SET- 2B

केंद्रीय विद्यालय संगठन, अहमदाबाद संभाग

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प्री-बोर्ड परीक्षा:2024-25

PRE-BOARD EXAMINATION: 2024-25

SUBJECT : PHYSICS (042)

CLASS : XII

TIME : 3 HOURS

MM : 70

**सामान्यनिर्देश/GENERAL INSTRUCTIONS:**

1. There are 33 questions in all. All questions are compulsory.
2. This question paper has five sections: Section A, Section B, Section C, Section D and Section E.
3. All the sections are compulsory.
4. Section A contains sixteen questions, twelve MCQ and four Assertion Reasoning based 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 four marks each and Section E contains three long answer questions of five marks each.
5. There is no overall choice. However, an internal choice has been provided in one question in Section B, one question in Section C, one question in each CBQ in Section D and all three questions in Section E. You have to attempt only one of the choices in such questions.
6. Use of calculators is not allowed.
7. You may use the following values of physical constants where ever necessary $c = 3 \times 10^8$ m/s, $m_e = 9.1 \times 10^{-31}$ kg, $e = 1.6 \times 10^{-19}$ C, $\mu_0 = 4\pi \times 10^{-7}$ $TmA^{-1}$, $\varepsilon_0 = 8.85 \times 10^{-12}$ $C^2N^{-1}m^{-2}$, $N_A = 6.023 \times 10^{23}$ /g mol.

| Q No | SECTION A | MM |
|---|---|---|
| 1 | The kinetic energy of an electron in an excited state of the hydrogen atom is about 1.51 eV.<br>How many emission spectral lines are possible for this excited electron?<br>(A) 1 (B) 2 (C) 6 (D) 3 | 1 |
| 2 | Electric potential varies with distance such that $V(x) = ax - bx^2$; where a and b are constants. Where will the electric field intensity be zero?<br>(A) $x = a/2b$ (B) $x = a/3b$<br>(C) $x = \frac{\sqrt{a}}{\sqrt{b}}$ (D) $x = \pm\frac{\sqrt{a}}{\sqrt{3b}}$ | 1 |
| 3 | If n cells each of emf E and internal resistance r are connected in series in same polarity order, then the total emf and internal resistances will be | 1 |

| | | |
|---|---|---|
| | (A) E, r/n (B) E, nr<br>(C) nE, r/n (D) nE, nr | |
| 4 | A charge q is moving with a velocity v parallel to a magnetic field B. Force on the charge due to magnetic field is<br>(A) q v B (B) q B/v<br>(C) zero (D) B v/q | |
| 5 | A step up transformer has a transformation ratio 2 : 1. What is the voltage in the primary coil if the voltage in the secondary coil is 100 V?<br>(A) 100 V (B) 50 V (C) 400 V (D) 10 V | 1 |
| 6 | The separation between successive fringes in a double slit arrangement is x. If the whole arrangement is dipped under water (refractive index = 4/3) then what will be the new fringe separation?<br>(A) 1.5 x (B) x (C) 0.75 x (D) 2 x | 1 |
| 7 | A n-type semiconductor is<br>(A) positively charged<br>(B) negatively charged<br>(C) uncharged<br>(D) uncharged at 0K but charged at higher temperatures | 1 |
| 8 | A thin glass (refractive index 1.5) lens has optical power of 5 D in air. Its optical power in a liquid medium with refractive index 1.6 will be<br>(A) – 5/8 D (B) 8/5 D (C) – 8/5 D (D) 5/8 D | 1 |
| 9 | A diffraction pattern is obtained by using beam of blue light. What will happen, if blue light is replaced by the red light?<br>(A) Bands disappear<br>(B) Bands become broader and farther apart<br>(C) No change will take place<br>(D) Diffraction bands become narrow and crowded together | 1 |
| 10 | Which of the following is/are true for electromagnetic waves?<br>I. They transport energy.<br>II. They have momentum.<br>III. They travel at different speeds in air depending on their frequency.<br>(A) I and III (B) II only<br>(C) I, II and III (D) I and II | 1 |
| 11 | An infinite line of charge has a linear charge density of $10^{-7}$ C/m. What will be the magnitude of the force acting on an alpha particle placed at a distance of 4 cm from the line of charge?<br>(A) $14.4 \times 10^{-15}$ N (B) $7.2 \times 10^{-15}$ N | 1 |

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| | (C) $4.5 \times 10^4$ N (D) $9 \times 10^4$ N | |
| 12 | Name the part of electromagnetic spectrum which is used in RADAR system for aircrafts navigation.<br>(A) Microwaves (B) Radio waves<br>(C) Infra red waves (D) X- rays | 1 |
| | For Questions 13 to 16, two statements are given –one labelled Assertion (A) and other labelled Reason (R). Select the correct answer to these questions from the options as given below.<br>A. Assertion and Reason are true and Reason is the correct explanation of Assertion.<br>B. Assertion and Reason are true but Reason is NOT the correct explanation of Assertion.<br>C. Assertion is true but Reason is false.<br>D. Both Assertion and Reason are false. | |
| 13 | **Assertion (A):** All atoms do not have a net magnetic moment.<br>**Reason (R):** Every electron in an atom possesses an intrinsic magnetic moment. | 1 |
| 14 | **Assertion:** In photoelectric effect, the kinetic energy of the emitted photoelectrons increases with increase in the intensity of the incident light.<br>**Reason:** Photoelectric current depends on the wavelength of the incident light. | 1 |
| 15 | **Assertion:** In Lyman series, the ratio of minimum and maximum wavelength is 3/4.<br>**Reason:** Lyman series constitute spectral lines corresponding to transition from higher energy states to ground state of hydrogen atom. | 1 |
| 16 | **Assertion**: The mass of a nucleus is less than the mass of the constituent particles.<br>**Reason:** Energy is absorbed when the nucleons are bound together to form the nucleus. | 1 |
| | **SECTION - B** | |
| 17 | Two identical coils with a common centre are oriented at an angle of 45° to each other. Both the coils have the same radius 'a', the same number of turns 'n', and carry the same current 'I'. | 2 |

$\frac{13.6}{10.2}$

$\frac{1}{24} - \frac{1}{1}$ $\quad -\frac{3}{4}$

$\frac{1}{2^2} - \frac{1}{1}$

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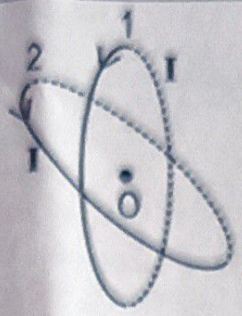
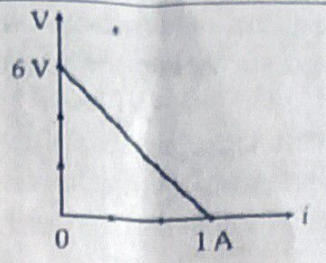
|---|---|---|
| |  <br>What is the value of the resultant magnetic field at their center O?<br>**OR**<br>Two very long, straight, parallel wires A and B carry currents of 10 A and 20 A respectively, and are at a distance 20 cm apart. If a third wire C (length 15 cm) having a current of 10 A is placed between them, how much force will act on C? The direction of current in all the three wires is same. | |
| 18 | Explain the term 'drift velocity' of electrons in a conductor. Hence obtain the expression for the current through a conductor in terms of 'drift velocity'. | 2 |
| 19 | What is the effect on interference fringes in a Young's double slit experiment due to each of the following operations:<br>(a) The screen is moved away from the slits.<br>(b) The monochromatic source is replaced by white source of light.<br>Justify your answer. | 2 |
| 20 | The ground state energy of Hydrogen atom is -13.6 eV.<br>(a) What is the kinetic energy of electron in 2nd excited state?<br>(b) What is the potential energy of electron in 3rd excited state? | 2 |
| 21 | The carbon-13 nucleus has one additional neutron as compared to nucleus of carbon-12. The difference in the BE of these two nuclei is approx. 5 MeV. Take mass of neutron = 1.0086 u.<br>Using this information, determine the difference in the atomic masses of these two nuclei. | 2 |
| | **SECTION C** | |
| 22 | (a) Distinguish between electromotive force and terminal potential difference of a cell.<br>(b) The plot of the variation of potential difference across a combination of three identical cells in series versus current is as shown in figure. What is the emf and internal resistance of each cell? | 3 |

$\frac{13.6}{4}$

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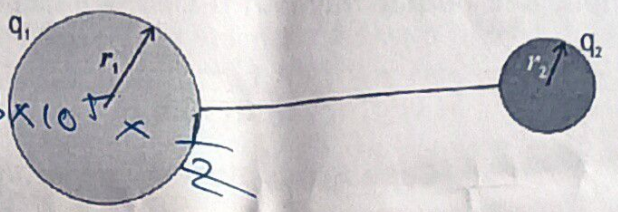
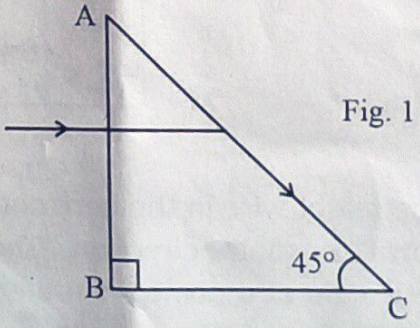
| 23 | (a) Define electric dipole and write its SI unit.<br>(b) A dipole consisting of an electron and a proton separated by a distance of $4 \times 10^{-10}$ m is situated in an electric field of intensity $3.3 \times 10^{5}$ N $C^{-1}$ at an angle of 30° with the field. Calculate the dipole moment and the torque acting on it. Charge on an electron $=1.6 \times 10^{-19}$ C.<br>**OR**<br>(a) Write two important properties of equipotential surfaces.<br>(b) A conducting wire connects two charged conducting spheres such that they attain equilibrium with respect to each other. The distance of separation between the two spheres is very large as compared to either of their radii.<br>3.2<br>$6.4 \times 10^{-29} \times 3.3 \times 10^{5} \times \frac{1}{2}$<br>$10 \times -24$<br>  <br><br>Find the ratio of the magnitudes of the electric fields at the surfaces of the two spheres. | 3 |
| 24 | (a) Out of two magnetic materials A has relative magnetic permeability slightly greater than unity while B has less than unity. Identify the nature of materials A and B. Will their susceptibilities be positive or negative?<br>(b) Draw a sketch to show the modification in uniform magnetic field when a diamagnetic specimen is placed. | 3 |
| 25 | (a) Write down two necessary conditions for total internal reflection to take place.<br>(b) A light ray entering a right-angled prism undergoes refraction at the face AC as shown in Fig. 1.<br>  <br><br>Fig. 1<br>What is the refractive index of the material of the prism in Fig.1? | 3 |

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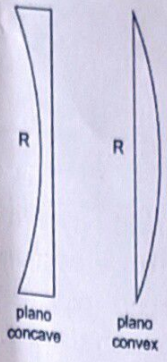
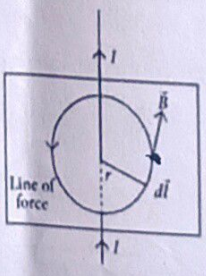
| 26 | Compare the focal lengths of the two lenses shown below if the rad curvature of the curved surface is the same in both lenses.<br>  <br> | |
| 27 | Draw the energy band diagram when intrinsic semiconductor ($Ge^{32}$) is doped with impurity atoms of Antimony ($Sb^{51}$). Name the extrinsic semiconductor so obtained and majority charge carriers in it. Also, what will be the ratio $n_e$: $n_h$ for the semiconductor so obtained, where $n_e$ is the number density of electrons and $n_h$ is the number density of holes? | 3 |
| 28 | Draw a circuit diagram of full wave rectifier. Explain its working principle. Draw the input and output waveforms clearly indicating the functions of two diodes. | 3 |
| | **SECTION D**<br><br>**Case Study Based Questions** | |
| 29 | Read the following paragraph and answers the questions:<br><br>**Ampere's law** gives a method to calculate the magnetic field due to given current distribution. According to it, the circulation of the resultant magnetic field along a closed plane curve is equal to $\mu_0$ times the total current crossing the area bounded by the closed curve provided the electric field inside the loop remains constant. Ampere's law is more useful under certain symmetrical conditions. Consider one such case of a long Straight wire with circular cross-section (radius R) carrying current I uniformly distributed across this cross-section.<br>  <br><br>(i) A long straight wire in the horizontal plane carries a current of 50 A in the north to south direction. The magnitude and direction of the magnetic field at a point 2.5m east of the wire is<br>(A) $4 \times 10^{-6}$ T vertically upward<br>(B) $4 \times 10^{-6}$ T vertically downward | 4 |

(C) $3 \times 10^{-6}$ T vertically upward
(D) $3 \times 10^{-6}$ T vertically downward

(ii) A long solenoid carrying a current produces a magnetic field B along its axis. If the current is doubled and the number of turns per cm is halved, what will be the new value of the magnetic field?
(A) B/2 (B) B (C) 2B (D) 4B

(iii) In a current carrying long solenoid, field produced depends upon:
(A) Number of turns per unit length
(B) Current flowing
(C) Radius of the solenoid
(D) All of the above

(iv) A current of 100 A flows through an infinitely long straight wire. The magnetic field produced at a point 1 cm away from it is
(A) $2 \times 10^{-3}$ T (B) $2\pi \times 10^{-3}$ T
(C) $2 \times 10^{-7}$ T (D) $2\pi \times 10^{-7}$ T

**OR**

A coil of diameter 0.2 cm is formed by a 6.28 m long wire and a current of 10 amp is passed in it. The magnetic induction at its centre will be
(A) $6.28 \times 10^{-5}$ T (B) $7.25 \times 10^{-5}$ T
(C) $6.28 \times 10^{-2}$ T (D) 6.28 T

30 Read the following paragraph and answers the questions: 4

When a photon is incident on a metallic surface, it interacts with an atom in the metal and transfers all its energy to one of the atom's electrons. This electron may then escape through the electric field at the surface, which keeps less energetic electrons inside the metal. The emerging electron then has energy equal to the energy of the photon minus the energy W lost in escaping the metal. W, the work function of the surface, is a material-dependent constant. Since electrons also lose energy in collisions with other electrons before emerging, we may only specify the maximum possible energy for an electron liberated by light of frequency f from a metal. If the material work function is W, this maximum energy is $E_{max} = hf - W$.

(i) Stopping potential of a photosensitive material depends on

(A) frequency of incident radiation
(B) intensity of incident radiation
(C) work function of metal
(D) both A and C

(ii) Photo electric effect experiment
(A) Confirm Quantum nature of light
(B) help to measure work function
(C) help to measure planck's constant
(D) All of the above

(iii) What is true about emitted photo electron from the metal surface?

(A) $hf - W < 0$ (B) $hf - W \geq 0$
(C) f > threshold frequency (D) both b & c

(iv) How does the maximum kinetic energy of electrons emitted vary with the increase in work function of the metal?
(A) increase (B) decrease
(C) remain same (D) no effect

**OR**

(iv) Experimental study of photoelectric effect shows that

I. Photocurrent is directly proportional to intensity of light.

II. Saturation current is directly proportional to intensity of light.

III. photoemission occurs only at frequency greater than threshold frequency.

IV. photoemission is an instantaneous process.

The correct statements are

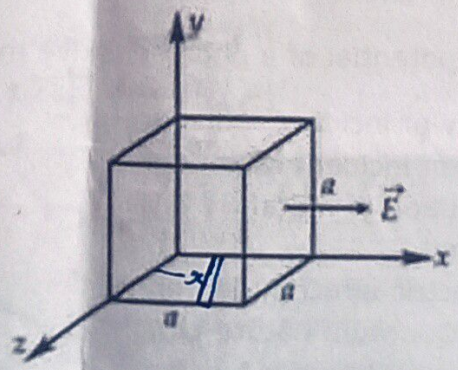
(A) I and II (B) I, II and III
(C) I, III and IV (D) I, II, III and IV

## SECTION E

31 (a) A spherical Gaussian surface encloses a positive charge q. Explain with a reason what happens to the net electric flux through the Gaussian surface if: 5

(i) the charge is tripled
(ii) the volume of the sphere is tripled
(iii) the charge is moved into another location inside the Gaussian surface

(b) Given the electric field in the region $\mathbf{E} = 2x\,\mathbf{i}$, find the net electric flux passing through the cube.

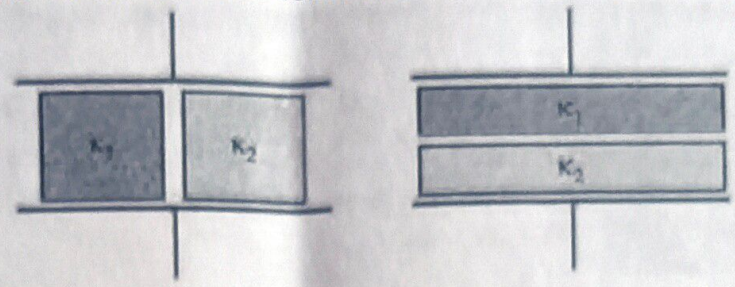


face?

**OR**

(a) Find the expression for the capacitance of a parallel plate capacitor of area A and plate separation d if a dielectric slab of thickness t (t<d) is introduced between the plates of the capacitor.

(b) Find the ratio of the capacitances of a capacitor in two different arrangements shown below filled with two dielectrics of same dimensions but of dielectric constants $K_1$ and $K_2$ respectively.

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| 32 | (a) Draw a ray diagram for the formation of image of a distant object by an astronomical telescope in normal adjustment position. Write the expression for its magnifying power.<br>(b) The magnifying power of an astronomical telescope in normal adjustment position is 100. The distance between the objective and eyepiece is 101 cm. Find out the focal lengths of objective and eyepiece.<br>**OR**<br>(a) State Huygen's Principle. Use Huygen's construction to show how a plane wavefront at t=0 propagates and produces a wavefront at a later time.<br>(b) Verify Snell's law of refraction for a plane wavefront propagating from denser medium to rarer medium.<br>(c) Illustrate with the help of diagram the action of convex lens on a plane wavefront incident on it. | 5 |
| 33 | (a) Define mutual inductance and write its SI unit.<br>(b) Derive an expression for the mutual inductance of two long co-axial solenoids of same length wound one over the other.<br>(c) An emf of 0.5 V is developed in the secondary coil, when current in primary coil changes from 5.0 A to 2.0 A in 300 milliseconds. Calculate the mutual inductance of the two coils.<br>**OR**<br>(a) A series LCR circuit is connected to an ac source having voltage $e = e_0 \sin\omega t$. Derive the expression for the instantaneous current and its phase relationship to the applied voltage. Obtain the condition for resonance to occur.<br>(b) In a series LR circuit, $X_L = R$ and the power factor of the circuit is $P_1$. When a capacitor of capacitance C such that $X_L = X_C$ is put in series, the power factor becomes $P_2$. Find $P_1/P_2$. | 5 |

$f_o = 100 f_e$

$100 f_e + f_e = 101$

$101 f_e = 101$

$f_e = 1$ cm

$f_o + f_e = 101$ cm

$f_o = 100$ cm