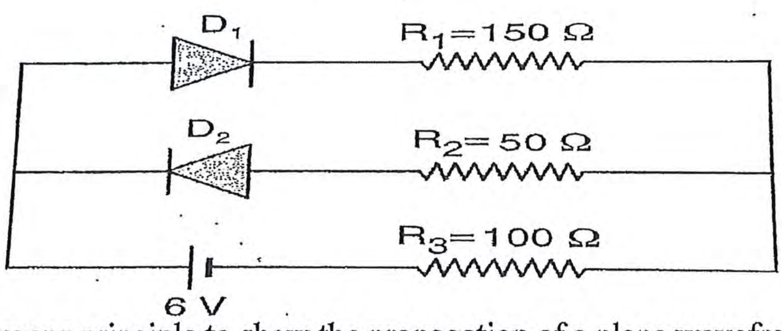
22. A short bar magnet of magnetic moment M=0.32 J/T is placed in a uniform magnetic field of 0.15 T. If the bar is free to rotate in the plane of the field, which orientation would correspond to its i) stable and ii) unstable equilibrium? What is the potential energy of magnet in each case?

23. Derive an expression for the magnetic dipole moment of a revolving electron?

24. The threshold frequency of a metal is f_0. When the light of frequency $2f_0$ is incident on the metal plate, maximum velocity of electrons emitted is V_1. When the frequency of incident radiation is increased to $5f_0$ maximum velocity of electrons emitted is V_2. Find the ratio of V_1 to V_2?

25. Define the term self- inductance of a coil. If the number of turns in the solenoid is doubled, keeping other factors constant, how does the self-inductance of the coil changes?

26. The circuit shown in the figure contains two diodes each with a forward resistance 50Ω and with infinite backward resistance. If the battery voltage is 6 V, find the current through the 100 Ω resistance?



27. Use Huygens principle to show the propagation of a plane wavefront from a rarer medium to a denser medium. Hence derive Snell's law.

OR

a) Use Huygens geometrical construction to show the behaviour of a plane wavefront i) passing through a biconvex lens ii) reflected by a concave mirror.

b) When monochromatic light is incident on a surface separating two media why does the refracted light have the same frequency as that of incident light?

SECTION C

28. a) A straight thick long wire of uniform circular cross section of radius 'a' is carrying a steady current I. The current is uniformly distributed across the cross section. Use Ampere's circuital law to obtain a relation showing the variation of the magnetic field B inside and outside the wire with distance r,($r \leq a$) and $r > a$ of the field point from the centre of its cross section.
b) What is the magnetic field at the surface of this wire? Plot a graph showing the nature of this variation.

OR

a) Derive an expression for the magnetic field at a point P on the axis of a current carrying circular loop.

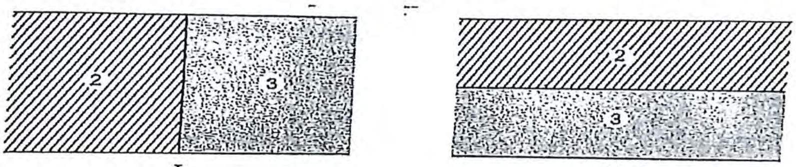
29. Using Bohr's postulates for hydrogen atom, show that the total energy (E) of the electron in the stationary states can be expressed as the sum of kinetic energy (K) and potential energy (U), where $K = -2U$. Hence deduce the expression for the total energy in the n^{th} energy level of hydrogen atom.

30. State the principle of working of p-n diode rectifier. Explain with the help of a circuit diagram the use of p-n diode as a full wave rectifier. Draw a sketch of the input and output waves forms?

31. i) Light passes through two polaroids P_1 and P_2 with axis of P_2 making an angle θ with the pass axis of P_1. For what value of θ is the intensity of emergent light zero?

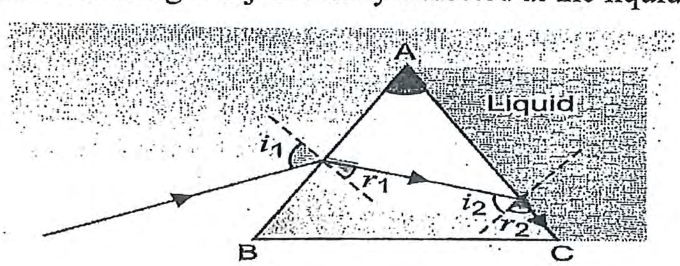
ii) A third polaroid is placed between P_1 and P_2 with its pass axis making an angle β with the pass axis of P_1. Find a value of β for which the intensity of light emerging from P_2 is $I_0/8$, where I_0 is the intensity of light on the polaroid P_1.

32. A parallel plate capacitor with no dielectric has a capacitance of 0.5 μF. The space between the plates is then filled with equal amounts of two dielectrics of dielectric constant 2 and 3. Find the ratio of capacitances CI and CII .



I II

33. One face of a prism of refractive index 3/2 and angle 75° is covered with a liquid of refractive index $\frac{3\sqrt{2}}{4}$. What should be the angle of incidence of light on clear face of the prism for which light is just totally reflected at the liquid covered face?



34. An early model for an atom considered it to have a positively charged point nucleus of charge Ze, surrounded by a uniform density of negative charge up to a radius R. The atom as a whole is neutral. For this model, what is the electric field at a distance r from the nucleus?

SECTION D

35. i)A point object is placed on the principal axis of a convex spherical surface of radius of curvature R, which separates the two media of refractive indices n_1 and n_2 ($n_2>n_1$). Draw the ray diagram and deduce the relation between the object distance (u) ,image distance (v) and the radius of curvature R for refraction to take place at the convex spherical surface from rarer to denser medium.

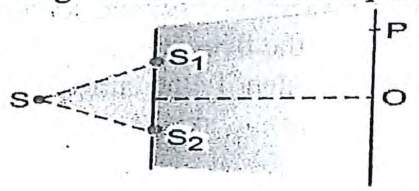
ii) In a liquid lens arrangement with equi convex lens of refractive index 1.5, a small needle with its tip on principal axis is moved along the axis until its inverted image is found at the position of the needle. The distance of needle from lens is measured to be 45cm. On removing liquid layer and repeating the experiment the distance is found to be 30cm. Find the refractive index of the liquid.

OR

i) Find the intensity at a point on a screen in Young's double slit experiment where the interfering waves have a path difference of a) $\lambda/6$ b) $\lambda/2$.

ii) Figure shows an experimental setup similar to young's double slit experiment to observe interference of light. Here SS_2-SS_1= $\lambda/4$. Write down the condition for Constructive interference and Destructive interference at any point P in terms of path difference S_2P-S_1P.

Does the central fringe observed in this setup lie above or below O. Give reason?

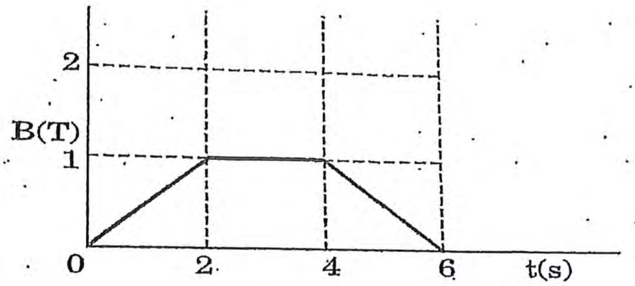


36. A device X is connected across an ac source of voltage $V=V_0 \sin\omega t$. The current through X is given as $I=I_0\sin(\omega t+\pi/2)$.

a) Identify the device X and write the expression for its reactance. b) Draw graphs showing variation of voltage and current with time over one cycle of ac for X.
c) How does the reactance of the device X vary with frequency of the ac? Show this variation graphically. d) Draw the phasor diagram for the device X.

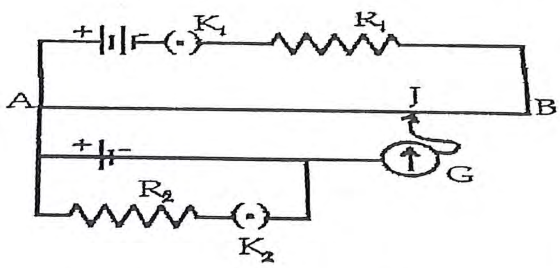
OR

i) State Faraday's law of electromagnetic induction.
ii) The magnetic field through a circular loop of wire 12cm in radius and 8.5Ω resistance, changes with time as shown in the figure. The magnetic field is perpendicular to the plane of the loop. Calculate the induced current in the loop and plot it as a function of time.



iii) Show that Lenz's law is a consequence of conservation of energy.

37. a) For the circuit shown here, would the balancing length increases, decreases or remain the same, if i) R_1 is decreased ii) R_2 is increased without any other change (in each case) in the rest of the circuit. Justify your answer in each case.



b) A cell of unknown emf E and internal resistance r , two unknown resistances R_1 and R_2 (R_2>R_1) and a perfect ammeter are given. The current in the circuit is measured in five different situations: i) without any external resistance in the circuit ii) with resistance R_1 only iii) with resistance R_2 only iv) with both resistances R_1 and R_2 used in series combination v) with both resistances R_1 and R_2 used in parallel combination. The currents obtained in the five cases are 0.42 A, 0.6A, 1.05A, 1.4A and 4.2 A but not necessarily in order, identify the currents in five cases listed above and calculate E, r, R_1 and R_2?

OR

i) a) In the meter bridge experiment, balancing point was observed at length L from the left end. The value of R and X were doubled and interchanged. What would be the new position of balancing point?

b) If the galvanometer and battery are interchanged at the balance position , how will the balance point get affected?

ii) The galvanometer in each of the two given circuits does not show any deflection. Find the ratio of the resistors R_1 and R_2 used in these two circuits.