MODEL QUESTION PAPER

Physics

XII Standard CBSE

Time Allowed: 3 Hours **Maximum Marks: 70**

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

   i. c = 3 x 108 m/s

   ii. m_e = 9.1 x10-^{31} kg

   iii. e = 1.6 x 10-19 C

   iv. $\mu_0 = 4\pi$ x 10-7 Tm$\boldsymbol{A^{-1}}$

   v. h = 6.63 x10^{-34} Js

   vi. ε_0 = 8.854 x10-12 $\boldsymbol{C^2N^{-1}m^{-2}}$

   vii. Avogadro's number = 6.023 X $\mathbf{10^{23}}$ per gram mole

SECTION-A

Answer all the questions **16×1=16**

S. No.	Questions	Marks
1	Which of the following is not the property of an equipotential surface? (a) They do not cross each other. (b) The work done in carrying a charge from one point to another on an equipotential surface is zero. (c) For a uniform electric field, they are concentric spheres. (d) They can be imaginary spheres.	1
2	An electric dipole placed in an electric field of intensity 2 × 105 N/C at an angle of 30° experiences a torque equal to 4 Nm. The charge on the dipole of dipole length 2 cm is (a) 7 μC (b) 8 mC (c) 2 mC (d) 5 mC	1
3	A metallic plate exposed to white light emits electrons. For which of the following colours of light, the stopping potential will be maximum? (a) Blue (b) Yellow (c) Red (d) Violet	1
4	When alpha particles are sent through a thin gold foil, most of them go straight through the foil, because (a) alpha particles are positively charged (b) the mass of an alpha particle is more than the mass of an electron (c) most of the part of an atom is empty space (d) alpha particles move with high velocity	1
5	An electron is moving along positive x-axis in a magnetic field which is parallel to the positive y-axis. In what direction will the magnetic force be acting on the electron? (a) Along -x axis (b) Along -z axis (c) Along +z axis (d) Along -y axis	1
6	The relative magnetic permeability of a substance X is slightly less than unity and that of substance Y is slightly more than unity, then (a) X is paramagnetic and Y is ferromagnetic (b) X is diamagnetic and Y is ferromagnetic (c) X and Y both are paramagnetic (d) X is diamagnetic and Y is paramagnetic	1
7	An ammeter of resistance 0.81 ohm reads up to 1 A. The value of the required shunt to increase the range to 10 A is (a) 0.9 ohm (b) 0.09 ohm (c) 0.03 ohm (d) 0.3 ohm	1

8	An electron with angular momentum L moving around the nucleus has a magnetic moment given by (a) e L/ 2m (b) e L/3m (c) e L /4m (d) e L / m	1
9	The large scale transmission of electrical energy over long distances is done with the use of transformers. The voltage output of the generator is stepped-up because of (a) reduction of current (b) reduction of current and voltage both (c) power loss is cut down (d) (a) and (c) both	1
10	The diagram below shows the electric field (E) and magnetic field (B) components of an electromagnetic wave at a certain time and location. The direction of the propagation of the electromagnetic wave is (a) perpendicular to E and B and out of plane of the paper (b) perpendicular to E and B and into the plane of the paper (c) parallel and in the same direction as E (d) parallel and in the same direction as B	1
11	The work function for a metal surface is 4.14 eV. The thresholdwavelength for this metal surface is: (a) 4125 Å (b) 2062.5 Å (c) 3000 Å (d) 6000 Å	1
12	The radius of the innermost electron orbit of a hydrogen atom is5.3×10^{-11} m. The radius of the n =3 orbit is (a) 1.01 x 10^{-10}m (b) 1.59 X 10^{-10}m (c) 2.12 x 10^{-10}m (d) 4.77 X 10^{-10}m	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.** **a) If both Assertion and Reason are true and Reason is 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): For the radiation of a frequency greater than the threshold frequency, photoelectric current is proportional to the intensity of the radiation. Reason (R): Greater the number of energy quanta available, greater is the number of electrons absorbing the energy quanta and greater is number of electrons coming out of the metal.	1

14	Assertion (A): Putting p type semiconductor slab directly in physical contact with n type semiconductor slab cannot form the pn junction. Reason (R): The roughness at contact will be much more than inter atomic crystal spacing and continuous flow of charge carriers is not possible.	1
15	Assertion (A): An electron has a higher potential energy when it is at a location associated with a negative value of potential and has a lower potential energy when at a location associated with a positive potential. Reason (R): Electrons move from a region of higher potential to a region of lower potential.	1
16	Assertion (A): Propagation of light through an optical fibre is due to total internal reflection taking place at the core-cladding interface. Reason (R): Refractive index of the material of the cladding of the optical fibre is greater than that of the core.	1

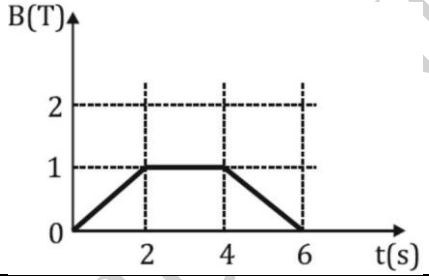
SECTION-B

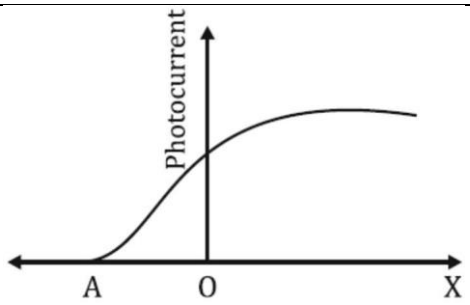
Answer all the questions **5×2=10**

17	(a) Name the device which utilizes unilateral action of a pn diode to convert ac into dc. (b) Draw the circuit diagram of full wave rectifier.	2
18	The wavelength λ of a photon and the de Broglie wavelength of an electron of mass m have the same value. Show that the energy of the photon is 2λmc/h times the kinetic energy of the electron, where c and h have their usual meanings.	2
19	A ray of monochromatic light passes through an equilateral glass prism in such a way that the angle of incidence is equal to the angle of emergence and each of these angles is 3/4 times the angle of the prism. Determine the angle of deviation and the refractive index of the glass prism.	2
20	A heating element using nichrome connected to a 230 V supply draws an initial current of 3.2 A which settles after a few seconds to a steady value of 2.8 A. What is the steady temperature of the heating element if the room temperature is 27.0 °C and the temperature coefficient of resistance of nichrome is $1.70 \times 10^{-4}°C^{-1}$?	2
21	Show that the least possible distance between an object and its real image in a convex lens is 4f, where f is the focal length of the lens. **OR** In an astronomical telescope in normal adjustment a straight black line of length L is drawn on the objective lens. The eyepiece forms a real image of this line whose length is l. What is the angular magnification of the telescope?	2

SECTION-C

Answer all the questions ***7×3=21***

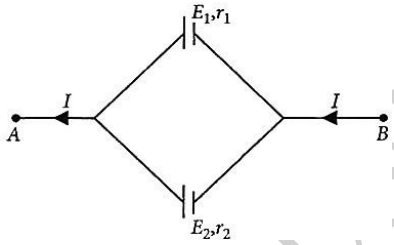
22	A given coin has a mass of 3.0 g. Calculate the nuclear energy that would be required to separate all the neutrons and protons from each other. For simplicity assume that the coin is entirely made of $_{29}Cu^{63}$ atoms (of mass 62.92960 u). Given m_p = 1.007825u and m_n = 1.008665u	3
23	Two long straight parallel conductors carrying currents I1 and I2 are separated by a distance d. If the currents are flowing in the same direction, show how the magnetic field produced by one exerts an attractive force on the other. Obtain the expression for this force and hence define 1 ampere.	3
24	The magnetic field through a circular loop of wire, 12cm in radius and 8.5Ω resistance, changes with time as shown in the figure. The magnetic field is perpendicular to the plane of the loop. Calculate the current induced in the loop and plot a graph showing induced current as a function of time.  	3
25	An a.c. source generating a voltage ε = ε_0 sin ωt is connected to a capacitor of capacitance C. Find the expression for the current I flowingthrough it. Plot a graph of ε and I versus ωt to show that the current is ahead of the voltage by π/2. **OR** An ac voltage $V = V_0$ sin ωt is applied across a pure inductor of inductance *L*. Find an expression for the current *i*, flowing in the circuit and show mathematically that the current flowing through it lags behindthe applied voltage by a phase angle of л/2. Also draw graphs of *V* and *i* versus ωt for the circuit	3
26	Radiation of frequency 10^{15} Hz is incident on three photosensitivesurfaces A, B and C. Following observations are recorded: **Surface A**: no photoemission occurs **Surface B**: photoemission occurs but the photoelectrons have zerokinetic energy. **Surface C**: photo emission occurs and photoelectrons have somekinetic energy. Using Einstein's photo-electric equation, explain the threeobservations. **OR** The graph shows the variation of photocurrent for aphotosensitive metal	3

	 (a) What does X and A on the horizontal axis represent? (b) Draw this graph for three different values of frequencies of incidentradiation υ_1, υ_2 and υ_3 ($\upsilon_3 > \upsilon_2 > \upsilon_1$) for the same intensity. Draw this graph for three different values of intensities of incidentradiation I_1, I_2 and I_3 ($I_3 > I_2 > I_1$) having the same frequency.	
27	The ground state energy of hydrogen atom is -13.6 eV. The photon emitted during the transition of electron from n=3 to n=1 state, isincident on a photosensitive material of unknown work function .The photoelectrons are emitted from the material with the maximum kineticenergy of 9eV.Calculate the threshold wavelength of the material used.	3
28	A ray of light is incident on a glass prism of refractive index μ and refracting angle A. If it just suffers total internal reflection at the other face, obtain a reflection between the angle of incidence, angle of prism and critical angle.	3

SECTION-D

Answer all the questions ***2×4=8***

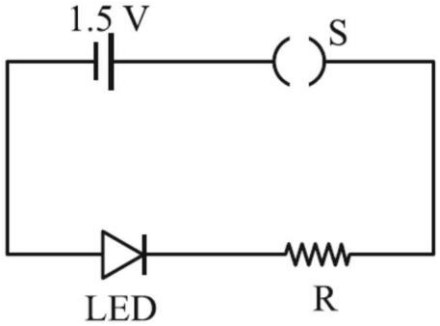
29	(a) Draw equipotential surfaces for (i) an electric dipole and (ii) two identical positive Charges placed near each other. (b) In a parallel plate capacitor with air between the plates, each plate has an area of 6 x $10^{-3}m^2$ and the separation between the plates is 3 mm. (i) Calculate the capacitance of the capacitor. (ii) If the capacitor is connected to 100V supply, what would be thethe charge on each plate? (iii) How would charge on the plate be affected if a 3 mm thick micasheet of k=6 is inserted between the plates while the voltage supplyremains connected? **OR** (a)Three charges –q, Q and –q are placed at equal distances on astraight line. If the potential energy of the system of these charges is zero, then what is the ratio Q:q? (b) (i) Obtain the expression for the electric field intensity due to a uniformly charged spherical shell of radius R at a point distant r from the centre of the shell outside it.	4

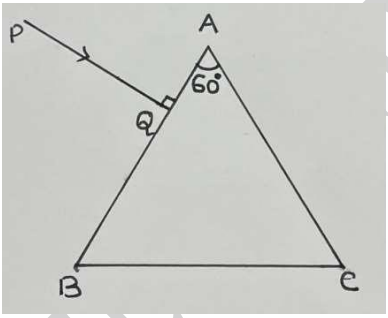
	(ii) Draw a graph showing the variation of electric field intensity E with r, for r > R and r < R.	
30	(a) Explain the term drift velocity of electrons in a conductor .Hence obtain the expression for the current through a conductor in terms of drift velocity. (b) Two cells of emfs $E1$ and $E2$ and internal resistances $r_1$and $r_2$respectively are connected in parallel as shown in the figure. Deduce the expression for the (i) equivalent emf of the combination (ii) equivalent internal resistance of the combination (iii) potential difference between the points *A* and *B*.  **OR** (a) State the two Kirchhoff's rules used in the analysis ofelectric circuits and explain them. (b) Derive the equation of the balanced state in a Wheatstone bridge using Kirchhoff's laws.	4

SECTION-E

Answer all the questions **3×5=15**

31	***Read the following paragraph and answer the questions.*** A number of optical devices and instruments have been designed and developed such as periscope, binoculars, microscopes and telescopes utilising the reflecting and refractingproperties of mirrors, lenses and prisms. Most of them are in common use. Our knowledge about the formation of images by the mirrors and lenses is the basic requirement for understanding the working of these devices. (i) Why the image formed at infinity is often considered mostsuitable for viewing. Explain (ii) In modern microscopes multicomponent lenses are used forboth the objective and the eyepiece. Why? (iii) Write two points of difference between a compound	5

	microscope and an astronomical telescope **OR** (iii) Write two distinct advantages of a reflecting type telescopeover a refracting type telescope.	
32	**Read the following paragraph and answer the questions** **LED** is a heavily doped P-N junction which under forward bias emits spontaneous radiation. When it is forward biased, due to recombination ofholes and electrons at the junction, energy is released in the form of photons. In the case of Si and Ge diode, the energy released in recombination lies in the infrared region. LEDs that can emit red, yellow, orange, green and blue light are commercially available. The semiconductor used for fabrication of visible LEDs must at least have a band gap of 1.8 eV. The compound semiconductor Gallium Arsenide — Phosphide is used for making LEDs of different colors.  LEDs of different kinds (i). Why are LEDs made of compound semiconductor and not of elemental semiconductors? (ii) What should be the order of bandgap of an LED, if it is requiredto emit light in the visible range? (iii) A student connects the blue colored LED as shown in the figure.The LED did not glow when switch S is closed. Explain why? 	5

	OR (iii) Draw V-I characteristic of a p-n junction diode in (i) forward bias and (ii) reverse bias	
33	(a) Draw the graph showing intensity distribution of fringes withphase angle due to diffraction through a single slit. What is the width of the central maximum in comparison to that of asecondary maximum? (b) A ray PQ is incident normally on the face AB of a triangular prism of refracting angle 60^0 as shown in figure. The prism is made of a transparent material of refractive index $\sqrt{3}$. Trace the path of the ray as it passes through the prism. Calculate the angle of emergence and the angle of deviation.  **OR** (a) Write two points of difference between an interference pattern and a diffraction pattern. (b) (i) A ray of light incident on face AB of an equilateral glass prism, shows minimum deviation of 30°. Calculate the speed of light through the prism. (ii) Find the angle of incidence at face AB so that the emergent ray grazes along the face AC.	5