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)	–	8(16)
2.	Current Electricity	2(5)	1(2)	–	–	
3.	Magnetic Effects of Current and Magnetism	3(3)	1(2)	–	–	8(17)
4.	Electromagnetic Induction and Alternating Current	–	2(4)	1(3)	1(5)	
5.	Electromagnetic Waves	4(4)	–	–	–	10(18)
6.	Optics	1(1)	2(4)	3(9)	–	
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. Explain the meaning of the statement 'electric charge of a body is quantised'.

OR

Does the charge given to a metallic sphere depend on whether it is hollow or solid. Give reason for your answer.

2. The refractive index and permeability of a medium are 1.5 and 5×10^{-7} H m^{-1} respectively. Calculate the relative permittivity of the medium.

3. What is the amount of work done in moving a point charge around a circular arc of radius *r* at the centre of which another point charge is located ?

4. Find the velocity of electromagnetic radiation in a medium of permittivity ε_0 and permeability μ_0.

OR

What is Green house effect?

5. Write two factors by which voltage sensitivity of a galvanometer can be increased.

6. A semiconducting device is connected in a series circuit with a battery and a resistance. A current is found to pass through the circuit. If the polarity of the battery is reversed, the current drops to almost zero. Find the device.

OR

To obtain a *p*-type germanium semi-conductor, it must be doped with which impurity atom?

7. Define one ampere, on the basis of force between two infinitely long parallel current carrying wire.

OR

Write the condition under which an electron will move undeflected in the presence of crossed electric and magnetic fields.

8. Write the relation between the refractive index and critical angle for a given pair of optical media.

9. The emf of a cell is always greater than its terminal voltage. Why?

10. If an electromagnetic wave propagating along north has its electric field vector upwards. In which direction its magnetic vector pointed?

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) : Earth's magnetic field does not affect the working of a moving coil galvanometer.

Reason (R) : The earth's magnetic field is quite weak as compared to magnetic field produced in the moving coil galvanometer.

12. Assertion (A) : Static crashes are heard on radio, when lightning flash occurs in the sky.

Reason (R) : Electromagnetic waves having frequency of radio wave range interfere with radio waves.

13. Assertion (A) : The positively charged nucleus of an atom has a radius of almost 10^{-15} m.

Reason (R) : In α-particle scattering experiment, the distance of closest approach for α-particles is 10^{-15} m.

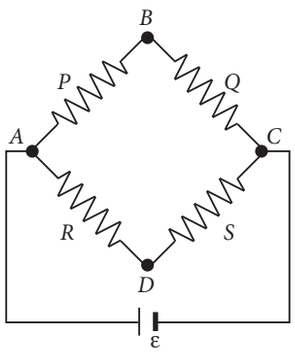
14. Assertion (A) : The number of electrons in a *p*-type silicon semiconductor is less than the number of electrons in a pure silicon semiconductor at room temperature.

Reason (R) : It is due to law of mass action.

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. The Wheatstone Bridge was originally developed by Charles Wheatstone to measure unknown resistance values and as a means of calibrating measuring instruments, voltmeters, ammeters, etc, by the use of a long resistive slide wire. The Wheatstone Bridge circuit is nothing more than two simple series-parallel arrangements of resistances connected between a voltage supply terminal and ground producing zero voltage difference between the two parallel branches when balanced. A Wheatstone bridge circuit has two input terminals and two output terminals consisting of four resistors configured in a diamond-like arrangement as shown.



A Wheat stone bridge as shown in figure is almost balanced, where $P = 10\ \Omega$, $Q = 20\ \Omega$, $R = 5\ \Omega$, $S = 11\ \Omega$, $\varepsilon = 48$ V and C is grounded.

(i) In Wheatstone bridge method, the instrument used as null detector is

(a) Ammeter

(b) Voltmeter

(c) Galvanometer

(d) All of these.

(ii) The potential of point B is

(a) 16 V

(b) 24 V

(c) 32 V

(d) 36 V

(iii) If a galvanometer is connected between B and D, the direction of current through galvanometer is

(a) B to D

(b) D to B

(c) depends on resistance of galvanometer

(d) in the beginning from B to D and later on form D to B.

(iv) For what additional value of the resistance in arm *BC* in series/parallel would make the bridge balanced?

(a) 22 Ω (b) 2 Ω (c) 20 Ω (d) 44 Ω

(v) In a wheatstone bridge if the battery and galvanometer are interchanged then the deflection in galvanometer will

(a) Change in previous direction (b) not change

(c) Change in opposite direction (d) none of these.

16. The Bohr model for an electron transition in hydrogen between quantized energy levels with different quantum numbers n yields a photon by emission with quantum energy. According to Bohr's theory, electrons of an atom revolve around the nucleus on certain orbits, or electron shells. Each orbit has its specific energy level, which is expressed as a negative value. The orbits closer to the nucleus have lower energy levels because they interact more with the nucleus, and vice versa.

(i) An excited state electron drops down to the $n = 2$ state and emits a photon of yellow light. If instead the electron drops down to ground state, then the light emitted would be

(a) red (b) infrared (c) ultraviolet (d) orange

(ii) The transission having shortest wavelength is

(a) $n = 4$ to $n = 1$ (b) $n = 5$ to $n = 4$ (c) $n = 7$ to $n = 1$ (d) $n = 2$ to $n = 1$

(iii) The electron in a hydrogen atom is in the first excited state, when the electron acquires an additional 2.55 eV of energy. What is the quantum number, n, of the state into which the electron moves?

(a) 2 (b) 3 (c) 4 (d) 5

(iv) On moving up in the energy states of a H-like atom, the energy difference between two consecutive energy states

(a) decreases (b) increases

(c) first decreases then increases. (d) first increases then decreases.

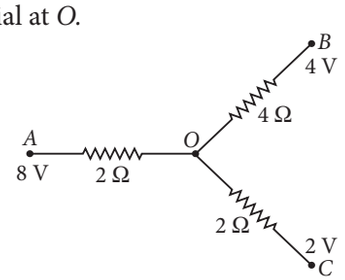
(v) The ionisation energy of hydrogen atom is 13.6 eV. Following Bohr's theory the energy corresponding to a transition between 3^{rd} and 4^{th} orbits is

(a) 3.40 eV (b) 1.51 eV (c) 0.85 eV (d) 0.66 eV

SECTION - C

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

17. In the following network, find potential at *O*.



OR

Plot a graph showing temperature dependence of resistivity for a typical semiconductor. How is this behaviour explained ?

18. Consider an arbitrary electrostatic field configuration. A small test charge is placed at a null point (*i.e.,* where $\vec{E} = 0$) of the configuration. Show that the equilibrium of the test charge is necessarily unstable.

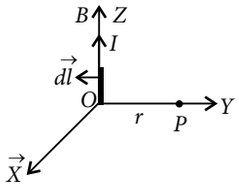
19. In a Young' double slit experiment if there is no initial phase difference between the light from the two slits, then find path difference of a point on the screen corresponding to the fifth minimum.

20. A capacitor is charged with a battery and energy stored is U. After disconnecting battery another capacitor of same capacity is connected in parallel to the first capacitor. Then calculate the energy stored in each capacitor.

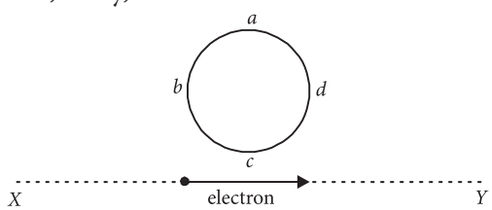
21. What is the advantage of using radial magnetic field in a moving coil galvanometer?

OR

State Biot-Savart law. A current I flows in a conductor placed perpendicular to the plane of the paper. Indicate the direction of the magnetic field due to a small element $\vec{dl}$ at point P situated at a distance $\vec{r}$ from the element as shown in the figure.



22. An electron moves on a straight line path XY as shown. The $abcd$ is a coil adjacent to the path of electron. What will be the direction of current, if any, induced in the coil?



23. **(i)** How does the refractive index of a transparent medium depend on the wavelength of incident light used?

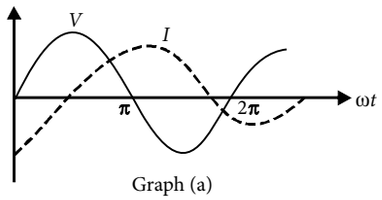
(ii) Velocity of light in glass is 2×10^8 m/s and in air is 3×10^8 m/s. If the ray of light passes from glass to air, calculate the value of critical angle.

24. If the atom $^{257}_{100}$Fm follows the Bohr model and the radius of fifth orbit of $^{257}_{100}$Fm is N times the Bohr radius, then find the value of N.

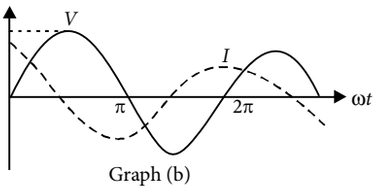
OR

When an electron falls from a higher energy to a lower energy level, the difference in the energies appears in the form of electromagnetic radiation. Why cannot it be emitted as other forms of energy?

25. For a series LCR circuit, connected to a sinusoidal ac voltage source, identify the graph that corresponds to $\omega > \frac{1}{\sqrt{LC}}$. Give reason.



Graph (a)



Graph (b)

SECTION - D

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

26. **(a)** State the essential conditions for diffraction of light.

(b) If the width of the slit is made double the original width, how does it affect the size and intensity of the central band?

27. Answer the following questions :

(a) In a double slit experiment using light of wavelength 600 nm, the angular width of the fringe formed on a distant screen is 0.1°. Find the spacing between the two slits.

(b) Light of wavelength 500 Å propagating in air gets partly reflected from the surface of water. How will the wavelengths and frequencies of the reflected and refracted light be affected?

28. Describe the use of a series resonant circuit in the tuning of a radio receiver.

OR

(a) State the condition under which the phenomenon of resonance occurs in a series *LCR* circuit. Plot a graph showing variation of current with frequency of ac source in a series *LCR* circuit.

(b) In a series *LCR* circuit, the voltages across an inductor, capacitor and resistor are 40 V, 20 V and 20 V respectively. What is the total operative voltage across the combination?

29. Derive the expression for the electric potential due to an electric dipole at a point on its axial line.

30. A convex lens of focal length 20 cm is placed coaxially with a convex mirror of radius of curvature 20 cm. The two are kept at 15 cm from each other. A point object lies 60 cm in front of the convex lens. Draw a ray diagram to show the formation of the image by the combination. Determine the nature and position of the image formed.

OR

A diverging lens of focal length f is cut into two identical parts, each forming a plano concave lens. What is the focal length of each part ?

SECTION - E

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

31. On the basis of energy bands in solids, distinguish between conductors, insulators and semiconductors.

OR

Derive an expression for electrical conductivity of a semiconductor. Explain the various factors responsible for the conductivity in semiconductor.

32. **(a)** Define mutual inductance between two long coaxial solenoids.

(b) Find out the expression for the mutual inductance of inner solenoid of length l having the radius r_1 and the number of turns n_1 per unit length due to the second outer solenoid of same length and n_2 number of turns per unit length.

OR

(a) Draw a labelled diagram of ac generator. Derive the expression for the instantaneous value of the emf induced in the coil.

(b) A circular coil of cross-sectional area 200 cm^2 and 20 turns is rotated about the vertical diameter with angular speed of 50 rad s^{-1} in a uniform magnetic field of magnitude 3.0×10^{-2} T. Calculate the maximum value of the current in the coil.

33. Write Einstein's photoelectric equation and point out any two characteristic properties of photons on which this equation is based. Briefly explain the three observed features which can be explained by this equation.

OR

(a) An electron is accelerated from rest through a potential V. Obtain the expression for the de-Broglie wavelength associated with it.

(b) What will be the change in the energy of the emitted electrons if the intensity of light with same wavelength is doubled?

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