Second Pre Board

Lucknow Region

CLASS XII : PHYSICS

TIME: 3 hour Max Marks: 70

General Instructions

1. There are 33 questions an all questions are compulsory.
2. There are a total of five sections A,B,C,D, and E in this paper.
3. Section A contains 12 MCQ s and 4 Assertion Reason questions of one mark each. Section B contains 5 questions of 2 marks each, section C contains 7 questions of 3 marks each, section D contains 2 case study based questions of 4 marks each and section E contains 3 long answer questions of 5 marks each.
4. There is no overall choice. Internal choice has been provided in one question in section B,C and one question each in CBQ and for all the three questions in section E.
5. Use of calculator is not allowed.
6. The following constants may be used wherever necessary.

$C = 3 \times 10^8$ m/s
$m_e = 9.1 \times 10^{-31}$ kg
$e = 1.6 \times 10^{-19}$C
$\mu_0 = 4\pi \times 10^{-7}$ Tm/A
$h = 6.63 \times 10^{-34}$ Js
$\varepsilon_0 = 8.854 \times 10^{-12}$ $C^2N^{-1}m^{-2}$

SECTION A

1.	A point charge Q is placed at a point O as shown in the figure. Is the potential difference V_A-V_B positive, negative or zero if Q is (i) positive (ii) negative ? O A B (a) negative, negative (b) negative, positive (c) positive, positive (d) Positive, negative	1
2.	A plane electromagnetic wave travels in free space along positive X axis. At a particular point in space, the electric field along Y axis is 9.3 V/m. The magnetic induction **B** along Z axis is (a) 3.1×10^{-7} T (b) 3.1×10^{-8} T (c) 3×10^{-5} T (d) 3×10^{-6} T	1
3.	Two wires of same length are shaped into a square and a circle respectively. If they carry same current, ratio of magnetic moment is: (a) 2 : π (b) π: 2 (c) π : 4 (d) 4 : π	1
4.	The current in ampere in an inductor is given by I = 5 + 16t where t is in second. The self induced emf in it is 10 mV. The self inductance is	1

	(a) 5.55×10^{-5} H (b) 6.25×10^{-4} H (c) 5.26×10^{-6} H (d) 7.5×10^{-7} H	
5.	A 15 ohm resistor, an 80 mH inductor and a capacitor of capacitance C are connected in series with a 50 Hz ac source. If the source voltage and current in the circuit are in phase, the value of capacitance is (a) 100 μF (b) 127 μF (c) 142 μF (d) 160 μF	1
6.	Two students A and B calculated the charge flowing through a circuit. A concludes that 300 C charge flows in one minute. B concludes that 3.125×10^{19} electrons flow in one second. If the current measured in the circuit is 5 A, then the correct calculation is done by: (a) A (b) B (c) both A and B (d) neither A nor B	1
7.	Beams of electrons and protons move parallel to each other in the same direction. They (a) Attract each other (b) Repel each other (c) neither attract nor repel (d) Attraction or repulsion depends upon Speed	1
8.	The momentum of a photon of wavelength λ is (a) hλ (b)h/λ (c) λ/h (d) h/cλ	1
9.	If the kinetic energy of a particle is increased to 16 times its previous value, the percentage change in the de Broglie wavelength of the particle is (a) 60 (b) 50 (c) 25 (d) 75	1
10.	A biconcave lens of power P vertically splits into two identical plano concave parts. The power of each part will be (a) 2P(b) P/2 (c) P (d) P/√2	1
11.	In an N – type silicon, which of the following statements is true ? (a) Electrons are majority carriers and trivalent atoms are dopants. (b) Electrons are minority carriers and pentavalent atoms are dopants. (c) Holes are minority carriers and pentavalent atoms are dopants. (d) Holes are majority carriers and trivalent atoms are dopants.	1
12.	The formation of depletion region in a P-N junction diode is due to (a) Movement of dopant atoms (b) Diffusion of electrons and holes (c) Drift of electrons only (d) Drift of holes only	1

Questions 13 to 16 consist of two statements, each labelled as Assertion and Reason. While answering these questions, you are required to choose any one of the following four responses.

(a) If both Assertion and Reason are correct and the Reason is a correct explanation of the Assertion.

(b) If both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.

(c) If the Assertion is correct but Reason is incorrect.

(d) If both the Assertion and Reason are incorrect.

13.	**Assertion :** The poles of magnet can not be separated by breaking into two pieces. **Reason :** The magnetic moment will be reduced to half when a magnet is broken into two equal pieces.	1
14.	**Assertion :** Induced emf will always occur whenever there is change in magnetic flux. **Reason :** Current always induces whenever there is change in magnetic flux.	1
15.	**Assertion :** If the rays are diverging after emerging from a lens; the lens must be concave. **Reason :** The convex lens cannot give diverging rays.	1
16.	**Assertion :** Energy is released when heavy nuclei undergo fission or light nuclei undergo fusion. **Reason :** For heavy nuclei, binding energy per nucleon increases with increasing Z while for light nuclei it decreases with increasing Z.	1

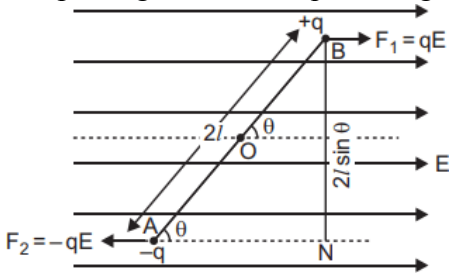
SECTION B

17.	Show diagrammatically the behavior of magnetic field lines in the presence of (i) paramagnetic and (ii) diamagnetic substances.	2
18.	A battery that contains emf E and internal resistance r when connected across an external resistance of 12 ohm, produces a current of 0.5 A. When connected across a resistance of 25 ohm, it produces a current of 0.25 A. Find (i) internal resistance and (ii) emf of the cell.	2
19.	A spherical rubber balloon carries a charge that is uniformly distributed over its surface. As the balloon is blown up, how does E vary for points (i) inside the balloon (ii) on the surface of the balloon.	2
20.	Draw the intensity pattern for single slit diffraction and double slit interference. Hence state two differences between interference and diffraction patterns. OR Two harmonic waves of monochromatic light $y_1 = a \cos \omega t$, $y_2 = a \cos (\omega t + \Phi)$ are superimposed on each other. Show that maximum intensity in interference pattern is four times the intensity due to each slit .	2
21.	Calculate the energy released in MeV in the following nuclear reaction : $_{92}U^{238} \longrightarrow {}_{90}Th^{234} + {}_{2}He^{4} + Q$ [Mass of $_{92}U^{238}$ = 238.05079 u Mass of $_{90}Th^{234}$ = 234.043630 u Mass of $_{2}He^{4}$ = 4.002600 u 1u = 931.5 MeV/c^2]	2

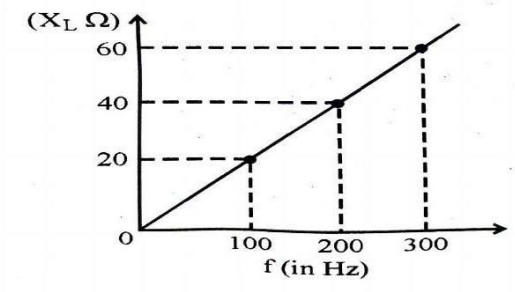
SECTION C

22.	A capacitor of unknown capacitance is connected across a battery of V volt. The charge stored is 360 μC. When potential across the capacitor is reduced by 120 V,	3

	the charge stored becomes 120 μC. Calculate the potential V and the unknown capacitance C	
23.	What is a wave front ? What is the geometrical shape of a wave front of light emerging out of a convex lens, when point source is placed at the focus ? Using Huygen's principle show that, for a parallel beam incident on a reflecting surface, the angle of reflection is equal to the angle of incidence.	3
24.	a) Name the em wave produced during radioactive decay of nucleus. Mention one use of it. b) Why do welders wear special type of goggles while working? c) Which part of electromagnetic spectrum has a wavelength range of 390 to 770 nm?	3
25	(a) Monochromatic light of wavelength 589 nm is incident from air on a water surface. If refractive index for water is 1.33 , find the wavelength, frequency and speed of refracted light. (b) A compound lens is made of two lenses in contact having powers +11.5 D and –1.5 D. An object is placed at 15cm from this compound lens. Find the position of the image formed.	3
26.	A potential difference of V volt is applied to a conductor of length l and diameter D. How will the drift velocity of electrons and the resistance of the conductor change when (i) V is doubled (ii) L is halved where the other two factors remain the same. Give reason.	3
27.	Draw a plot showing the variation of photoelectric current with collector plate potential for two different frequencies, $\nu_1 > \nu_2$, of incident radiation having the same intensity. In which case will the stopping potential be higher? Justify your answer.	3
28	(a) A student wants to use two p-n junction diodes to convert alternating current into direct current. Draw the labeled circuit diagram she would use and explain how it works. (b) Show graphically the input and output voltages. OR (a) Draw the circuit arrangement for studying the V – I characteristics of a p - n junction diode in forward bias. Draw the typical V – I characteristics of a silicon diode. (b) Describe briefly the following terms (i) 'Minority carrier injection' in forward bias (ii) 'Breakdown voltage' in reverse bias	3
	SECTION D	
29	A prism is a portion of a transparent medium bounded by two plane faces inclined to each other at a suitable angle. A ray of light suffers two refraction on passing through a prism and hence deviates through a certain angle from its original path . The angle of deviation of a prism is $d = (\mu-1) A$, through which a ray deviates on passing through a thin prism of small refracting angle A . If μ is	

	the refractive index of the material of the prism then the prism formula is $\mu = \sin(A+dm)/2)/\sin(A/2)$. (i) For which colour , angle of deviation is minimum ? (a) Voilet (b) Yellow (c) Red (d) Blue. (ii) When white light moves through vacuum (a) all colours have same speed (b) different colours have different speed (c) violet has more speed then red (d) red has more speed then violet. (iii)The deviation through a prism is maximum when angle of incidence is (a) 450 (b) 700 (c) 900 (d) 600 . OR What is the deviation produced by a prism of angle 60 ? (μ=1.644) (a) 3.840 (b) 4.595 (c) 7.259 (d) 1.252. (iv) A ray of light falling at an angle of 500 is refracted through a prism and suffers minimum deviation . If the angle of prism is 600, then the angle of minimum deviation is (a) 450 (b) 750 (c) 500 (d) 400	1 1 1 1
30	When electric dipole is placed in uniform electric field, its two charges experience equal and opposite forces, which cancel each other and hence net force on electric dipole in uniform electric field is zero. However these forces are not collinear, so they give rise to some torque on the dipole. Since net force on electric dipole in uniform electric field is zero, so no work is done in moving the electric dipole in uniform electric field. However some work is done in rotating the dipole against the torque acting on it.  (i) The dipole moment of a dipole in a uniform external field $\bar{E}$ is p. Then the torque τ acting on the dipole is (a) $\tau = p \times E$ (b) $\tau = p.\bar{E}$ (c) $\tau = 2(p + \bar{E})$ (d) $\tau = (p + E)$ (ii) An electric dipole consists of two opposite charges, each of magnitude 1.0 μC separated by a distance of 2.0 cm. The dipole is placed in an external field of 105 NC^{-1}. The maximum torque on the dipole is (a) 0.2 x 10-3 Nm (b) 1x 10-3 Nm	1 1

	(c) 2 x 10-3 Nm (d) 4x 10-3 Nm (iii) Torque on a dipole in uniform electric field is minimum when θ is equal to (a) 0° (b) 90° (c) 180° (d) Both (a) and (c) OR When an electric dipole is held at an angle in a uniform electric field, the net force F and torque τ on the dipole are (a) F = 0, τ = 0 (b) F ≠ 0, τ ≠ 0 (c) F = 0, τ ≠ 0 (d) F ≠ 0, τ = 0 (iv) An electric dipole of moment p is placed in an electric field of intensity E. The dipole acquires a position such that the axis of the dipole makes an angle with the direction of the field. Assuming that potential energy of the dipole to be zero when 0 = 90°, the torque and the potential energy of the dipole will respectively be (a) pEsinθ, -pEcosθ (b) pEsinθ, -2pEcosθ (c) pEsinθ, 2pEcosθ (d) pEcosθ, - pEsinθ	1 1
	SECTION E	
31	a) State Biot – Savart law. Using this law, find expression for the magnetic field at apoint on the axis of a circular current carrying coil. b) From the above result obtain an equation for magnetic field at the centre of the coil. c) Schematically represent the direction of the magnetic field lines through a circular coil carrying current. Also mention the law used to find the direction. OR (a) With the help of a diagram, explain the principle and working of a moving coil galvanometer. (b) What is the importance of radial magnetic field and how is it produced? (c) Why is it that while using a moving coil galvanometer as a voltmeter a high resistance in series is required whereas in an ammeter a shunt is used.	5
32	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 the 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 ac? Show this variation graphically. (d) Draw the phasor diagram for this device X. OR	5

	a) Show that an ideal inductor does not dissipate power in an ac circuit. b) The variation of inductive reactance (X_L) of an inductor with the frequency (f) of the ac source of 100 V and variable frequency is shown in the figure.  (i) Calculate the self inductance of the inductor. (ii) When this inductor is used in series with a capacitor of unknown value and a resistor of 10 ohm at 300 s^{-1}, maximum power dissipation occurs in the circuit. Calculate the capacitance of the capacitor .	
33	(a) Draw a schematic arrangement of Geiger-Marsden experiment showing the scattering of α-particles by a thin foil of gold. (b) Why is it that most of the α-particles go right through the foil and only a small fraction gets scattered at large angles ? (c) Draw the trajectory of the α-particle in the coulomb field of a nucleus. (d) What is the significance of impact parameter and what information can be obtained regarding the size of the nucleus ? (e)Estimate the distance of closest approach to the nucleus (Z = 79) if a 7.7 MeV α-particle before it comes momentarily to rest and reverses its direction OR (a) Depict the variation of potential energy of a pair of nucleons with the separation between them. (b) Plot a graph showing the variation of binding energy nucleon as a function of mass number. Which property of nuclear force explains the approximate constancy of binding energy in the range 30<A<170? How does one explain the release of energy in both the processes of nuclear fission and fusion from the graph?	5