Roll Number		

SET C

INDIAN SCHOOL MUSCAT
FIRST PRE-BOARD EXAMINATION
PHYSICS

CLASS: XII | Sub. Code: 042 | Time Allotted: 3 Hrs.

22.02.2021 | Max. Marks: 70

General Instructions:

- All questions are compulsory. There are 33 questions in all.
- This question paper has five sections: Section A, Section B, Section C, Section D and Section E.
- Section A contains ten very short answer questions (Q-1 to Q-10) and four assertion reasoning MCQs (Q-11 to Q-14) of 1 mark each.
- Section B has two case-based questions (Q-15 to Q-16) of 4 marks each.
- Section C contains nine short answer questions (Q-17 to Q-25) of 2 marks each.
- Section D contains five short answer questions (Q-26 to Q-30) of 3 marks each.
- Section E contains three long answer questions (Q-30 to Q-33) of 5 marks each.
- There is no overall choice. However internal choice is provided. You have to attempt only one of the choices in such questions.

Charge of an electron, e = 1.6×10^{-19} C; $h = 6.63 \times 10^{-34} Js$; $1eV = 1.6 \times 10^{-19} J$

$\mu_0 = 4\pi \times 10^{-7}$ T m A^{-1}

SECTION – A

(All questions are compulsory (1mark each). In case of internal choices, attempt any one of them.)

1 How does the depletion region of a p-n junction diode get affected under reverse bias? 1

2 The instantaneous current in an ac circuit is I = 0.5 sin 314t. What is the rms value of current? 1

OR

A solenoid with **N** loops of wire tightly wrapped around an iron-core is carrying an electric current **I.** If the current through this solenoid is doubled, then what change would you expect in inductance **L** of the solenoid?

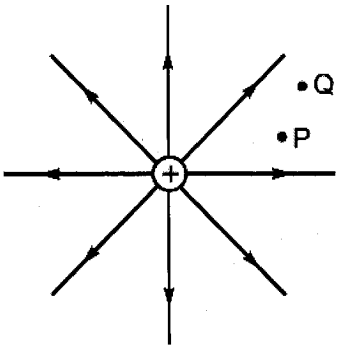
3 Which series of hydrogen spectra exists in visible region? 1

4 A proton and a deuteron having equal momenta enter in a region of uniform magnetic field at right angle to the direction of the field. Find the ratio of the radii of curvature of the path of the particles. 1

OR

Where on the earth's surface is the value of angle of dip maximum?

5 The figure shows the field lines of a positive point charge. What will be the sign of the potential energy difference of a small negative charge between the points Q and P? Justify your answer. 1



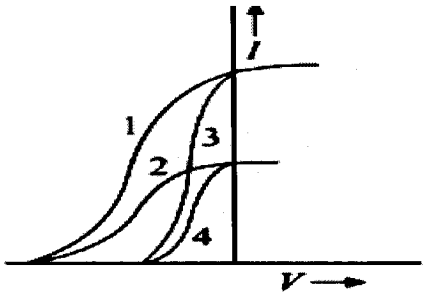
6 Write a relation for polarization $\vec{P}$ of a dielectric material in the presence of an external electric field $\vec{E}$. 1

7 A convex lens of refractive index 1.5 is immersed in a medium of refractive index 1.65. What is the nature of the lens? 1

8 What is the stopping potential of a photocell, in which electrons with a maximum kinetic energy of 6eV are emitted? 1

OR

The given graph shows the variation of photo-electric current (I) versus applied voltage (V) for two different photosensitive materials and for two different intensities of the incident radiation. Identify the pairs of curves that correspond to different materials but same intensity of incident radiation.



9 Why are infra-red radiations referred to as heat waves? 1

OR

The frequency of oscillation of the electric field vector of a certain electromagnetic wave is 5×10^{14} Hz. What is the frequency of oscillation of the corresponding magnetic field vector? Which part of the electromagnetic spectrum does it belong?

10 Name the electromagnetic radiations used for (a) water purification and (b) important role in earth's warming. 1

For question numbers 11, 12, 13 and 14, (1 mark each) two statements are given-one labeled Assertion (A) and the other labeled Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as 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 and R is also false

11 **Assertion:** The positively charged nucleus of an atom has a radius of almost 10^{-15}m. 1
Reason: In α-particle scattering experiment, the distance of closest approach for α-particles is ≈ 10^{-15}m.

12 **Assertion:** A p-n junction with reverse bias can be used as a photo-diode to measure light intensity. 1
Reason: In reverse bias condition the current is small but it is more sensitive to change in incident light intensity.

13 **Assertion:** Electron has higher mobility than hole in a semiconductor 1
Reason: Mass of electron is less than mass of hole

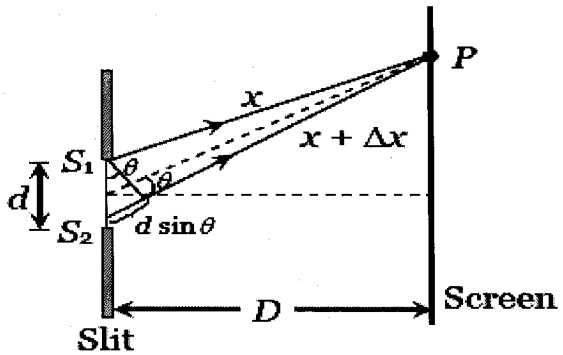
14 1
Assertion: Increasing the current sensitivity of a galvanometer necessarily increases the voltage sensitivity.

Reason: Voltage sensitivity is inversely proportional to current sensitivity.

SECTION - B

Questions 15 and 16 are Case Study based questions and are compulsory. Attempt any 4 sub parts from each question. Each question carries 1 mark.

15 Diffraction is the phenomenon of bending of light around the corners of an obstacle/aperture of the size of the wavelength of light. Diffraction is the characteristic of all types of waves. Greater the wavelength of wave, higher will be its degree of diffraction. Experimental study of diffraction was extended by Newton as well as Young. Most systematic study was carried out by Huygens on the basis of wave theory. In case of diffraction at a single slit, we get a central bright band with alternate bright (maxima) and dark (minima) bands of decreasing intensity.



(i) A single slit diffraction pattern is obtained using a beam of red light. What happens if the red light is replaced by the blue light?

(a) There is no change in diffraction pattern
(b) Diffraction fringes become narrower and crowded
(d) Diffraction fringes become broader and farther apart
(d) The diffraction pattern disappear

(ii) To observe diffraction, the size of the obstacle

(a) should be X/2, where X is the wavelength.
(b) should be of the order of wavelength.
(c) has no relation to wavelength.
(d) should be much larger than the wavelength.

(iii) If the width of the slit in single slit diffraction experiment is doubled, then the central maximum of diffraction pattern becomes

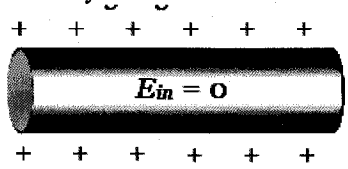
(a) broader and brighter
(b) sharper and brighter
(c) sharper and fainter
(d) broader and fainter.

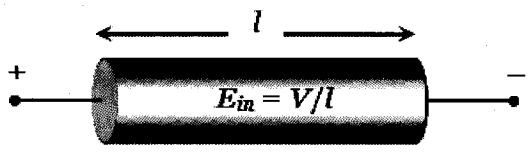
(iv) Two students are separated by a 5m partition wall in a room 10 m high. If both light and sound waves can bend around obstacles, we find that the students are unable to see each other even though they can converse easily. It is due to
(a) Diffraction of sound
(b) Diffraction of light
(c) Diffraction of both sound and light
(d) Interference of light

(v) If a tiny obstacle is placed in the path of light from a distant source, a bright spot is seen. It is due to the wave diffracted from the edge of circular obstacle

(a) interfere constructively at the centre of the shadow
(b) interfere destructively at the centre of the shadow
(c) only due to diffracted beam
(d) only due to interference of light

16 Human body, though has a large resistance of the order of kΩ (say 10 kΩ), is very sensitive to minute currents even as low as a few mA. Electrocution excites and disorders the nervous system of the body and hence one fails to control the activity of the body. dc flows uniformly throughout the cross-section of conductor while ac mainly flows through the outer surface area of the conductor. This is known as skin effect. It is worth noting that electric field inside a charged conductor is zero, but it is non zero inside a current carrying conductor and is given by E= V/*l* where V = potential difference across the conductor and *l* = length of the conductor.
The small value of drift velocity produces a large amount of electric current, due to the presence of extremely large number of free electrons in a conductor. The propagation of current is almost at the speed of light and involves electromagnetic process. It is due to this reason that the electric bulb glows immediately when switch is on. In the absence of electric field, the paths of electrons between successive collisions are straight line while in presence of electric field the paths are generally curved.





(i) A wire has a non-uniform cross-sectional area as shown in figure. A steady current i flows through it. Which one of the following statement is correct?

(a) The drift speed of electron is constant
(b) The drift speed increases on moving from A to B
(c) The drift speed decreases on moving from A to B
(d) The drift speed varies randomly

(ii) In a wire of circular cross-section with radius r, free electrons travel with a drift velocity v, when a current i flows through the wire. What is the current in another wire of half the radius and of the some material when the drift velocity is $2v$?

(a) $2i$ (b) i (c) $i/2$ (d) $i/4$

(iii)A potential difference of V is applied at the ends of a copper wire of length l and diameter d. On doubling only d, drift velocity

(a) Becomes two times
(b) Becomes half
(c) Does not change
(d) Becomes one fourth

(iv)Two wires A and B of the same material, having radii in the ratio 1 : 2 and carry currents in the ratio 4 : 1. The ratio of drift speeds of electrons in A and B is

(a) 16 : 1 (b) 1 : 16 (c) 1 : 4 (d) 4 : 1

(v) Number of electrons crossing a cross section of a conductor per second to constitute 1 ampere current are

(a) 6.25×10^{19} (b) 6.25×10^{18} (c) 6.25×10^{20} (d) 6.25

SECTION – C

All questions are compulsory (2 marks each). In case of internal choices, attempt anyone.

17 The radii of curvature of both the surfaces of a lens are equal. If one of the surfaces is made plane by grinding, then by what factor will the focal length of lens change? What change will occur for the power? 2

18 Give two advantages of a light emitting diode over conventional incandescent lamps. 2

OR

Give any two differences between intrinsic and extrinsic semiconductors.

19 Draw energy band diagrams of an n-type and p-type semiconductor at temperature T > 0K. Mark the donor and acceptor energy levels with their energies. 2

20 Obtain the expression for the energy stored in a capacitor connected across a dc battery. Hence define energy density of the capacitor. 2

OR

Derive the expression for the torque acting on an electric dipole, when it is held in a uniform electric field. Identify the orientation of the dipole in the electric field, in which it attains a stable equilibrium.

21 (i) In what respect is a toroid different from a solenoid? 2
(ii) How is the magnetic field inside a given solenoid made strong?

22 A compass needle, free to turn in a vertical plane orients itself with its axis vertical at a certain place on the earth. Find out the values of (i) Horizontal component of earth's magnetic field and (ii) angle of dip at that place. 2

OR

At a place the horizontal component of earth's magnetic field is B and angle of dip is 60^0. What is the value of horizontal component of the earth's magnetic field at equator?

23 An electric lamp connected in series with a capacitor and an ac source is glowing with a certain brightness. How does the brightness of the lamp change on reducing the (i) capacitance and (ii) frequency? 2

24 (i) Name the electromagnetic waves which are (a) produced during radioactive decay of a nucleus (b) produced by bombarding a metal target by high speed electrons. 2
(ii) Welders wear special glass goggles while working. Why? Explain.

25 Draw a labelled ray diagram showing the image formation by a compound microscope. 2

SECTION – D

All questions are compulsory (3 marks each). In case of internal choices, attempt anyone

26 (i) Derive the equation for de Broglie wavelength associated with an electron accelerated through a potential of V volt. 3
(ii) The work function of caesium is 2.14eV. Find the threshold frequency of caesium.

OR

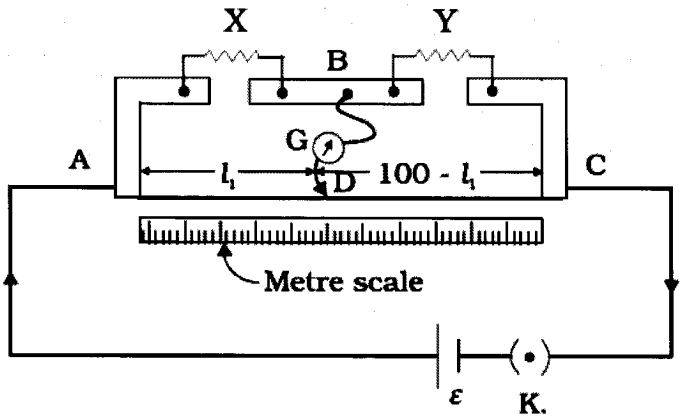
(i) Write Einstein's photoelectric equation and state any two experimentally observed features in the phenomenon of photoelectric effect.
(ii) Monochromatic light of frequency 6.0×10^{14} Hz is produced by a laser. The power emitted is 2.0×10^{-3} W. Estimate the number of photons emitted per second on an average by the source.

27 (i) State the principle on which potentiometer works. 3
(ii) In a potentiometer arrangement, a cell of emf 1.25 V gives a balance point at 35.0 cm length of the wire. If the cell is replaced by another cell and the balance point shifts to 63.0 cm, what is the emf of the second cell?
(iii) Draw a graph to show the variation of resistance of a metal wire as a function of its diameter keeping its length and material constant.

OR

(i) State the principle of working of a metre bridge.

(ii) In a meter bridge, the balance point is found to be at 39.5 cm from the end *A*, when the resistor *Y* is of 12.5 Ω. Determine the resistance of *X*.



(iii) Why are the connections between resistors in a Wheatstone or meter bridge made of thick copper strips?

28 (i) State the reason, why heavy water is generally used as a moderator in a nuclear reactor. 3

(ii) Plot a graph showing the variation of potential energy of a pair of nucleons as a function of their separation. Indicate the regions in which the nuclear force is (a) attractive and (b) repulsive.

OR

(i) Name the (a) absorbing material used to control the reaction rate of neutrons (b) coolant in a nuclear reactor.

(ii) Show that nuclear density in a given nucleus is independent of mass number A.

(iii)Two nuclei have mass numbers in the ratio 8:125. What is the ratio of their nuclear radii?

29 (i)Using Bohr's second postulate of quantization of orbital angular momentum show that the circumference of the electron in the n^{th} orbital state in hydrogen atom is 'n' times the de Broglie wavelength associated with it. 3

(ii) The electron in hydrogen atom is initially in the third excited state. What is the maximum number of spectral lines which can be emitted when it finally moves to the ground state?

30 Draw a schematic diagram of a step-up transformer. State its working principle. Derive the expression for the secondary to primary voltage in terms of the number of turns in the two coils. 3

SECTION – E

All questions are compulsory (5 marks each). In case of internal choices, attempt anyone.

31 (i) Define a wavefront. 5

(ii) Using Huygens' principle, draw the diagrams to show the nature of the wavefronts when an incident plane wavefront gets

(a) reflected from a concave mirror

(b) refracted from a convex lens.

(iii) Draw a diagram showing the propagation of a plane wavefront from denser to a rarer medium and verify Snell's law of refraction.

OR

(i) In Young's double slit experiment, derive the conditions for obtaining constructive and destructive interference fringes at a point on the screen.
(ii) Draw the intensity distribution for (a) the fringes produced in interference and (b) the diffraction bands produced due to single slit.

32 (i) Define equipotential surface. Why the electric field at any point on the equipotential surface is directed normal to the surface? 5
(ii) Draw the equipotential surfaces for an electric dipole. Why does the separation between successive equipotential surfaces get wider as the distance from the charges increases?
(iii) Draw 3 equipotential surfaces corresponding to a field that uniformly increases in magnitude but remains constant along Z- direction.

OR

(i) Show, using Gauss's law, that for a parallel plate capacitor consisting of two large plane parallel conductors having surface charge densities + σ and – σ, separated by a small distance in vacuum, the electric field.
(a) in the outer regions of both the plates is zero.
(b) is σ/ε_0 in the inner region between the charged plates.

(ii) Explain what is the effect of inserting a dielectric slab of dielectric constant 'k' in the intervening space inside the plates on
(a) the electric field,
(b) the capacitance of the capacitor.

33 (i) Define mutual inductance and write its S.I. unit. 5
(ii) Derive an expression for the mutual inductance of two long co-axial solenoids of same length wound one over the other.
(iii) A toroidal solenoid with an air core has an average radius of 15 cm, area if cross-section 12cm^2 and 1200 turns. Ignoring the field variation across the cross- sections of the toroid calculate the self-inductance of the toroid.

OR

(i) State the principle of an a.c. generator.
(ii) Explain briefly, with the help of labelled diagram, its working and obtain the expression for the emf generated in the coil.
(iii) A long solenoid with 15turns per cm has a small loop of area 2cm^2 placed inside, normal to the axis of the soleniod. If current carried by the solenoid changes steadily from 2 A to 4 A in 0.1 s, what is the induced voltage in the loop, while the current is changing?

End of the Question Paper