

Physics Pre-Board Sample Paper

General Instructions:

- (1) There are 33 questions in all. All questions are compulsory.
- (2) This question paper has five sections: Section A, Section B, Section C, Section D and Section E.
- (3) Section A contains sixteen questions, twelve MCQ and four Assertion Reasoning based of 1 mark each, Section B contains five questions of two marks each, Section C contains seven questions of three marks each, Section D contains two case study based questions of four marks each and Section E contains three long answer questions of five marks each.
- (4) There is no overall choice. However, an internal choice has been provided in one question in Section B, one question in Section C, one question in each CBQ in Section D and all three questions in Section E. You have to attempt only one of the choices in such questions
- (5) Use of calculators is not allowed.
- (6) You may use the following values of physical constants where ever necessarily.
 - i. $c = 3 \times 10^8 \text{ m/s}$
 - ii. $m_e = 9.1 \times 10^{-31} \text{ kg}$
 - iii. $e = 1.6 \times 10^{-19} \text{ C}$
 - iv. $\mu_0 = 4\pi \times 10^{-7} \text{ TmA}^{-1}$
 - v. $h = 6.63 \times 10^{-34} \text{ Js}$
 - vi. $\epsilon_0 = 8.854 \times 10^{-12} \text{ C}^2\text{N}^{-1}\text{m}^{-2}$
 - vii. Avogadro's number = 6.023×10^{23} per gram mole

Section - A

1. A transformer works on the principle of:

- a) Coulomb's law b) Ampere's law
c) Faraday's law of electromagnetic induction d) Ohm's law

2. The S.I. unit of electric flux is:

- a) Volt b) Coulomb c) Weber d) Volt-meter

3. Which of the following has the smallest wavelength?

- a) Gamma rays b) X-rays c) Ultraviolet rays d) Infrared rays

4. The number of electrons in one coulomb of charge is approximately:

- a) 1.6×10^{19}

- b) 6.25×10^{18}
- c) 3.2×10^{19}
- d) 1.6×10^{18}

5. A diode is used as?

- a) Rectifier b) Amplifier c) Inverter d) As an AND Gate

6. In a pn junction diode, in forward bias:

- a) Junction resistance decreases
- b) Width of depletion layer decreases
- c) Both a and b
- d) None of the above

7. The work function of a metal is:

- a) The minimum energy required to remove an electron from the metal surface
- b) The maximum energy required to remove an electron from the metal surface
- c) The average energy required to remove an electron from the metal surface
- d) None of the above

8. A concave mirror of focal length 15 cm forms an image of an object placed at 10 cm from the mirror. The image formed is:

- a) Real and inverted b) Virtual and erect c) Real and erect d) Virtual and inverted

9. A point charge Q is moved along a circular path around another fixed-point charge. So, the work done is

- a) always zero
- b) zero only if Q returns to its starting position
- c) zero only if the two charges have the same magnitude
- d) zero only if the two charges have the same magnitude and opposite signs

10. Which of the following principle is used in optical fiber?

- a) Total internal reflection b) Scattering
- c) Interference d) Diffraction

11. The longest wavelength in the ultraviolet region of the hydrogen spectrum is 122 nm. The shortest wavelength in the infrared region of the hydrogen spectrum (to the nearest integer) is

- a) 823 nm b) 802 nm c) 1882 nm d) 1648 nm

12. If an a.c. main supply is given to be 220 V, the average e.m.f. during a positive half cycle will be

- a) 240 V b) $220\sqrt{2}$ V c) 220 V d) 198 V

13. Assertion (A): Corpuscular theory fails in explaining the velocities of light in air and water.

Reason (R): According to Corpuscular theory, the light should travel faster in denser media than in rarer media.

- 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 but R is true.

14. 18. Assertion (A): In an intrinsic semiconductor, the number of electrons in the conduction band is equal to the number of holes in the valence band.

Reason (R): Intrinsic semiconductors are doped with impurity atoms to increase their conductivity.

- 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 but R is true.

15. Assertion (A): When two semiconductor of p and n - type are brought in contact, they form p - n junction which act like a rectifier.

Reason (R): A rectifier is used to convert alternating current into direct current.

- 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 but R is true.

16. Assertion (A): The inductance of a solenoid depends on the number of turns and the length of the solenoid.

Reason (R): Increasing the number of turns or decreasing the length of the solenoid increases the magnetic flux linkage per unit current.

- 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 but R is true.

Section - B

17. Define electric dipole moment. Give its S.I. unit.

18.. State Gauss's law. How is it useful in calculating the electric field due to a uniformly charged spherical shell?

19. Five balls, numbered 1 to 5 are suspended using separate threads. Pairs (1, 2), (2, 4), (4, 1) show electrostatic attraction, while pairs (2, 3) and (4, 5) show repulsion. What is the nature of the charge on ball 1?

20. Derive the relation between current and drift velocity.

21. For a glass prism ($\mu = \sqrt{3}$), the angle of minimum deviation is equal to the angle of the prism. Find the angle of the prism.

Section - C

22. State the basic assumption of the Rutherford model of the atom. Explain in brief why this model cannot account for the stability of an atom?

23. Explain the working of PN junction diode in Forward bias with suitable circuit diagram.

24. A metallic rod of length l and resistance R is rotated with a frequency ν , with one end hinged at the centre and the other end at the circumference of a circular metallic ring of radius l , about an axis passing through the centre and perpendicular to the plane of the ring. A constant and uniform magnetic field B parallel to the axis is present everywhere.

i) Derive the expression for the induced emf and the current in the rod.

ii) Due to the presence of the current in the rod and of the magnetic field, find the expression for the magnitude and direction of the force acting on this rod.

iii) Hence obtain the expression for the power required to rotate the rod.

25. Describe the principle, construction, and working of a moving coil galvanometer.

26. What are the different types of polarization of light? Explain any one type in detail.

27. Describe the principle, construction, and working of a moving coil galvanometer.

28. Using Kirchhoff's rules, calculate the current in a circuit having three resistors R_1 , R_2 and R_3 in series with a battery of emf E .

Section - D

29. Read the following passage and answer the questions that follow:

The hydrogen spectrum consists of several series of lines in different regions of the electromagnetic spectrum. These series are named after their discoverers: Lyman, Balmer, Paschen, Brackett, and Pfund. Each series corresponds to electron transitions between different energy levels in the hydrogen atom.

- a) Which series of hydrogen spectral lines lies in the visible region?
- b) Calculate the wavelength of the first line of the Lyman series. (Given: Rydberg constant ($R = 1.097 \times 10^7 \text{ m}^{-1}$))
- c) Why are the spectral lines of hydrogen important in astronomy?

30. Read the following passage and answer the questions that follow:

A coil of wire is connected to a galvanometer. When a bar magnet is moved towards the coil, the galvanometer shows a deflection. When the bar magnet is moved away from the coil, the galvanometer shows a deflection in the opposite direction. The faster the magnet is moved, the greater the deflection.

- a) Name the phenomenon demonstrated in the above experiment.
- b) State Faraday's law of electromagnetic induction.
- c) What will happen if the number of turns in the coil is increased?

Section - E

31. (a) Explain the formation of a PN junction diode and discuss its working principle.

(b) Draw and describe the V-I characteristics of a PN junction diode in forward bias and reverse bias conditions.

32. i) Draw a schematic arrangement for winding of primary and secondary coils in a transformer when the two coils are wound on top of each other.

(ii) State the underlying principle of a transformer and obtain the expression for the ratio of secondary to primary voltage in terms of the

- number of secondary and primary windings and
- primary and secondary currents.

(iii) Write the main assumption involved in deriving the above relations.

(iv) Write any two reasons due to which energy losses may occur in actual transformers.

33. (a) Derive the lens maker's formula for a convex lens.

(b) A convex lens has a focal length of 20 cm. Where should an object be placed so that its image is formed 40 cm from the lens?