SAMPLE QUESTION PAPER

BLUE PRINT

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

S. No.	Chapter	VSA/ AR/ Case Based (1 mark)	SA-I (2 marks)	SA-II (3 marks)	LA (5 marks)	Total
1.	Electrostatics	2(2)	2(4)	1(3)	–	**9(16)**
2.	Current Electricity	2(2)	1(2)	1(3)	–	
3.	Magnetic Effects of Current and Magnetism	1(1)	1(2)	–	–	**6(17)**
4.	Electromagnetic Induction and Alternating Current	1(4)	1(2)	1(3)	1(5)	
5.	Electromagnetic Waves	3(3)	1(2)	–	–	**11(18)**
6.	Optics	3(3)	2(4)	2(6)	–	
7.	Dual Nature of Radiation and Matter	–	–	–	1(5)	**4(12)**
8.	Atoms and Nuclei	2(5)	1(2)	–	–	
9.	Electronic Devices	2(2)	–	–	1(5)	**3(7)**
	Total	**16(22)**	**9(18)**	**5(15)**	**3(15)**	**33(70)**

Subject Code : 042

PHYSICS

Time allowed : 3 hours ***Maximum marks : 70***

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

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

(iii) 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.

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

SECTION - A

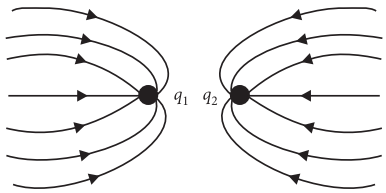
All questions are compulsory. In case of internal choices, attempt any one of them.

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

2. Interference was observed in interference chamber where air was present, now the chamber is evacuated, and if the same light is used, what will a careful observer see?

3. A parallel plate condenser with oil between the plates (dielectric constant of oil $K = 2$) has a capacitance C. If the oil is removed, then what is the capacitance of the capacitor?

4. The given figure gives electric lines of force due to two charges q_1 and q_2. What are the signs of the two charges?

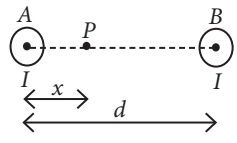


OR

What is the SI unit of the electric polarization vector $\vec{P}$.

5. If an electron in hydrogen atom jumps from an orbit of level $n = 3$ to an orbit of level $n = 2$, then find the frequency of emitted radiation.
(R = Rydberg constant, c = velocity of light)

6. Two long straight parallel wires A and B separated by a distance d, carry equal current I flowing in same direction as shown in the figure. Find the magnetic field at a point P situated between them at a distance x from one wire.



OR

State Ampere's circuital law, expressing it in the integral form.

7. Name the electromagnetic waves that are widely used as a diagnostic tool in medicine.

OR

What is the frequency of electromagnetic waves produced by oscillating charge of frequency υ?

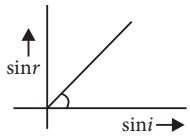
8. Nichrome and copper wires of same length and same radius are connected in series. Current I is passed through them. Which wire gets heated up more? Justify your answer.

9. In an n-type semiconductor, where does the donor energy level lies

OR

What is the difference between an n-type and a p-type extrinsic semiconductor?

10. A ray of light is incident on a medium with angle of incidence 'i' and is refracted into a second medium with angle of refraction 'r'. The graph of sin i versus sin r is as shown. Find the ratio of the velocity of light in the first medium to the velocity of light in the second medium.



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) : Fuse wire must have high resistance and low melting point.
Reason (R) : Fuse is used for small current flow only.

12. Assertion (A) : The existence of electromagnetic waves was shown by Maxwell and Hertz.
Reason (R) : Roentgen showed that X-rays were electromagnetic waves.

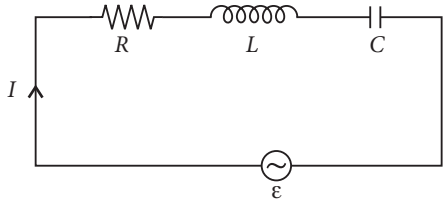
13. Assertion (A) : The phenomenon of X-ray production is basically inverse of photoelectric effect.
Reason (R) : X-rays are electromagnetic waves

14. Assertion (A) : Silicon is preferred over germanium for making semiconductor devices.
Reason (R) : The energy band for germanium is more than the energy band of silicon.

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. An LCR circuit, also known as a resonant circuit, tuned circuit or an RLC circuit, is an electrical circuit consisting of an inductor (L), capacitor (C) and resistor (R) connected in series or parallel. Consider a series LCR circuit as shown in figure, containing an inductor 100 mH, a capacitor 100 μF and a resistor 120 Ω driven by an AC source of 30 V, 50/π Hz.



(i) Calculate the impedance of the circuit.

(a) $20\sqrt{10}\ \Omega$ (b) 150 Ω (c) 120 Ω (d) 100 Ω

(ii) Find the resonant frequency of the circuit.

(a) 50 Hz (b) 100 Hz (c) 40 Hz (d) $50/\pi$ Hz

(iii) Find the peak current in the circuit.

(a) 0.1 A (b) 0.2 A (c) 1 A (d) 2 A

(iv) Which of the following components of an *LCR* circuit, with ac supply, dissipates energy?

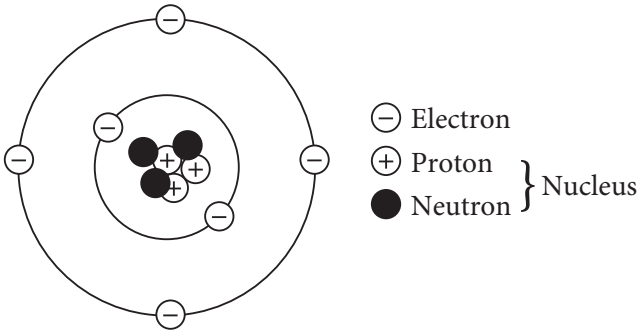
(a) *L* (b) *C* (c) *R* (d) all of these

(v) The current in series *LCR* circuit will be maximum when ω is

(a) as large as possible (b) equal to natural frequency of *LCR* system

(c) $\sqrt{LC}$ (d) $\sqrt{\frac{1}{LC}}$

16. Atomic number (Z) of an element is the number of protons present in the nucleus of every atom of that element. Mass number (A) of an element is the total number of protons and neutrons present in the nucleus of atom of that element. The size of nucleus is given by $R = R_0A^{1/3}$, where R is the radius of nucleus of mass number A and R_0 is a constant whose value is 1.2×10^{-15} m. Mass per unit volume of a nucleus is called nuclear density and can be expressed as, $\rho = \frac{3m}{4\pi R_0^3}$ = constant = 2.29×10^{17} kg/m^3.



(i) Number of neutrons in a gold nucleus with $A = 197$ and $Z = 79$ is

(a) 79 (b) 197 (c) 118 (d) none of these

(ii) The nuclear radius of an atom with mass number 125 is

(a) 1.2 fermi (b) 6 fermi (c) 5 fermi (d) none

(iii) The density of hydrogen nucleus with $Z = 1$ is 2.29×10^{17} kg/m^3. The density of gold nucleus with $Z = 79$ would be

(a) $\frac{2.29}{79} \times 10^{17}$ kg/m^3 (b) $2.29 \times 79 \times 10^{17}$ kg/m^3

(c) 2.29×10^{17} kg/m^3 (d) $\frac{2.29}{\sqrt{79}} \times 10^{17}$ kg/m^3

(iv) If mass of a proton is 1.007825 a.m.u. and mass of a neutron is 1.008665 a.m.u., then mass of $_3Li^7$ nucleus would approximately be

(a) 7.058075 a.m.u. (b) 7.000000 a.m.u.

(c) 7.023475 a.m.u. (d) 7.034600 a.m.u.

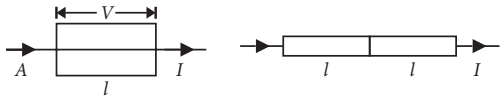
(v) If r_1 and r_2 are the radii of the atomic nuclei of mass numbers 64 and 125 respectively, then the ratio $\frac{r_1}{r_2}$ is

(a) $\frac{64}{125}$ (b) $\sqrt{\frac{64}{125}}$ (c) $\frac{5}{4}$ (d) $\frac{4}{5}$

SECTION - C

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

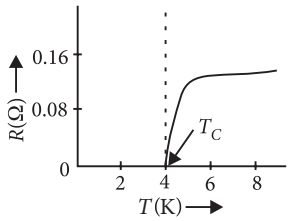
17. A metal rod of square cross-sectional area A having length l has current I flowing through it when a potential difference of V volt is applied across its ends (figure I). Now the rod is cut parallel to its length into two identical pieces and joined as shown in figure II. What potential difference must be maintained across the length of $2l$ so that the current in the rod is still I ?



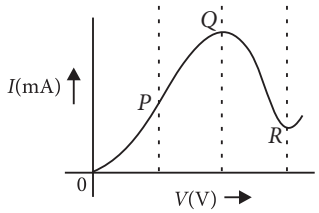
(I) **(II)**

OR

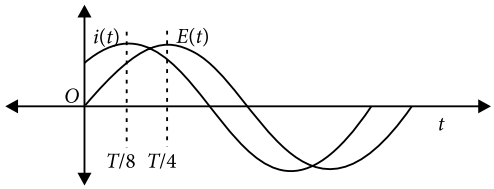
(i) The graph between resistance (R) and temperature (T) for Hg is shown in the figure. Explain the behaviour of Hg near 4 K.



(ii) Which region of the graph shown in the figure has negative resistance and why?



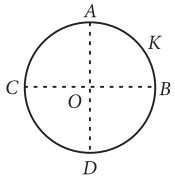
18. The figure shows two sinusoidal curves representing oscillating supply voltage and current in an ac circuit.



Draw a phasor diagram to represent the current and supply voltage appropriately as phasors. State the phase difference between the two quantities.

19. The angle of a prism is A. One of its refracting surfaces is silvered. Light rays falling at an angle of incidence $2A$ on the first surface returns back through the same path after suffering reflection at the silvered surface. What is the refractive index of the prism ?

20. A thin conducting ring of radius R is given a charge $+Q$. The electric field at the centre O of the ring due to the charge on the part AKB of the ring is E. What is the electric field at the centre due to the charge on the part $ACDB$ of the ring ?



21. A narrow slit is illuminated by a parallel beam of monochromatic light of wavelength λ equals to 6000 Å and the angular width of the central maxima in the resulting diffraction pattern is measured. When the slit is next illuminated by light of wavelength λ', the angular width decreases by 30%. Calculate the value of the wavelength λ.

22. Answer the following questions:

(a) Name the *e.m.* waves which are suitable for radar systems used in aircraft navigation. Write the range of frequency of these waves.

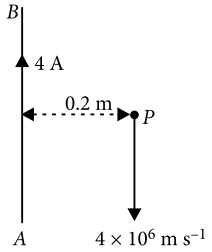
(b) If the Earth did not have atmosphere, would its average surface temperature be higher or lower than what it is now? Explain.

(c) An e.m. wave exerts pressure on the surface on which it is incident. Justify.

23. What do you mean by current sensitivity of a moving coil galvanometer. On what factors does it depend?

OR

A long straight wire AB carries a current of 4 A. A proton P travels at 4×10^6 m s^{-1} parallel to the wire 0.2 m from it and in a direction opposite to the current as shown in the figure. Calculate the force which the magnetic field due to the current carrying wire exerts on the proton. Also specify its direction.



24. Why is the classical (Rutherford) model for an atom of electron orbiting around the nucleus not able to explain the atomic structure?

OR

Define the distance of closest approach. An α-particle of kinetic energy 'K' is bombarded on a thin gold foil. The distance of the closest approach is 'r'. What will be the distance of closest approach for an α-particle of double the kinetic energy?

25. The electric potential V at any point (x, y, z), all in metres in space is given by $V = 4x^2$ volt. Calculate the electric field at the point (1, 0, 2).

SECTION - D

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

26. Answer the following :

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

(b) Why is it generally preferred to obtain the balance point in the middle of the metre bridge wire?

(c) Which material is used for the meter bridge wire and why?

27. A particle of charge 2 μC and mass 1.6 g is moving with a velocity $4\hat{i}$ m s^{-1}. At $t = 0$ the particle enters in a region having an electric field $\vec{E}$ (in N C^{-1}) = $80\hat{i} + 60\hat{j}$. Find the velocity of the particle at $t = 5$ s.

28. **(a)** What is the principle of transformer?

(b) Explain how laminating the core of a transformer helps to reduce eddy current losses in it?

(c) Why the primary and secondary coils of a transformer are preferably wound on the same core?

OR

Show that in the free oscillations of an *LC* circuit, the sum of energies stored in the capacitor and the inductor is constant in time.

29. Define wavefront of a travelling wave. Using Huygens principle, obtain the law of refraction at a plane interface when light passes from a rarer to a denser medium.

30. **(a)** Draw a labelled ray diagram showing the formation of a final image by a compound microscope.

(b) The total magnification produced by a compound microscope is 20. The magnification produced by the eye piece is 5. The microscope is focussed on a certain object. The distance between the objective and eyepiece is observed to be 14 cm. If least distance of distinct vision is 20 cm, calculate the focal length of the objective and the eye piece.

OR

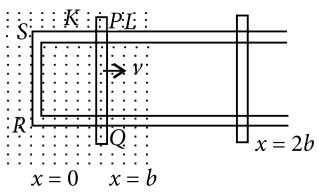
(a) State the necessary conditions for producing total internal reflection of light.

(b) Draw ray diagrams to show how specially designed prisms make use of total internal reflection to obtain inverted image of the object by deviating rays (i) through 90° and (ii) through 180°.

SECTION - E

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

31. In the following diagram, the arm *PQ* of the rectangular conductor is moved from $x = 0$; outwards.



The uniform magnetic field is perpendicular to the plane and extends from $x = 0$ to $x = b$ and is zero for $x > b$. Only the arm *PQ* possesses substantial resistance '*r*'. Consider the situation when the arm *PQ* is pulled outwards from $x = 0$ to $x = 2b$, and is then moved back to $x = 0$ with constant speed '*v*'. Obtain expressions

for the (i) electric flux, (ii) the induced emf,(iii)the force necessary to pull the arm and (iv) the power dissipated as Joule heat. Sketch the variation of these quantities with distance.

OR

(a) Describe a simple experiment (or activity) to show that the polarity of emf induced in a coil is always such that it tends to produce a current which opposes the change of magnetic flux that produces it.

(b) A wheel with 8 metallic spokes each 50 cm long is rotated with a speed of 120 rev/min in a plane normal to the horizontal component of the Earth's magnetic field. The Earth's magnetic field at the place is 0.4 G and the angle of dip is 60°. Calculate the emf induced between the axle and the rim of the wheel. How will the value of emf be affected if the number of spokes were increased?

32. Explain how Einstein's photoelectric equation is used to describe photoelectric effect satisfactorily.

OR

(a) *X*-rays fall on a photosensitive surface to cause photoelectric emission. Assuming that the work function of the surface can be neglected, find the relation between the de-Broglie wavelength (λ) of the electrons emitted and the energy (E_v) of the incident photons. Draw the nature of the graph for λ as a function of E_v.

(b) An electron microscope uses electrons accelerated by a voltage of 50 kV. Determine the de Broglie wavelength associated with the electrons.

(c) An α-particle and a proton are accelerated through the same potential difference. Find the ratio of their de Broglie wavelengths.

33. Explain briefly with the help of necessary diagrams, the forward and the reverse biasing of a *p-n* junction diode. Also draw their characteristic curves in the two cases.

OR

Draw the circuit diagram of a half wave rectifier and explain its working.

—