Indian School Al Wadi Al Kabir
Second Rehearsal Examination (2024-2025)

Class: XII	Subject: Physics (042)	Max. marks: 70
Date: 04/02/2025	SET I	Time: 3 Hours

General Instructions:

(1) All questions are compulsory. There are 33 questions in all.

(2) This question paper has 5 sections: Section A, Section B, Section C, Section D and Section E.

(3) Section A contains 16 objective multiple-choice questions of 1 mark each, Section B contains 5 very short answer type questions of 2 marks each,

Section C contains 7 short answer questions of 3 marks each,

Section D contains 2 case-based study questions of 4 marks each.

Section E contains 3 long answer type questions of 5 marks each

(4) 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 case-based question in section D and all three questions in section E. You have to attempt only one of the choices in such questions.

(5) All questions are compulsory. In case of internal choices, attempt any one of them.

You may use the following values of physical constants where ever necessary.

$c = 3 \times 10^{8}\ ms^{-1}$, $h = 6.626 \times 10^{-34} Js$, $e = 1.602 \times 10^{-19}\ C$,

$\mu_0 = 4\pi \times 10^{-7}\ T\ m\ A^{-1}$, $\frac{1}{4\pi\epsilon 0} = 9 \times 10^{9}\ N\ m^2\ C^{-2}$,

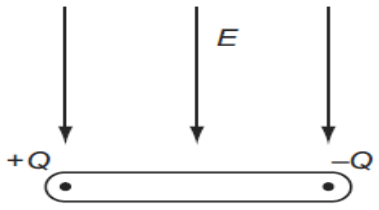
$\epsilon o = 8.854 \times 10^{-12}\ C^2N^{-1}m^{-2}$, $m_e = 9.1 \times 10^{-31} kg$, $m_n = 1.675 \times 10^{-27} kg$,

$m_p = 1.673 \times 10^{-27} kg$, Avogadro's number $N_A = 6.023 \times 10^{23}\ /mol^{-1}$

Boltzmann constant $= 1.38 \times 10^{-23} J\ K^{-1}$

(SECTION-A) (16 x 1 = 16 marks)

(1) An electric field of strength E acts on the rod in downward direction. Then the resultant force and resultant torque:



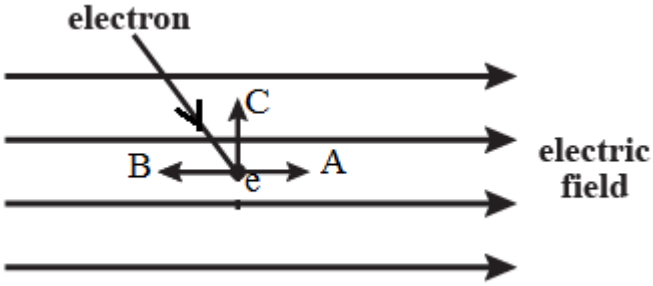
(a) resultant force is upwards, resultant torque clockwise

(b) resultant force is zero, resultant torque clockwise

(c) resultant force downwards, resultant torque clockwise

(d) resultant force is zero, resultant torque anti - clockwise

(2) The diagram shows an electron in a uniform electric field. In which direction will the field accelerate the electron?



(a) execute circular motion (b) direction A (c) direction B (d) direction C

(3) An ammeter and a voltmeter are connected in series to a battery. Their readings are noted as 'A' and 'V' respectively. If a resistor is connected in parallel with the voltmeter, then

(a) A will increase, V will decrease.
(b) A will decrease, V will increase.
(c) Both A and V will decrease.
(d) Both A and V will increase.

(4) Name the physical quantity having unit $\frac{weber}{m^2}$

(a) Magnetic flux
(b) Magnetic dipole moment
(c) Magnetic flux density
(d) Magnetic susceptibility

(5) An alternating emf of e = 220 sin100 πt is applied to a circuit containing an inductance of $\frac{1}{\pi}$ Henry Write an equation for instantaneous current through the circuit.

(a) I = 2.2 sin $(100\pi t + \frac{\pi}{2})$
(b) I = 2.2 sin $(100\pi t - \frac{\pi}{2})$

(c) I = 2.2 sin $(100\pi t - \pi)$
(d) I = 2.2 sin $(100\pi t + \pi)$

(6) The electromagnetic waves used in radar systems are:

(a) X-rays
(b) Infra-red rays

(c) Ultra violet rays
(d) Microwaves

(7) A reflecting type telescope has a concave reflector of R = 120 cm. Calculate the focal length of eye piece to secure a magnification of 20.

(a) 4 cm (b) 6 cm (c) 3 cm (d) 2cm

(8) A double convex lens made out of glass of refractive index 1.5 has both curvature of radii 20cm. An object 2cm high is placed 2cm from this lens. Find the position and height of the image?

(a) $\frac{20}{4}$, 1.8 cm (b) $\frac{-20}{4}$, 2.4 cm (c) $\frac{20}{9}, 1.5cm$ (d) $\frac{-20}{9}$, 2.2 cm

(9) What will be the effect on fringe width in Young's double slit experiment if (i) the wavelength of light be increased (ii) the separation between the slits be decreased?

(a) fringe width increases, separation increases
(b) fringe width decreases, separation decreases
(c) fringe width increases, separation decreases
(d) fringe width decreases separation increases

(10) In a single slit diffraction experiment, the width of the slit is made double the original width. How does this affect the size and intensity of the central diffraction band?

(a) doubled, doubled
(b) reduced to half, increases by 4 times
(c) reduced to half, increases by 2 times
(d) doubled, remains the same

(11) The ratio of the nuclear densities of two nuclei having mass numbers 64 and 225 is

(a) 8:15 (b) 1:1 (c) 2:1 (d) 1:2

(12) In the energy - band diagram of n type Si, the gap between the bottom of the conduction band Ec and the donor energy level Ed is of the order of:

(a) 0.01eV (b) 0.5 eV (c) 1 eV (d) 1.6eV

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.
A. If both Assertion and Reason are true and Reason is the correct explanation of Assertion.

B. If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

C. If Assertion is true but Reason is false.

D. If both Assertion and Reason are false.

(13) **Assertion (A):** A proton and electron with the same momenta enter a uniform magnetic field in a direction perpendicular to the field lines. The radius of the path followed by them will be the same.
Reason(R): Electron has less mass than the proton.

(14) **Assertion(A):** In a Young's double slit experiment, interference pattern is not observed when two coherent sources are infinitely close to each other.
Reason(R): The fringe width is proportional to the separation between the two sources.

(15) **Assertion(A):** When impact parameter of α–particle is zero, the α–particle travelling directly towards the centre of the nucleus retraces its path.
Reason(R): Unit of impact parameter is the unit of distance.

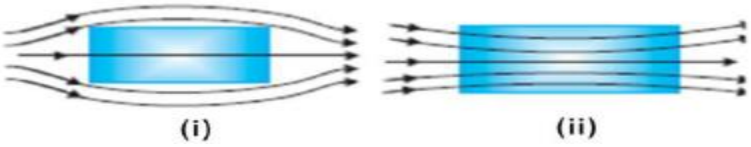
(16) **Assertion(A)**: ${}_2He^3$and ${}_1He^3$ are the isotopes of He and binding energy of ${}_1He^3$ is greater than ${}_2He^3$
Reason(R): Mass defect of ${}_1He^3$ is lesser than ${}_2He^3$

(SECTION – B) (5x2=10 marks)

(17) What is meant by relaxation time of free electrons in a conductor? Show that the resistance of a conductor can be expressed by, R = $\frac{m\ell}{ne^2\tau A}$

(18) (i) Two magnetic materials are subjected to an external magnetic field. Study the figures carefully and identify the magnetic materials

(ii) Draw the graph showing the variation of susceptibility with temperature for specimen (i)



(19) What is meant by the term displacement current? Briefly explain how this current is different from a conduction current.

(20) With the help of a ray diagram, explain the refraction of light using wave theory.

(21) (A) (i) Prove that the nuclear density is same for all nuclei.
(ii) Draw a plot of potential energy of a pair of nucleons as a function of their separation.

OR

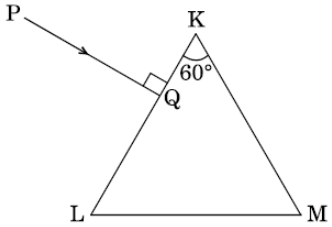
(21) (B) Draw the graph showing the variation of binding energy per nucleon with mass number A of nuclei. Use this graph to explain the release of energy in nuclear fission.

(SECTION – C) (7x3=21 marks)

(22) (a) Draw the circuit diagrams for obtaining the V-I characteristics of a p-n junction diode.
(b) Explain briefly the salient features of the V - I characteristics in
(i) forward biasing, and (ii) reverse biasing
(c) With the help of a graph define the term knee voltage and zener voltage.

(23) A 80 µF capacitor is charged by a 50v battery. The capacitor is now disconnected from the battery and connected across another uncharged 320 µF capacitor. Calculate the charge on second capacitor.

(24) A triangular prism of refracting angle 60^0 is made of a transparent material of refractive index $\frac{2}{\sqrt{3}}$. A ray of light is incident normally on the face KL as shown in the figure. Trace the path of the ray as it passes through the prism and calculate the angle of emergence and angle of deviation.



(25) (i) What do you mean by doping?

(ii) Suppose a pure Si crystal has 5 x10^{28} atoms m^{-3}. It is doped by 1 ppm concentration of boron. Calculate the concentration of holes and electrons, given that n_i =1.5 x10^{16} m^{-3}. Is the doped crystal n-type or p-type?

(26) A sinusoidal voltage is applied to an electric circuit containing a circuit element X in which current leads the voltage by $\frac{\pi}{2}$..
(a) Identify the circuit element X in the circuit.
(b) Write the formula for its reactance.
(c) Show graphically the variation of this reactance with frequency of ac voltage.
(d) Explain the behaviour of this element when it is used in (i) an ac circuit, and (ii) a dc circuit.

(27) (A) A photon emitted during the de-excitation of electron from a state n to the first excited state in a hydrogen atom, irradiates a metallic cathode of work function 2 eV, in a photo cell, with a stopping potential of 0·55 V. Obtain the value of the quantum number of the state n.

OR

(27) (B) The short wavelength limit for the Lyman series of the hydrogen spectrum is 913.4 A^o. Calculate the short wavelength limit for Balmer series of hydrogen spectrum.

(28) State Gauss's law. Use Gauss's theorem to find the intensity of electric field due to a thin straight infinitely long conducting wire of linear charge density 'λ'.

(SECTION D) (2x4=8 marks)

Questions number 29 and 30 are case study-based questions. Read the following paragraphs and answer the questions that follow.

(29) The magnitude of force acting on a moving charge is given by the expression F = qvB sinθ and its direction is given by Fleming's left-hand rule. The force is perpendicular to both the velocity and the magnetic field.

(a) When magnetic field is applied on a stationary electron, it

(i) it moves perpendicular to the direction of the field.

(ii) It moves in the direction of the field.

(iii) it remains stationary.

(iv) spins about its own axis.

(b) A proton is projected with a uniform velocity along the axis of a current carrying solenoid, then

(i) the proton will be accelerated along the axis.

(ii) the proton path will be circular about the axis.

(iii) the proton moves along the helical path.

(iv) the proton will continue to move with the same velocity long the axis.

(c) Under what condition does an electron moving through a magnetic field experience
(a) maximum force (b) minimum force.

(i) (a) when charge moves perpendicular to the magnetic field (b) when charge moves parallel to the magnetic field

(ii) (a) when charge moves parallel to the magnetic field (b) when charge moves perpendicular to the magnetic field.

(iii) (a) when charge makes an angle of 45^0 with the magnetic field (b) when charge moves perpendicular to the magnetic field.

(iv) (a) when charge moves parallel to the magnetic field (b) when charge makes an angle of 45^0 with the magnetic field

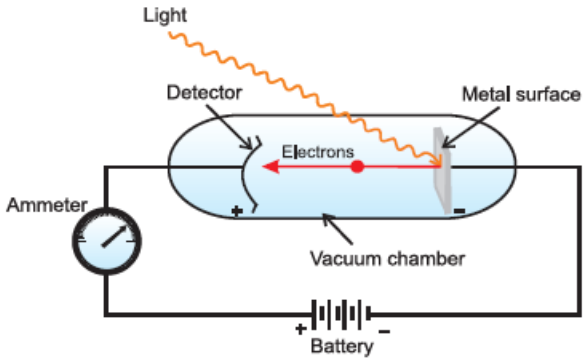
(d) A charge q moves with a velocity 2m/s along X-axis in a uniform magnetic field,
B =($\hat{\imath}$ + 2 $\hat{\jmath}$ +3 $\hat{k}$)Tesla, then the charge will experience force of

(i) $(4q\hat{k} + 6q\,\hat{\jmath})$ Newton
(ii) $(4q\hat{k} - 6q\,\hat{\jmath})$ Newton
(iii) $(4q\hat{k} - 3q\,\hat{\jmath})$ Newton
(iv) zero

OR

The magnetic force acting on a charged particle of charge $-2\mu c$ in a magnetic field of 2T acting Y direction, when the particle velocity is $(2\hat{\imath} + 3\,\hat{\jmath})$ X 10^6 m/s is
(i) 8N in Z direction
(ii) 4N in Z direction
(iii) 8N in -Y direction
(iv) 8N in -Z direction

(30) When ultraviolet light falls on certain metals like zinc, cadmium and magnesium etc. electron emission take place from the surface. Alkali metals emit electrons even with visible light. After the discovery of electrons in 1897, these electrons were termed as photoelectrons and the phenomenon is photoelectric effect.



(a) Alkali metals show photoelectric effect with visible light but Zn, Mg and Cd respond to uv light. Why?
(i) Alkali metals have less threshold wavelength.
(ii) Zn, Cd and Mg have greater threshold wavelength.
(iii) Alkali metals have greater threshold frequency.
(iv) Zn, Cd and Mg have greater threshold frequency.

(b) U.V light is incident on two photosensitive materials having work functions W1 and W2 (W1 > $W2$).In which case will the kinetic energy of the emitted electrons be greater ?
(i) metal with work function W1
(ii) metal with work function W2
(iii) equal kinetic energy
(iv) can't predicted

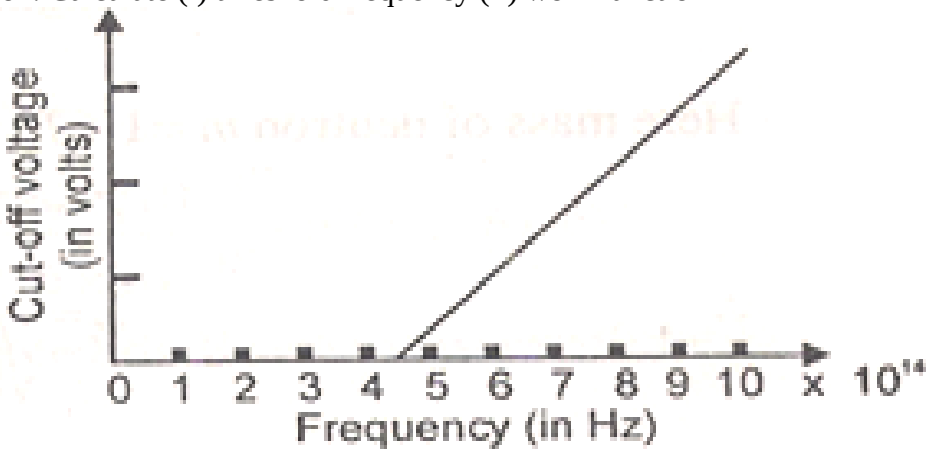
(c) Maximum kinetic energy of the emitted photoelectrons is 5eV. What is its stopping potential?
(i) 5v (ii) 4 v (iii) 4.5 v (iv) 5.5 v

OR

The threshold frequency for a given metal is f0. If light of frequency 2f0 is incident on it, velocity of the emitted photoelectrons is v1 and for frequency 5f0, velocity is v2. Find ratio of velocities.

(i) $\frac{V2}{V1}$ = 1:1 (ii) $\frac{V2}{V1}$ = 2:1 (iii) $\frac{V2}{V1}$ = 1:2 (iv) $\frac{V2}{V1}$ = 1:4

(d) For photoelectric effect in sodium, the fig. shows the plot of cut-off voltage versus frequency of incident radiation. Calculate (i) threshold frequency (ii) work function



(i) 4.5 Hz, 29.7 x10^{-20} J
(ii) 4.5 x10^{14}Hz, 29.7 x10^{-10} J
(iii)10.5 x10^{14}Hz, 29.7 x10^{-20} J
(iv) 4.5 x10^{14}Hz, 29.7 x10^{-20} J

(SECTION E) (3 x 5 = 15 marks)

(31)(A)(i) Deduce Ohm's law using the concept of drift velocity.

(ii) Plot a graph showing the variation of resistivity of a conductor with temperature.

(iii) A conductor of length ℓ is connected to a dc source of emf V. If this conductor is replaced by another conductor of same material and same area of cross section but of length 3ℓ,how will the drift velocity change ?

OR

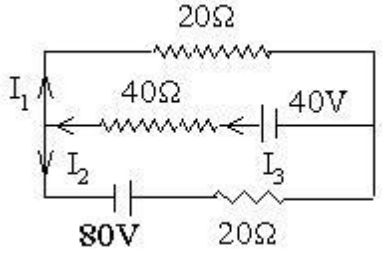
(31)(B) (i) Sketch a graph showing variation of resistivity of carbon with temperature.

(ii) Explain how the internal resistance of a cell changes in the following cases:

(a) when the concentration of the electrolyte is increased

(b) when the temperature of the electrolyte is increased

(iii) Using Kirchhoff's rules of current distribution in an electrical network, determine the value of the current I_1 in the electric circuit given below.



(32) (A) (i) Define coefficient of self-induction. Obtain an expression for self-inductance of a long solenoid of length ℓ, area of cross section A having N turns.

(ii) Calculate the self-inductance of a coil using the following data obtained when an AC source of frequency $\frac{200}{\pi}$ Hz and DC source is applied across the coil.

AC SOURCE

S. No.	V volts	I A
1	3	0.5
2	6	1
3	9	1.5

DC SOURCE

S. No.	V volts	I A
1	4	1
2	6	1.5
3	8	2

OR

(32) (B) (a)With the help of a labelled diagram, describe the principle and working of an ac generator. Hence obtain an expression for the instantaneous value of the emf generated.

(b) The coil of an ac generator consists of 100 turns of wire, each of area $0.5m^2$.The resistance of the wire is 100 ohm. The coil is rotating in a magnetic field of 0.8T perpendicular to its axis of rotation, at a constant angular speed of 60 radian per second. Calculate the maximum emf generated and power dissipated in the coil.

(33)(A)(i) Draw a ray diagram to show the formation of the image of a point object placed in a medium of refractive index μ1 on the principal axis of a convex spherical surface of radius of curvature R and refractive index μ2. Using the ray diagram, derive the relation

$$\frac{\mu 2-\mu 1}{R} = \frac{\mu 2}{v} - \frac{\mu 1}{u}$$

(ii) A convex lens made up of glass of refractive index 1.5 is dipped, in turn, in:
(a) Medium A of refractive index 1.65
(b) Medium B of refractive index 1.33
Explain, giving reasons, whether it will behave as a converging lens or a diverging lens in each of these two media.

OR

(33)(B) (i) With the help of a ray diagram, explain how a virtual image is formed in a compound microscope in distinct vision adjustment. Hence derive an expression for magnifying power.

(ii) In a telescope, the focal length of the objective and eyepiece are 60 cm and 5 cm respectively. What is its(i) magnification (ii) tube length?