# O. P. JINDAL SCHOOL, SAVITRI NAGAR

## SAMPLE PAPER - 07

**Class: XII** **MM: 70**

**Subject: Physics** **Time: 3 Hrs**

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**General Instruction:-**

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

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

(ix) 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.

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

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

*(xii) 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* $= 9.8\ ms^{-2}$

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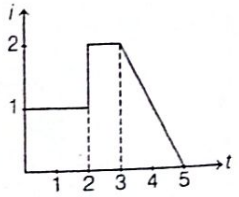
## SECTION-A

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

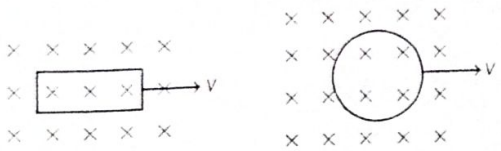
**1.** The potential at a point x (measured in μm) due to some charges situated on the X-axis is given by $V(x) = \frac{20}{(x^2 - 4)}$ V. Find out the electric field $E$ at $x = 4$ μm.

**2.** The plot represents the flow of current through a wire at three different times. Calculate the ratio of charges flowing through the wire at different times.



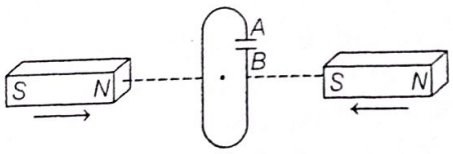

**3.** A rectangular loop and a circular loop are moving out of a uniform magnetic field region in the given figure to a field free region with a constant velocity $v$. In which loop, do you expect the induced emf to be constant during the passage out of the field region? Give reason.

* You are advised to attempt this sample paper without referring the solutions given here. However, cross check your solutions with the solutions given at the end of paper after you complete the paper.




*Or*

Predict the polarity of the capacitor in the situation described in the given figure.




**4.** If $I_0$ is the intensity of the principal maximum in the single slit diffraction pattern, then what will be its intensity when the slit width is doubled?

***Or***

For an aperture of size 3 mm illuminated by high of wavelength 500 nm, calculate the distance upto which ray optics is a good approximation.

**5.** Magnification of a compound microscope is 30 and focal length of eyepiece is 5 cm. If the image is formed at the least distance of distinct vision (25 cm), then calculate the magnification of the objective lens.

***Or***

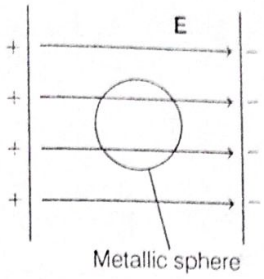
The angle of prism is 6°and its refractive index for green light is 1.5. If a green ray passes through it, then calculate the deviation.

**6.** Why does doping with pentavalent or trivalent impurities reduce the energy gap $E_g$?

***Or***

Why does a reverse biased diode have very large value of resistance?

**7.** A metallic sphere is placed between two charged metallic plates. A student draws the line of force as shown in the figure below. Is he correct?




**8.** A jet plane is travelling at a speed of 1800 km/h towards West. What is the voltage developed between the ends of the wings having a span of 25 m? Earth's magnetic field at the location is 5G and angle of dip is 30°.

**9.** What is the effect on the velocity of photo electrons, if the wavelength of incident light is decreased?

**10.** In a certain region, magnetic field is along Y-axis and a charged particle is moving along X-axis. What would be the direction of Lorentz force for (i) an electron (ii) a proton?

**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 capacitor can be given only a limited quantity of charge.

**Reason** Charge stored by a capacitor depends on the shape and size of the plates of capacitor and the surrounding medium.

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

**Reason** On increasing temperature, conductivity of metallic wire decreases.

13. **Assertion** A magnetic field interacts with a moving charge and not with a stationary charge.

**Reason** A moving charge produce a magnetic field.

14. **Assertion** In a *n*-type semiconductor, number of holes gets reduced.

**Reason** Rate of recombination of holes is increased.

## 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.*

### Discovery of Nucleus

15. The nucleus was first discovered in 1911 by Lord Rutherford and his associates by experiments on scattering of α-particles by atoms. He found that the scattering results could be explained, if atoms consist of a small, central, massive and positive core surrounded by orbiting electrons.The experimental results indicated that the size of the nucleus is of the order of $10^{-14}$ m and is thus 10000 times smaller than the size of atom.

(i) Ratio of mass of nucleus with mass of atom is approximately

(a) 1 (b) 10 (c) $10^3$ (d) $10^{10}$

(ii) Masses of nuclei of hydrogen, deuterium and tritium are in ratio

(a) 1 : 2 : 3 (b) 1 : 1 : 1

(c) 1 : 1 : 2 (d) 1 : 2 : 4

(iii) Density of a nucleus is

(a) more for lighter elements and less for heavier elements

(b) more for heavier elements and less for lighter elements

(c) very less compared to ordinary matter

(d) a constant

(iv) If $R$ is the radius and $A$ is the mass number, then log $R$ *versus* log $A$ graph will be

(a) a straight line (b) a parabola

(c) an ellipse (d) None of these

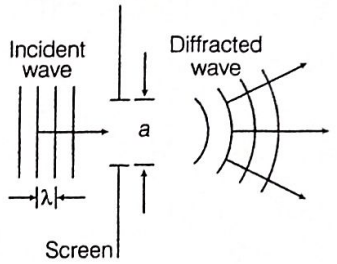
(v) The ratio of the nuclear radii of the gold isotope $^{197}_{79}$ Au and silver isotope $^{107}_{47}$ Au is

(a) 1.23 (b) 0.216

(c) 2.13 (d) 3.46

### Diffraction of Light

16. The phenomenon of bending of light around the sharp corners and the spreading of light within the geometrical shadow of the opaque obstacles is called diffraction of light. The light thus deviates from its linear path. The deviation becomes much more pronounced, when the dimensions of the aperture or the obstacle are comparable to the wavelength of light.




(i) Light seems to propagate in rectilinear path because

(a) its speed is very large

(b) its wavelength is very small

(c) reflected from the upper surface of atmosphere

(d) it is not absorbed by atmosphere

(ii) In diffraction from a single slit the angular width of the central maxima does not depends on

(a) λ of light used

(b) width of slit

(c) distance of slits from the screen $D$

(d) ratio of λ and slit width

(iii) In a single slit diffraction of light of wavelengths λ is used and slit of width $e$, the size of the central maxima on a screen at a distance $b$ is

(a) $2b\lambda + e$ (b) $\frac{2b\lambda}{e}$ (c) $\frac{2b\lambda}{e} + e$ (d) $\frac{2b\lambda}{e} - e$

(iv) What should be the slit width to obtain 10 maxima of the double slit pattern within the central maxima of the single slit pattern of slit width 0.4 mm?

(a) 0.4 mm (b) 0.2 mm

(c) 0.6 mm (d) 0.8 mm

(v) In a single diffraction pattern observed on a screen placed at $D$ metre distance from the slit of width $d$ metre, the ratio of the width of the central maxima to the width of other secondary maxima is

(a) 2 : 1 (b) 1 : 2 (c) 1 : 1 (d) 3 : 1

## SECTION-C

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

**17.** A charge of 8 mC is located at the origin. Calculate the work done in taking a small charge $-2\times10^{-9}$ C from a point $P$ (0, 0, 3 cm) to a point $Q$(0, 4 cm, 0), *via* a point $R$(0, 6 cm, 9 cm).

***Or***

Two charges $5\times10^{-8}$ C and $-3\times10^{-8}$ C are located 16 cm apart. At what point (s) on the line joining the two charges between them is the electric potential zero? Take potential at infinity to be zero.

**18.** Prove that the radius of the $n$th Bohr orbit of an atom is directly proportional to $n^2$, where $n$ is principal quantum number.

***Or***

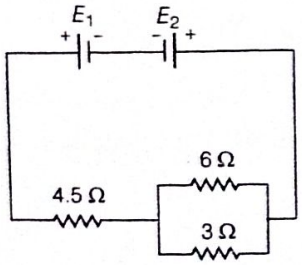
You are given two nuclides ${}^{7}_{3}X$ and ${}^{4}_{3}Y$.

(i) Are they the isotopes of the same element? Why?

(ii) Which one of two is likely to be more stable? Give reason.

**19.** Two cells $E_1$ and $E_2$ connected as shown in figure have an emf 5V and 9V and internal resistances of 0.3 Ω and 1.2 Ω, respectively.

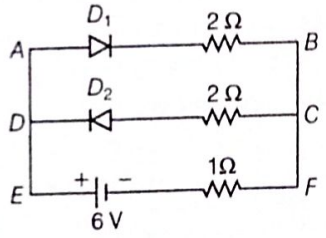
Calculate the value of current flowing through the resistance of 3 Ω.




**20.** Name the important processes that occur during the formation of $p$-$n$ junction with the help of a suitable diagram.

***Or***

Assuming that, the two diodes $D_1$ and $D_2$ used in the electric circuit as shown in the figure are ideal, find out the value of the current flowing through 1 Ω resistor.




**21.** Define (i) electric field intensity (ii) electric flux. Write SI unit of each. State whether they are scalar or vector.

**22.** State with reason, how would the linear width of central maximum change, if

(i) monochromatic yellow light is replaced red light and

(ii) distance between the slit and the screen is increased.

**23.** (i) How are gamma rays produced?

(ii) Arrange gamma rays, ultraviolet rays and visible light according to their energy.

**24.** In a plot of photoelectric current *versus* anode potential, how does

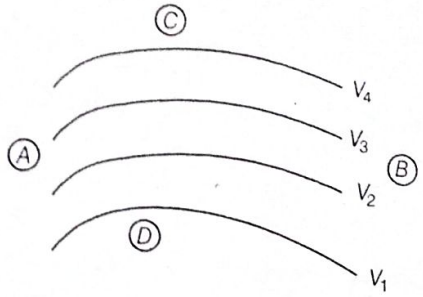
(i) the saturation current vary for incident radiations of different frequencies but same intensity?

(ii) the stopping potential vary for incident radiations of different intensities but same frequency?

Justify your answer in each case.

**25.** (i) Why a person in the car is not affected by lightning?

(ii) The four equipotential surfaces are shown in the figure. Draw the corresponding electric field lines for the given pattern of the equipotential surfaces.




(Given, $V_1 < V_2 < V_3 < V_4$)

## SECTION-D

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

**26.** State Bohr's postulate for the permitted orbits of the electron in a hydrogen atom. Use this postulate to prove that the circumference of the $n$th permitted orbit for the electron can contain exact $n$ wavelengths of the de-Broglie wavelength associated with the electron in that orbit.

***Or***

A 12.5 eV electron beam is used to bombard gaseous hydrogen at room temperature. Upto which energy level the H-atoms would be excited? Calculate the wavelengths of the first member of Lyman and first member of Balmer series.

**27.** (i) A 200 V variable frequency AC source is connected to a series combination of $L = 5$ H, $C = 80\ \mu$F and $R = 40\ \Omega$. Calculate

(a) angular frequency of source to get the maximum current in the circuit

(b) current amplitude at resonance

(ii) When $L$ and $C$ are connected in parallel, currents in $L$ and $C$ are 180° out of phase. Comment.

***Or***

An emf $E = 100 \sin 314t$ is applied across a pure capacitor of 637 μF. Find

(i) the instantaneous current $I$

(ii) the frequency of power and

(iii) the maximum energy stored in the capacitor.

**28.** Draw a ray diagram to show the image formation in a refracting type astronomical telescope when the final image is formed at infinity. Write down the expression for its magnifying power. Why should the diameter of the objective of telescope be larger?

**29.** To study the $V$-$I$ characteristics of a diode, the circuit connections were made for making the diode forward and reverse biased successively. The values obtained for forward current and reverse current for different values of applied voltage were observed and tabulated as under.

Forward bias

| Voltage (V) | Forward current (mA) |
|---|---|
| 0.1 | 0 |
| 0.2 | 0 |
| 0.3 | 0 |
| 0.4 | 2 |
| 0.6 | 5 |
| 0.5 | 3 |
| 0.7 | 10 |
| 0.8 | 15 |
| 0.9 | 20 |
| 1.0 | 30 |
| 1.1 | 45 |

Reverse bias

| Voltage (V) | Reverse current (μA) |
|---|---|
| 1 | 1 |
| 2 | 1 |
| 3 | 1 |
| 4 | 1 |
| 5 | 1 |

(i) Plot the forward and reverse bias characteristics from the above data.

(ii) Calculate the resistance of diode at a forward current of (a) 15 mA (b) reverse voltage of 4V.

**30.** It is desired to supply a current of 2A through a resistance of 10Ω. 20 cells are provided, each of them has 2V emf and internal resistance of 0.5Ω. Two students of class XIIth, Shikha and Shahana try their hands on the requirement. Shahana succeeds but Shikha not.

(i) Justify the set-up of Shahana.

(ii) What might have gone wrong with Shikha, when she gets 1.2 A current in the load?

(iii) What is the maximum current that can be drawn from the given cell?

## SECTION-E

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

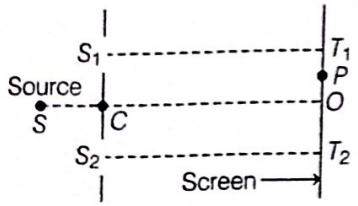
**31.** How is the working of a telescope different from that of a microscope?

The focal lengths of the objective and eyepiece of a microscope are 1.25 cm and 5 cm, respectively. Find the position of the object relative to the objective in order to obtain an angular magnification of 30 in normal adjustment.

***Or***

(i) Consider a two slit interference arrangement (figure) such that the distance of the screen from the slits is half the distance between the slits.

Obtain the value of $D$ in terms of $\lambda$ such that the first minima on the screen falls at a distance $D$ from the centre $O$.




(ii) Why are coherent sources required to create interference of light?

**32.** An electron and a positron are released from (0,0,0) and (0,0,1.5$R$) respectively, in a uniform magnetic field $\mathbf{B} = B_0\hat{\mathbf{i}}$, each with an equal momentum of magnitude $p = eBR$. Under what conditions on the direction of momentum will the orbits be non-intersecting circles?

***Or***

Explain the elements of Earth's magnetic field and their meaning. Show these elements in a labelled diagram and deduce various relations between them.

**33.** (i) What are the different ways by which emf can be induced in a conductor?

(ii) Using Faraday's law, derive the expression for motional emf induced in a straight conductor moving in a uniform magnetic field in a plane perpendicular to the direction of magnetic field.

(iii) How can we find the polarity of induced emf?

***Or***

For an AC voltage given by $E = E_0 \sin \omega t$ applied to a circuit containing pure resistance $R$, derive an expression for

(i) instantaneous current.

(ii) average power dissipated over one complete cycle of AC.

(iii) Draw a phasor diagram representing phase relation between instantaneous current and voltage.