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| **EEE CONSORTIUM**  **PRE BOARD EXAMINATION – II (2023 -2024)** | | | | |
| **PB2/PHQP/1223/E 02-JAN-2024** | | | | |
| **Subject: Physics**  **Grade: XII** | | | **Max. Marks: 70**  **Time :3 hours** | |
| **Name:** | | **Section:** | **Roll No:** | |
| ***General Instructions:***   * *There are* ***33*** *questions in total. All questions are compulsory.* * *This question paper has five sections: Section A, Section B, Section C, Section D and Section E. All the sections are compulsory.* * *Section A contains twelve MCQs and four A & R questions of 1 mark each, Section B contains five questions of two marks each, Section C contains seven questions of three marks each, section D contains two case study-based questions of 4 marks each and Section E contains three long questions of five marks each.* * *There is no overall choice. However, an internal choice has been provided in two questions of section B, two questions of section C and all three questions of section D. You have to attempt only one of the given choices in such questions.* * *You may use the following values of physical constants wherever necessary:*   c = 3 x 10 8ms–1 h = 6.63 x 10 – 34 Js  e = 1.6 x 10 – 19 C Rydberg’s constant R = 1.09 x 107 m – 1  Mass of electron, me = 9.1 x 10 – 31 kg Mass of proton, mp = 1.673 x 10 – 27 kg  Avogadro’s number = 6.023 x 10 23 per gram mole Boltzmann constant, kB=1.38 x 10 – 23 J K – 1 | | | | |
| **SECTION A** | | | | |
|  | Two spheres A and B of radius ‘a’ and ‘b’ respectively are charged to the same potential. Find the ratio of surface charge density of sphere A to B.  a) b) c) d) | | | 1 |
|  | A metallic hemisphere of radius ‘r’ is placed in a region having a uniform electric field E perpendicular to its cross -section. The electric flux passing through the hemisphere is:  a) πr2E b) 2πr2E c) 2πrE d) 2/3 πr3E | | | 1 |
|  | The maximum kinetic energy(Ek) of photoelectrons varies with frequency (*f*) of the incident radiation as:  a)b)c) d) | | | 1 |
|  | At an axial point, distance ‘r’ away from the center of an electric dipole, the electric potential is proportional to:  a) r b) r – 1  c) r3 d) r – 3 | | | 1 |
|  | A conducting circular loop of radius ‘r’ carries a constant current ‘I’. It is placed in a uniform magnetic field ‘B’, such that magnetic field is perpendicular to the plane of the loop. The magnetic force acting on the loop is:  a) πrB b) 2πrB c) zero d) πr2B | | | 1 |
|  | A diamagnetic substance is brought near the north or south pole of a bar magnet. It will be :   1. repelled by both the poles. 2. attracted by both the poles. 3. repelled by the north pole and attracted by the south pole. 4. attracted by the north pole and repelled by the south pole. | | | 1 |
|  | A long straight wire of radius ‘a’ carries a steady current ‘I’. The current is uniformly distributed over its cross-section. The ratio of the magnetic fields B and B′, at radial distances a/2 and 2a respectively, from the axis of the wire is.   1. 1/2 2. 1 3. 2 4. 4 | | | 1 |
|  | The magnetic field lines near a substance are as shown in the figure. The substance is :     1. Copper 2. Iron 3. Sodium 4. Aluminium | | | 1 |
|  | Figure shows two electric circuits A and B. Calculate the ratio of power factor of the circuit B to the Power factor of the circuit A     1. 2 2. 1 3. 4 | | | 1 |
|  | Displacement current exists only when   1. electric field is changing. 2. magnetic field is changing. 3. electric field is not changing. 4. magnetic field is not changing | | | 1 |
|  | When current in a coil change from 5 A to 2 A in 0.1 s, average voltage of 50 V is produced. The self-inductance of the coil is  a) 1.67 H  b) 6 H  c) 3 H  d) 0.67 H | | | 1 |
|  | Which one did Rutherford consider to be supported by the results of experiments in which α-particles were scattered by gold foil?  a) The nucleus of an atom is held together by forces which are much stronger than electrical or gravitational forces.  b) The force of repulsion between an atomic nucleus and an α-particle varies with distance according to inverse square law.  c) α-particles are nuclei of Helium atoms.  d) Atoms can exist with a series of discrete energy levels | | | 1 |
|  | **Two statements are given-one labelled Assertion (A) and the other labelled Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below.**  **a) Both A and R are true and R is the correct explanation of A**  **b) Both A and R are true and R is NOT the correct explanation of A 1**  **c) A is true but R is false**  **d) A is false and R is also false**  **Assertion:** Though light of a single frequency (monochromatic) is incident on a metal, the energies of emitted photoelectrons are different.  **Reason:** The energy of electrons emitted from inside the metal surface, is lost in collision with the other atoms in the metal. | | | 1  1 |
|  | **Two statements are given-one labelled Assertion (A) and the other labelled Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below.**  **a) Both A and R are true and R is the correct explanation of A**  **b) Both A and R are true and R is NOT the correct explanation of A 1**  **c) A is true but R is false**  **d) A is false and R is also false**  **Assertion:** The temperature coefficient of resistance is positive for metals and negative for p-type semiconductor.  **Reason:** The effective charge carriers in metals are negatively charged whereas in p-type semiconductor they are positively charged. | | | 1 |
|  | **Two statements are given-one labelled Assertion (A) and the other labelled Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below.**  **a) Both A and R are true and R is the correct explanation of A**  **b) Both A and R are true and R is NOT the correct explanation of A 1**  **c) A is true but R is false**  **d) A is false and R is also false**  **Assertion:** Hydrogen atom consists of only one electron, but its emission spectrum has many lines.  **Reason:** Only Lyman series is found in the absorption spectrum of hydrogen atom whereas in the emission spectrum, all the series are found. | | | 1 |
|  | **Two statements are given-one labelled Assertion (A) and the other labelled Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below.**  **a) Both A and R are true and R is the correct explanation of A**  **b) Both A and R are true and R is NOT the correct explanation of A 1**  **c) A is true but R is false**  **d) A is false and R is also false**  **Assertion:** The focal length of an equiconvex lens of radius of curvature R made of material of refractive index μ = 1.5, is R.  **Reason:** The focal length of the lens will be R/2. | | | 1 |
| **SECTION B** | | | | |
|  | Draw the circuit diagram of a full wave rectifier. Also write its working principle. | | | 2 |
|  | Plot a graph showing the variation of de Brogue wavelength (λ) associated with a charged particle of mass m, versus 1/√ V where V is the potential difference through which the particle is accelerated. How does this graph give us information regarding the magnitude of the charge of the particle? | | | 2 |
|  | A ray of light is incident on a prism at an angle of 45 and passes symmetrically as shown in the figure. Calculate: the angle of minimum deviation  the refractive index of the material of the prism, and  the angle of refraction at the point P. | | | 2 |
|  | Three cells, each of emf E but internal resistances 2r,3r and 6r are connected in parallel across a resistor R. Obtain expressions for a) current flowing in the circuit b) the terminal potential difference across the equivalent cell. | | | 2 |
|  | Draw a labelled diagram of image formation by a refracting telescope when final image if formed at least distance of distinct vision of human eye.  **OR**  Draw a labelled diagram of image formation by a compound microscope when final image if formed at least distance of distinct vision of human eye. | | | 2 |
| **SECTION C** | | | | |
|  | 1. Depict the variation of the potential energy of a pair of nucleons with the separation between them. 2. Imagine the fission of a into two equal fragments of nucleus. Is fission energetically possible? Justify your answer by working out the Q value of the process.   Given: m = 55·93494 u, m = 27·98191 u. | | | 3 |
|  | 1. Define electric flux and write its SI unit. 2. Use Gausss law to obtain an expression for the electric field intensity at a point due to an infinitely long uniformly charged straight wire with uniform linear charge density λ .Draw the necessary diagram. | | | 3 |
|  | The energy levels of an atom of element are shown in the diagram. Which one of the level transitions result in the emission of photons of wavelength 620 nm?  Support your answer with mathematical calculations. | | | 3 |
|  | State Kirchhoff's rules.Use these rules to write the expressions the  currents I_1,I_2 and I_3 in the circuit diagram shown.a) Use the Kirchhoff’s rules to write the expressions  for currents I1, I2 and I3 in the circuit diagram shown  on the side.  b) Also find the value of these currents. | | | 3 |
|  | Two identical circular wires P and Q each of radius R and carrying current ‘I’ are kept in perpendicular planes such that they have a common centre as shown in the figure. Find the magnitude and direction of the net magnetic field at the common centre of the two coils.    Important Questions for Class 12 Physics Chapter 4 Moving Charges and Magnetism Class 12 Important Questions 221 | | | 3 |
|  | a) Write two properties of electromagnetic waves.  b) Draw the waveform of an electromagnetic wave travelling along + z axis having electric field oscillating along + y axis. | | | 3 |
|  | A coil of number of turns N, area A, is rotated at a constant angular speed ω, in a uniform magnetic field B, and connected to a resistor R. Deduce expressions for :  a) Maximum emf induced in the coil.  b) Power dissipation in the coil.  **OR**  A conducting rod rotates with angular speed w with one end at the centre and other end at circumference of a circular metallic ring of radius R, about an axis passing through the centre of the coil perpendicular to the plane of the coil A constant magnetic field B parallel to the axis is present everywhere. Show that the emf. between the centre and the metallic ring is | | | 3 |
| **SECTION D** | | | | |
|  | A silicon p-n junction diode is connected to a resistor R and a battery of voltage VB through milliammeter (mA) as shown in figure. The knee voltage for this junction diode is VN = 0 7. V. The p-n junction diode requires a minimum current of 1 mA to attain a value higher than the knee point on the I-V characteristics of this junction diode. Assuming that the voltage V across the junction is independent of the current above the knee point. A p-n junction is the basic building block of many semiconductor devices like diodes. Important process occurring during the formation of a p-n junction are diffusion and drift. In an n-type semiconductor concentration of electrons is more as compared to holes. In a p-type semiconductor concentration of holes is more as compared to electrons.      1) Draw energy band diagram of n-typed and p-typed semiconductor at temperature T > 0 K. Mark the donor and acceptor energy level with their energies.  2) In which of the following figures, the p-n diode is forward biased.    3) The V I - characteristic of a silicon diode is as shown in the figure. Calculate the resistance of  the diode at  1. I = 15 mA  2. V =− 10 V.    **OR**  3) Answer the following questions, giving reasons:  i) Why is the current under reverse bias almost independent of the applied potential up to a critical voltage?  ii) Why does the reverse current show a sudden increase at the critical voltage? | | | 4 |
|  | When light travels from an optically denser to rarer medium at the interface, it is reflected back into the same medium. This is called total internal reflection of light. When light gets reflected by a surface, normally some fraction of light gets transmitted. Optical fiber is one of the best examples of total internal reflection.  (i) Which of the following in one of the conditions for total internal reflection to take place?  a) When light ray travels from rarer to denser medium.  b) When light ray incident making an angle of 450 to the normal of the surface.  c) When light ray travels from denser to rarer medium with angle of incidence greater than critical angle.  d) When light ray travels from rarer to denser medium with angle of incidence greater than critical angle.  (ii) Which one of the following is an example of total internal reflection?  a) Twinkling of stars b) Mirage  c) Thin film of soap bubble d) Image formation by Mirrors  (iii) In total internal reflection, when the angle of incidence is equal to the critical angle forthe pair of media in contact, what will be the angle of refraction?  a) 00 b) 900 c) 1800 d) 450  (iv) The refractive index of a glass slab is 1.62. The sine of the critical angle for total internal reflection at the glass – air interface is:  a) 0.40 b) 0.62 c) 0.74 d) 1  **OR**  (iv) If the critical angle for total internal reflection from a medium to vacuum is 300, then the speed of light in the medium is:  a) 6 x 108 m/s b) 3 x 108 m/s c) 1.5 x 108 m/s d) 2 x 108 m/s | | | 4 |
| **SECTION E** | | | | |
|  | a) In YDSE deduce the conditions for (i) constructive, and(ii) destructive interference at a point on the screen. Draw a graph showing variation of the resultant intensity in the interference pattern against position ‘x’ on the screen.  b) In YDSE the two slits 0· 15 mm apart are illuminated by monochromatic light of wavelength 450 nm. The screen is 1 m away from the slits. Find the distance of the second (i) bright fringe, (ii) dark fringe from the central maximum.  **OR**  a) State Huygens’ principle. With the help of a suitable diagram, prove Snell’s law of refraction using Huygens’ principle.  b) Draw the geometrical shape of the wave fronts when (i) light diverges from a point source, and (ii) light emerges out of a convex lens when a point source is placed at its focus. | | | 5 |
|  | 1. Consider two identical point charges located at points **(0,0)** and **(a,0)** 2. Is there a point on the line joining them at which the electric field is zero? 3. Is there a point on the line joining them at which the electric potential is zero?   Justify your answer in each case.   1. Two point charges q1 and q2 are kept r distance apart in a uniform external electric field E . Find the amount of work done in assembling this system of charges. 2. Three charges are placed at the corners of an equilateral triangle ABC of side 2.0 m as shown in figure. Calculate the electric potential energy of the system of three charges.     **OR**   1. Derive the expression for the capacitance of a parallel plate capacitor having plate area A and plate separation d. 2. Capacitance of a capacitor becomes 4/3 times its original value if a dielectric slab of thickness t=d/2 is inserted between the plates (d = separation between the plates). Find the dielectric constant of the slab. 3. A network of four capacitors each of capacitance 12 µF is connected to a battery as shown in the figure .Find the total charge stored in the network | | | 5 |
|  | a) An ac source generating a voltage V = Vosinωt is connected to a capacitor of capacitance C. Find the expression of the current I flowing through it. Plot a graph of V and I versus ωt to show that the current is ahead of the voltage.  b) A resistor of 200 Ω and a capacitor of 15 µF are connected in series to a 220 V, 50 Hz ac source. Calculate the current in the circuit and the rms voltage across the resistor and the capacitor. Why the algebraic sum of these voltages is more than the source voltage?  **OR**  a) State the principle of working of a transformer.  b) Define efficiency of a transformer.  c) State any two factors that reduce the efficiency of a transformer.  d) Calculate the current drawn by the primary coil of a 90% efficient transformer which steps down 220 V to 22 V, if the output resistance is 440 Ω. | | | 5 |

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