O. P. JINDAL SCHOOL, SAVITRI NAGAR

SAMPLE PAPER - 03

Class: XII **MM: 70**

Subject: Physics **Time: 3 Hrs**

General Instruction:-

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

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

(xv) Section A contains ten very short answer questions and four assertion reasoning MCQs of 1 mark each, Section B has two case based questions of 4 marks each, Section C contains nine short answer questions of 2 marks each, Section D contains five short answer questions of 3 marks each and Section E contains three long answer questions of 5 marks each.

(xvi) There is no overall choice. However internal choice is provided. You have to attempt only one of the choices in such questions.

(xvii) Use of calculators is not permitted. However, you may use log tables, if necessary.

(xviii) *You may use the following physical constant where ever necessary:*

Gravitational constant $G = 6.6 \times 10^{-11}\ Nm^2\ kg^{-2}$

Gas constant $R = 8.314\ J\ mol^{-1}\ k^{-1}$

Mass of electron $= 9.110 \times 10^{-31}\ kg$

Mechanical equivalent of heat $= 4.185\ J\ cal^{-1}$

Standard atmospheric pressure $= 1.013 \times 10^5\ Pa$

Absolute zero (0 K) $= -273.15^0 C$

Acceleration due to gravity $= 9.8\ ms^{-2}$

SECTION-A

All questions are compulsory. In case of internal choices, attempt anyone of them.

1. The north pole of a long horizontal bar magnet is being brought closer to a vertical conducting plane along the perpendicular direction. What will be the direction of induced current in the conducting plane?

   Or

   An alternating voltage is connected in series with a resistance R and inductance L. If the potential drop across the resistance is 200 V and across the inductance is 150 V, then find the applied voltage.

2. If the energy of a photon of sodium light ($\lambda = 580\,nm$) equals the band gap of semiconductor, then find the minimum energy required to create hole-electron pair.

3. What is the effect of heating of a conductor on the drift velocity of free electrons?

4. Two charges $5\,\mu C$ and $10\,\mu C$ are placed 1 m apart. What amount of work is done to bring these charges at a distance 0.5 m from each other? ($k = 9 \times 10^9$ SI)

5. What is the de-Broglie wavelength of a electron accelerated through a potential difference of 100 V?

Or

In what way has the wave nature of electron beam exploited in electron microscope?

6. A galvanometer having internal resistance 10Ω requires 0.01 A for a full scale deflection. To convert this galvanometer to a voltmeter of full scale deflection at 120 V, what value of series resistance is needed?

7. 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?

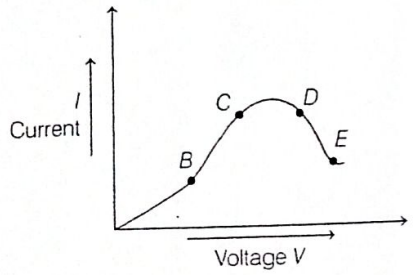
8. Give any two consequences of reverse biasing.

9. Give the ratio of radii of the orbits corresponding to second excited state and ground state in a H-atom.

Or

What is the ratio of nuclear densities of the two nuclei having mass numbers in the ratio 1 : 4?

10. Graph given below shows the variation of current *versus* voltage for a material GaAs.



Identify the region of negative resistance.

Or

How is current kept continuous inside a conductor of finite length?

For question numbers 11, 12, 13 and 14, two statements are given-one labelled Assertion (A) and the other labelled **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** A magnetic needle, which is free to swing horizontally, would lie in the magnetic meridian and the North-pole of the needle would point towards the magnetic North-pole.

Reason The line joining the magnetic poles is tilted with respect to the geographic axis of the earth, the magnetic meridian at a point makes angle with the geographic meridian.

12. **Assertion** Upon displacement of charges within a closed surface, **E** at any point on the surface does not change.

Reason The flux crossing through a closed surface depends on the location of charge within the surface.

13. **Assertion** If a plane glass slab is placed on the letters of different colours all the letters appear to be raised up to different height.

Reason Different colours have different wavelengths.

14. **Assertion** The drift velocity of electrons in a metallic wire decreases when temperature of the wire is increases.

Reason On increasing temperature, conductivity of metallic wire decreases.

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.

Electrical Resonance

15. Electrical resonance is said to take place in a series *L-C-R* circuit when the circuit allows maximum current for a given frequency of the source of alternating supply for which capacitive reactance becomes equal to the inductive reactance. Impedance of this *L-C-R* circuit is minimum and hence current is maximum. Resonant circuits are used to respond selectively to signals of a given frequency while discriminating against signals of different frequencies. If the response of the circuit is more narrowly peaked around the chosen frequency, we say that the circuit has higher "selectivity or sharpness". This sharpness is measures with the help of *Q*-factor.

(i) Bandwidth of the resonant *L-C-R* circuit is

(a) $\frac{R}{L}$ (b) $R/2L$ (c) $\frac{2R}{L}$ (d) $\frac{4R}{L}$

(ii) To reduce the resonant frequency in an *L-C-R* series circuit with a generator

(a) the generator frequency should be reduced

(b) another capacitor should be added in parallel to the first

(c) the iron core of the inductor should be removed

(d) dielectric in the capacitor should be removed

(iii) In a series *L-C-R* circuit, the capacitance *C* is changed to 4*C*. To keep the resonant frequency same, the inductance must be changed by

(a) 2*L* (b) *L*/2

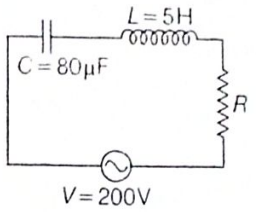
(c) 4*L* (d) *L*/4

(iv) In non-resonant circuit, what will be the nature of circuit for frequencies higher than the resonant frequency?

(a) Resistive (b) Capacitive

(c) Inductive (d) None of these

(v) Figure shows a series *L-C-R* circuit, connected to a variable frequency 200 V source. $C = 80\ \mu F$ and $R = 40\ \Omega$. The source frequency which drives the circuit at resonance is



(a) 25 Hz (b) $\frac{25}{\pi}$ Hz

(c) 50 Hz (d) $\frac{50}{\pi}$ Hz

Dual Nature of Matter

16. Matter cannot exist both as a particle and as a wave simultaneously. At a particular instant of time, it is either the one or the other aspect, i.e. the two aspects are complementary to each other.

According to de-Broglie, a wave is associated with moving material particle which controls the particle in every respect. The wave associated with moving material particle is called matter wave or de-Broglie wave whose wavelength is called de-Broglie wavelength.

(i) The de-Broglie wave of a moving particle does not depend on

(a) mass (b) charge

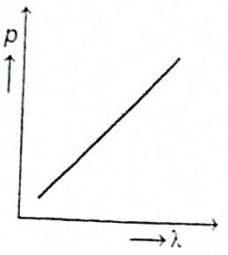
(c) velocity (d) momentum

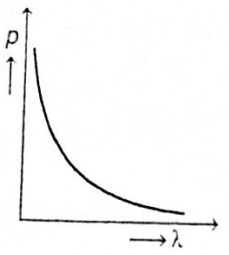
(ii) The de-Broglie wavelength of a particle of KE, *K* is λ. What will be the wavelength of the particle, if it's kinetic energy is $\frac{K}{9}$?

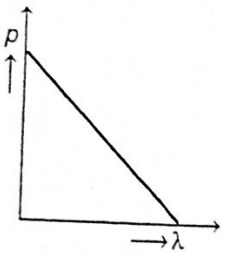
(a) λ (b) 2λ

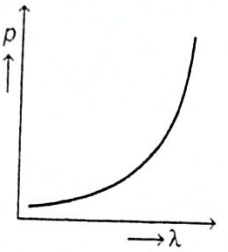
(c) 3λ (d) 4λ

(iii) Which of the following figures represent the variation of particle momentum and the associated de-Broglie wavelength?

(a) 

(b) 

(c) 

(d) 

(iv) de-Broglie wavelength associated wit an electron, accelerating through a potential difference of 100 V lies in th region of

(a) Gamma rays (b) X-rays
(c) Ultraviolet rays (d) Visible region

(v) A proton and an α-particle are accelerated through the same potentia difference. The ratio of de-Broglie wavelength λ_p to that of λ_α is

(a) $\sqrt{2}:1$ (b) $\sqrt{4}:1$ (c) $\sqrt{6}:1$ (d) $\sqrt{8}:1$

SECTION-C

All questions are compulsory. In case of internal choices, attempt anyone.

17. The current in the forward bias (mA) is known to be more than the current in the reverse bias (μA). What is the reason to operate the photodiode in reverse bias?

18. A rectangular loop of length $l = 2$m and breadth $b = 0.3$m is placed at distance of $x = 0.6$m from infinitely long wire carrying current, $I = 2$A such that the direction of current is parallel to breadth. If the loop moves away from the current wire in a direction perpendicular to it with a velocity $v = 3 ms^{-1}$, what will be the magnitude of emf in the loop?

Or

A resistance of 20 Ω is connected to a source of alternating current rated 110 V, 50 Hz. Find the

(i) rms current
(ii) maximum instantaneous current in the resistor

19. Name the part of the electromagnetic spectrum which is

(i) suitable for radar systems used in aircraft navigation.
(ii) produced by bombarding a metal target with high speed electrons.

20. How many electrons pass through a lamp in 1 min, if the current is 300 mA? Given, the charge on an electron is 1.6×10^{-19} C.

Or

Find the current flow through a copper wire of length 0.2 m, area of cross-section 1 mm^2, when connected to a battery of 4 V. Given that, for electron mobility is $4.5 \times 10^{-6} m^2 s^{-1} V^{-1}$ and charge on an electron is 1.6×10^{-19} C. The number density of electrons in copper wire is $8.5 \times 10^{28}\ m^{-3}$.

21. Give any two differences between electric charge and mass.

22. Two lenses of power 10D and –5D are placed in contact.

(i) Calculate the power of lens combination.
(ii) Where should an object be held from the lens, so as to obtain a virtual image of magnification 2?

23. Draw a labelled graph to show, how electrical resistance varies with temperature for

(i) a metallic wire
(ii) a piece of carbon.

24. State Bohr's postulate of hydrogen atom that gives the relationship for the frequency of emitted photon in a transition.

Or

Would the Bohr's formula for the H-atom remains unchanged, if proton had a charge $(+4/3)\,e$, and electron had a charge $(-3/4)\,e$, where, $e = 1.6 \times 10^{-19}$ C. Give reasons for your answer.

25. Even though an electric field E exerts a force qE on a charged particle yet electric field of an electromagnetic wave does not contribute to the radiation pressure (but transfers energy). Explain.

SECTION-D

All questions are compulsory. In case of internal choices, attempt anyone.

26. (i) Why is the mass of a nucleus always less than the sum of masses of constituents, neutrons and protons?

(ii) What is obtained by fusion of two deuterons?

(iii) ${}^{3}_{2}He$ and ${}^{3}_{1}He$ nuclei have the same mass number .

Do they have same bindng energy?

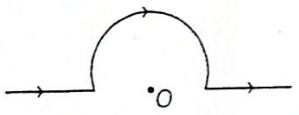
27. (i) A diverging lens of focal length f is cut into two identical parts, each forming a plano-convex lens. What is the focal length of each part?

(ii) A ray of light passes through an equilateral glass prism such that the angle of incidence is equal to angle of convergence and each of these angles is equal to $\frac{3}{4}$ of angle of prism. What is the value of angle of deviation?

28. A straight wire carrying a current of 10 A is bent into a semi-circular arc of radius 2.0 cm as shown in the figure. What is the magnetic field at O due to

(i) straight segments

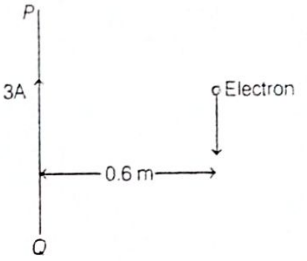
(ii) the semi-circular arc?



Or

(i) A circular coil of wire consisting of 100 turns, each of radius 8.0 cm carries a current of 0.40 A. What is the magnitude of magnetic field at the centre of the coil?

(ii) PQ is a long straight conductor carrying a current of 3A as shown in figure below. An electron moves with a velocity of 2×10^{7} ms^{-1} parallel to it. Find the force acting on the electron.



29. (i) Out of blue and red lights, which is more deviated by a prism? Give reason.

(ii) Give one application of prism.

(iii) If a prism of 5° angle gives deviation of 3.2°, then what will be the refractive index of prism?

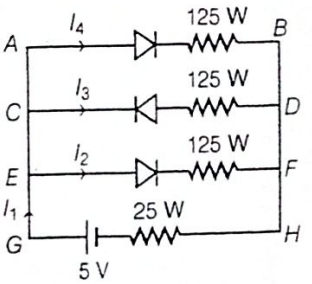
30. (i) What is the ratio of the number of holes and the number of conduction electrons in an intrinsic semiconductor?

(ii) Draw the energy band diagram of *n*-type semiconductor.

(iii) Draw I *versus* V graph of a forward biased junction diode.

Or

If each diode in figure has a forward bias resistance of 25 Ω and infinite resistance in reverse bias, what will be the values of the currents I_1, I_2, I_3 and I_4?

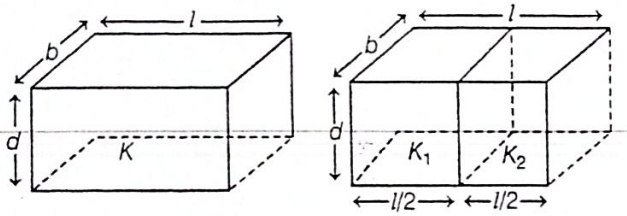


SECTION-E

All questions are compulsory. In case of internal choices, attempt anyone.

31. (i) A aluminium sheet of area $1m^2$ is fixed on the top of a 2m insulating slab by a man outside his house one evening. Will he get an electric shock, if he touches the metal sheet next morning?

(ii) Two identical capacitors of plate dimensions $l \times b$ and plate separation d have dielectric slabs filled in between the space of the plates as shown in the figures.



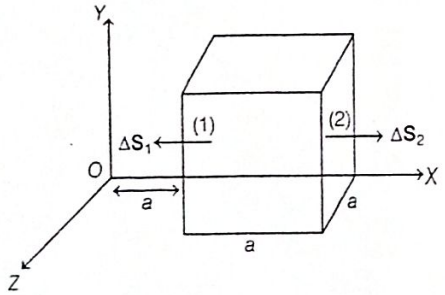
Find the ratio capacitance in each case.

(iii) In SI unit, V at a point in an electric field is given by $V = -\frac{6}{x} + 2$. Find the value of **E** in the field at the point (2, 0, 0).

Or

State Gauss's law in electrostatics.

The electric field components in figure shown are $E_x = \alpha x^{1/2}$, $E_y = E_z = 0$ in which $\alpha = 800\ N/Cm^{1/2}$.



Calculate

(i) the electric flux through the cube

(ii) the charge within the cube

where, the side of cube = 0.1 m.

32. What is diffraction of light? Draw a graph showing the variation of intensity with angle in a single slit diffraction experiment. Write one feature which distinguishes the observed pattern from the double slit interference pattern.

How would the diffraction pattern of a single slit be affected when

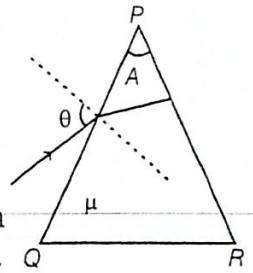
(i) the width of the slit is decreased?

(ii) the monochromatic source of light is replaced by a source of white light?

Or

(i) Explain the superposition principle with the help of diagram.

(ii) Monochromatic light is incident on a glass prism of angle A. If the refractive index of the material of the prism is μ and ray incident at an angle θ, on the face PQ. Now prove that, the ray only get transmitted through the face PR of prism, if $\theta > \sin^{-1}\left[\mu \sin\left(A - \sin^{-1}\left(\frac{1}{\mu}\right)\right)\right]$



(iii) Write conditions for sustained interference.

33. An electron beam passes through a region in which a magnetic field of 2×10^{-3} T and an electric field 3.4×10^4 V/m both acting simultaneously at right angles to each other. If the path of the electron remains undeflected, calculate the speed of the electrons. If the electric field is removed, what will be the radius of the circular path of electrons?

Or

(i) The magnetic field B and the magnetic intensity H in a material are found to be 1.6 T and 1000 Am^{-1}, respectively. Determine the relative permeability μ_r and the susceptibility χ_m of the material.

(ii) A solenoid of 600 turns per metre is carrying a current of 4 A. Its core is made of iron with relative permeability of 5000. Calculate the magnitudes of magnetic intensity, intensity of magnetisation and magnetic field inside the core.