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MODEL EXAMINATION 2023-2024

CLASS XII

PHYSICS [042]

Maximum Marks : 70 **Time : 3 Hrs**

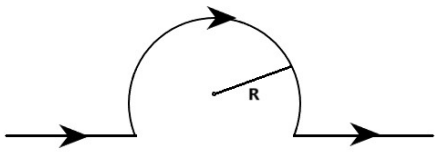
General Instructions:

(a) There are 33 questions in this question paper with internal choice.
(b) **SECTION A** comprises **16** multiple - choice questions carrying 1 mark each.
(c) **SECTION B** comprises **5** short answer questions carrying 2 marks each.
(d) **SECTION C** comprises **7** short answer questions carrying 3 marks each.
(e) **SECTION D** comprises **2** case – based questions carrying 5 marks each.
(f) **SECTION E** comprises **3** long answer questions carrying 5 marks each.
(g) All questions are compulsory.
(h) Use of log tables and calculators is not allowed.

SECTION A

1	Equipotentials at a great distance from a collection of charges whose total sum is not zero are approximately (a) Spheres (b) Planes (c) Paraboloids (d) Ellipsoids	1
2	An electric dipole of dipole moment $4x10^{-5}$cm is kept in a uniform electric field of 10^{-3} N/C experiences a torque of $2x10^{-8}$ Nm. The angle made by the dipole with the electric field is (a) 45° (b) 30° (c) 60° (d) 90°	1

3	The slope of stopping potential versus frequency graph for photo electric effect is equal to (a) h (b) he (c) $\frac{h}{e}$ (d) e	1
4	An **α**- particle shows zero kinetic energy in Rutherfords experiment at (a) distance of closest approach (b) Maximum distance from gold nucleus (c) At the periphery of the nucleus (d) Inside the nucleus of gold atom	1
5	A test charge of 1.6×10^{-19} C is moving with a velocity of $(4\hat{i} +3\hat{k})$m/s in a magnetic field of $(4\hat{i} +3\hat{k})$T. The force on the test charge is (a) $24\hat{j}$ N (b) $-24\ \hat{i}$ N (c) $24\ \hat{k}$ N (d) 0	1
6	The magnetic susceptibility of an ideal diamagnetic substance is (a) +1 (b) 0 (c) -1 (d) α	1
7	A galvanometer coil of resistance 120Ω shows full scale deflection for a current of 2.5 mA. The value of shunt resistance needed to convert it into an ammeter of range (0-7.5A) is (a) 0.04Ω (b) 0.08Ω (c) 0.12Ω	1

	(d) 0.16Ω	
8	A circular coil of radius 4 cm and of 20 turns carries a current of 3A. It is placed in a magnetic field of intensity 0.5 W/m^2. The magnetic dipole moment of the coil is (a) 0.15 Am^2 (b) 0.03 Am^2 (c) 0.45 Am^2 (d) 0.6 Am^2	1
9	The output of a step-down transformer is measured to be 24V when connected to a 12W light bulb. The value of the peak current is (a) $\frac{1}{\sqrt{2}}$ A (b) $\sqrt{A}$ (c) 2A (d) $2\sqrt{2A}$	1
10	The source of electromagnetic waves can be a charge (a) moving with constant velocity (b) moving in a circular orbit (c) at rest (d) falling in a magnetic field	1
11	The strength of magnetic field at the centre of the given circular coil is  (a) $\frac{\mu oI}{R}\left[1-\frac{1}{\pi}\right]$ (b) $\frac{\mu oI}{\pi R}$ (c) $\frac{\mu oI}{2R}\left[1-\frac{1}{\pi}\right]$	1

	(d) $\frac{\mu o I}{2R}\left[1+\frac{1}{\pi}\right]$	
12	Energy of an electron in the second orbit of hydrogen atom is E. Energy of the electron in the third orbit of helium atom will be (a) $\frac{16\,E}{3}$ (b) $\frac{16\,E}{9}$ (c) $\frac{4\,E}{9}$ (d) $\frac{4\,E}{3}$	1

Given below are two statements labeled as Assertion (A) and Reason (R). Select the most appropriate from the options given below.

A) Both A and R are true and R is the correct explanation of A

B) Both A and R are true but R is not the correct explanation of A

C) A is true but R is false

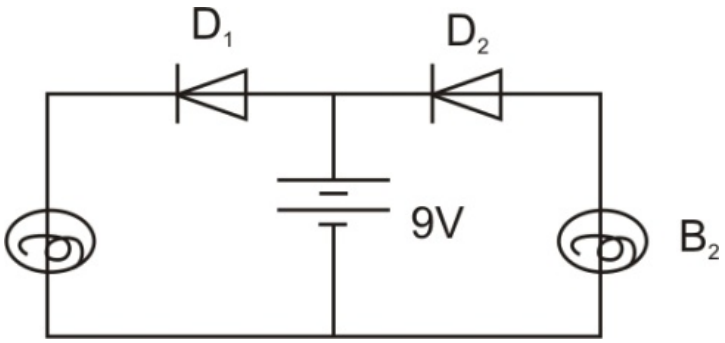
D) A is false but R is true

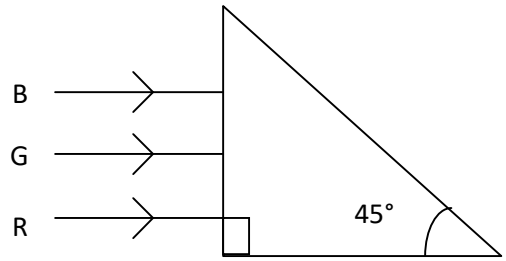
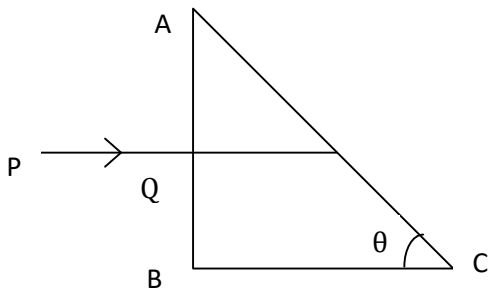
13	Assertion (A) - Photo electric effect demonstrates the particle nature of light Reason (R) – Photo electric current is proportional to intensity of incident radiation for frequencies more than threshold frequency.	1
14	Assertion (A) - In n-type semiconductor the number density of electrons is greater than the number density of holes but the crystal maintains an overall neutrality. Reason (R) - The charge of electrons donated by donor atoms is just equal and opposite to that of the ionised donor	1
15	Assertion (A) - Electric field lines form closed loops. Reason (R) - Direction of electric field is not from positive to negative charge.	1

16	Assertion (A) - A fly is sitting on the objective of a telescope will not be seen on the final image. Reason (R) – This is true but the intensity of image gets reduced.	1

SECTION B

This section Contains 5 questions with internal choice in one question. The following questions are very short answer type and carry 2 marks each.

17	(a) In the following diagram which bulb out of B_1 and B_2 will glow and why?  (b) Explain briefly the three process due to which generation of emf takes place in a Solar cell.	2
18	An **α**- particle when accelerated through a potential difference of **V**volt has a wavelength **λ** associated with it. In order to have the same wavelength, by what potential difference a proton must be accelerated? Given $m_\alpha = 4m_p$ and $q_\alpha = 2\ q_p$	2
19	(a) Three rays of light Red, Green and Blue are incident on face AB of a right angled prism ABC. The refractive indices of the material of the prism for red, green and blue wavelengths are 1·39, 1.44 and 1.47 respectively. Trace the path of the rays through the prism.	

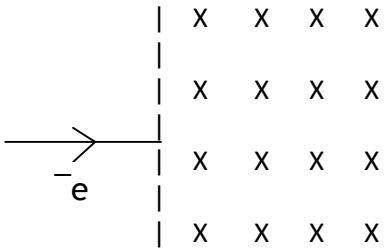
	 (b) How will the situation change if these rays were incident normally on one of the faces of an equilateral prism ?	2
20	Fox two nichrome wires connected in series with a battery, how does the ratio of drift velocity of electrons in them depend on their (a) lengths and (b) diameters.	2
21	Using the data given below, state which two of the given lenses will be preferred to construct a (a) telescope and a (b) microscope. Also indicate t which is to be used as objective and as eyepiece in each case. Lenses | Power (P) | Aperture (A) L_1 | 6D | 1 cm L_2 | 3D | 8 cm L_3 | 10D | 1 cm OR A right angled prism made from a material of refractive index 'n' is kept in air. A ray PQ is incident normally on the side AB of as shown 	2

	Find the maximum value of 'n' upto which this incident ray necessarily undergoes total internal reflection at the face AC of the Prism	

SECTION C

This section contains 7 questions with internal chore in one question. The following questions are short answer type and carry 3 marks each

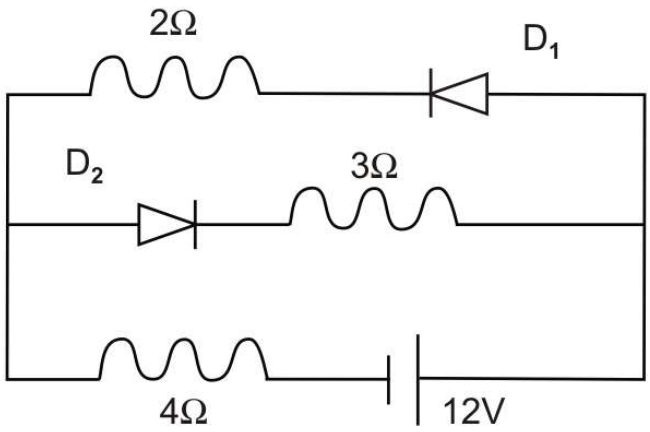
22	(a) In a nuclear reaction $_2He^3 + _2He^3 \rightarrow _2He^4 + _1H^1 + _1H^1 + 12.86$ MeV, though the number of nucleons is conserved on both sides of the reaction, yet the energy is released. How? Explain. (b) Draw a plot of potential energy between a pair of nucleons as a function of their separation. Mark the regions showing attraction and repulsion range of nuclear forces.	3
23	Find the ratio of potential differences that must be applied across the parallel and series combination of two capacitors C_1 and C_2 with their capacitances in the ratio 1:2 So that the energy stored in the two cases becomes the same.	3
24	Using Bohr postulates, derive the expression for orbital period of electron moving in the n^{th} orbit of hydrogen atom.	3
25	(a) Define the trem conductivity of a metallic wire. Write its SI unit. (b) Using the concept of free electrons in a conductor, derive the expression for the conductivity of a wire in terms of number density and relaxation time. Hence obtain the relation between current density and the applied electric field E.	3
26	(a) An electron moving horizontally with a velocity of $4x10^4$m/s, enters a region of uniform magnetic field of 10^{-5} T acting	

	vertically upward as shown in figure. Draw its trajectory and find out the time it takes to come out of the region of magnetic field.  (b) A straight wire of mass 200gm and length 1.5m carries a current of 2A. It is suspended in mid air by a uniform magnetic field 'B'. What is the magnitude of this magnetic field.	3
27	Identify the following electromagnetic radiations as per the frequencies given below. Write one application of each. (a) $10^{20}H_2$ (b) $10^{9}H_2$ (c) $10^{11}H_2$	3
28	(a) Define self inductance and write its SI unit. (b) The magnetic flux through a coil is given by $\varnothing=(5t^3+4t^2+2t-5)$wb. What is the current induced in the coil at t=2sec. If the resistance of the coil is 5Ω OR (c) The current flowing through an inductor of self inductance 'L' is continously increasing. Plot graphs showing the variations of i) Magnetic flux verses current ii) Induced emf verses $\frac{dI}{dt}$ iii) Magnetic potential energy stored verses the current	3

SECTION D

The following questions are case-based questions. Each question has an internal choice and carried 4 [1+1+2] marks each. Read the passage carefully and answer the questions.

29	There are different techniques of fabrication of p-n junction. In one such technique, called fused junction techniques, an aluminium film is kept on the wafer of n-type semiconductor and the combination is then heated to a high temperature. As a result aluminium fused into silicon and produces p-type semiconductor and in this way a p-n Junction is formed. i) When a p-n Junction is reverse biased, then how does the height of potential barrier change? (a) Increases (b) Decreases (c) No change (d) None of these ii) The cause of potential barrier in p-n junction is (a) Depletion of positive charges near the junction (b) Concentration of negative charges near the junction (c) Concentration of positive and negative charges near the junction (d) Depletion of negative charges near the junction iii) The circuit has two oppositely connected ideal diodes in parallel. What is the current flowing in the circuit	4



(a) 1.17 A

(b) 2 A

(c) 2.31 A

(d) 1.33 A

iv) Carbon, germanium and silicon all are fourteenth group elements

(a) Carbon and germanium are semiconductors

(b) Carbon and silicon are semiconductor

(c) All carbon, silicon and germanium are semiconductors

(d) Silicon and germanium are semiconductors

OR

v) When a p-n junction is forward biased then

(a) Only diffusion current flows

(b) Both diffusion and drift current flows

(c) Only drift current flows

(d) None of these

30	Read the following paragraph and answer the questions that follow. Case II An optical fibre is a hair-thin long strand of quality glass or quartz known as core surrounded by a glass coating of slightly lower	

	refractive index known as cladding. For proving safety and strength, the core cladding of optical fibres is enclosed in the plastic jacket. A bundle of optical fibres is called a light pipe. A single fibre can't be used to see complete image. But if the image is broken into larger number of fine dots and each portion of image is seen through a seperate fibre, the complete image can be seen. A light pipe can be used to transmit the image accurately i) On what principle do these optical fibres work (a) Laws of reflection (b) Laws of refraction (c) Hughen's principle (d) Total internal reflection ii) Which of the following should have greater refractive index (a) Core (b) Cladding (c) Butter coating (d) Both (b) and (c) iii) What is light pipe (a) It is a tube having lightening element (b) A source of light (c) A bundle of optical fibres (d) None of the above iv) A ray of light will undergo total internal reflection if it (a) Goes from rarer medium to denser medium (b) Incidents at an angle less than the critical angle (c) Strikes the interface normally (d) Incidents at an angle greater than the critical angle OR v) Which of the following is not due to total internal reflection of light (a) Brilliance of diamond	4

	(b) Mirage formation (c) Optical fibre working (d) None of these	

SECTION E

The following questions are long answer type and carry 5 marks each. All questions have an internal choice. Answer the following questions.

31	(a) State Huygen's Principle. Using this principle draw a diagram to show how a plane wavefront incident at the interface of two media gets refracted when it propagates from a rarer to denser medium. Hence verify Snell's law of refraction. (b) When monochromatic light travels from rarer to denser medium, explains the following by giving reasons. i) Is the frequency of reflected and refracted light same as the frequency of incident light ii) Does the decrease in speed imply a reduction in the energy carried by light waves ? OR (a) Define interference of light ? (b) Write a short note on Young's double slit experiment and describe how dark and bright fringes are obtained on a screen kept in front of slits. (c) The ratio of intensities at minima and maxima in Youngs double slit experiment is 9:25. Find the ratio of widths of the two slits.	5
32	(a) A parallel plate capacitor is charged by a battery to a potential. The battery is disconnected and a dielectric slab is inserted to completely fill the space between the plates. How will its (i) capacitance (ii) electric field and (iii) energy stored in them, be affected ? Justify your necessary mathematical expressions for each case. (b) Sketch the pattern of electric field lines due to a conducting	

	sphere having negative charge in it OR (a) Define energy density of a parallel plate capacitor ? (b) Two point charges $q_1 = 10x10^{-8}C$ and $q_2 = {}^{-}2 \times 10^{-8}C$ are seperated by a distance from the first charge q_1, would the electric potential be zero (c) Calculate the electrostatic potential energy of the system.	5
33	(a) Explain the term inductive reactance. Show graphically the variation of capacitive reactance with frequency of applied alternating voltage. (b) An ac voltage $E = E_m \sin \omega t$ is applied across a pure capacitor of capacitance (c) Show mathematically that the current flowing through it leads the applied voltage by a phase angle of $\frac{\pi}{2}$ OR A device X is connected across an ac source of voltage $V = V_0 \sin \omega t$. The current through X is given by $I = I_o \sin (\omega t + \frac{\pi}{2})$ (d) Identify the device X and write the expression for its reactance (e) Draw graphs showing the variation of voltage and current with time over 1 cycle of ac for X. (f) How does the reactance of the device X-vary with frequency of ac, show it graphically (g) Draw the phasor diagram for the device X	5