

Class XII Exam 2022-23

Physics

Time: 3 Hours

Max.

Marks: 70

General Instructions:

1. There are 35 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. All the sections are compulsory.
3. Section A contains eighteen MCQ of 1 mark each, Section B contains seven questions of two marks each, Section C contains five questions of three marks each, section D contains three long questions of five marks each and Section E contains two case study based questions of 4 marks each.
4. There is no overall choice. However, an internal choice has been provided in section B, C, D and E. You have to attempt only one of the choices in such questions.
5. Use of calculators is not allowed.

SECTION-A

1. Two charged spheres separated by a distance d exert some force F on each other. If they are immersed in a liquid of dielectric constant 4, then what is the force exerted, if all other conditions are same?
(a) $2F$ (b) $4F$ (c) $F/2$ (d) $F/4$
2. The electrostatic energy stored in a capacitor is
(a) $\frac{1}{2} QV$ (b) $1/ QV$ (c) $2/QV$ (d) QV
3. If the length of a conductor is halved, then its conductance will be
(a) halved (b) doubled (c) quadrupled (d) unchanged
4. A proton is moving in a space with constant velocity in an electric field E and magnetic field B . The angle between electric field and magnetic field should be
(a) 0° (b) 30° (c) 45° (d) 90°
5. At the magnetic poles of the earth, a compass needle will be
(a) vertical (b) horizontal
(c) inclined at 10° with the vertical
(d) inclined at 45° with the horizontal
6. In a p n- junction diode, the holes are due to
(a) protons (b) neutrons
(c) extra electrons (d) missing electrons
7. The electrical resistance of a healthy man is
(a) $50\ 000\ \Omega$ (b) $10\ 000\ \Omega$ (c) $1\ 000\ \Omega$ (d) $10\ \Omega$

8. Two coils are placed close to each other. The mutual inductance of the pair of coils depends upon
- currents in the coils
 - materials of the wires of the coils
 - relative position and orientation of the coils
 - rates at which the currents are changing in the coils
9. Reactance of a capacitor of capacitance C for an alternating current of frequency 400π Hz is 25Ω . The value of C is
- $25 \mu\text{F}$
 - $50 \mu\text{F}$
 - $75 \mu\text{F}$
 - $100 \mu\text{F}$
10. Which of the following electromagnetic waves have the smallest wavelength?
- γ -rays
 - X-rays
 - UV waves
 - IR rays
11. When two converging lenses of same focus f are placed in contact, the focal length of the combination is
- f
 - $2f$
 - $f/2$
 - $3f$
12. The ratio of no. of turns of primary coil to secondary coil in a transformer is 2:3. If a cell of 6V is connected across the primary coil, then voltage across the secondary coil will be
- 3 V
 - 6 V
 - 9 V
 - 12 V
13. Mass of a photon of frequency ν is given by
- $m = h/\lambda$
 - $m = hc/\nu$
 - $m = h\nu/c$
 - $m = h\nu/c^2$
14. In some substances, charge can flow at ordinary temperature, but not at very low temperatures. These substances are called
- conductors
 - insulators
 - dielectrics
 - semiconductors
15. The energy produced in the sun is due to
- fission reaction
 - fusion reaction
 - chemical reaction
 - motion of electrons and ions

Read questions 16 to 18 and choose the correct answer:

- Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.
- Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
- Assertion is correct but Reason is incorrect.
- Assertion is incorrect but Reason is correct.

16. Assertion : The magnetic field at the centre of the circular coil in the following figure due to the currents I_1 and I_2 is zero.

Reason : $I_1 = I_2$ implies that the fields due to the current I_1 and I_2 will be balanced.

17. Assertion : The ferromagnetic substance do not obey Curie's law.
Reason : At Curie point a ferromagnetic substance start behaving as a paramagnetic substance.
18. Assertion : Long distance power transmission is done at high voltage.
Reason : At high voltage supply power losses are less.

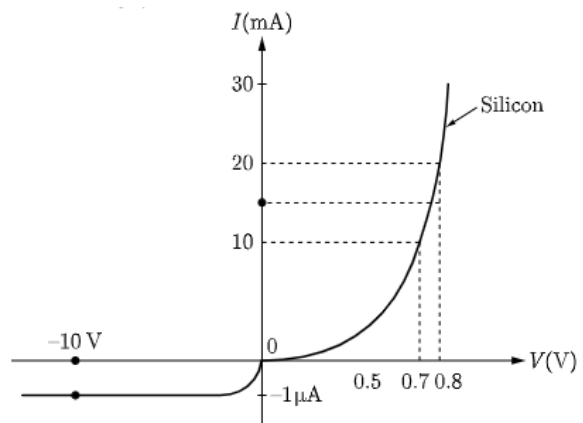
SECTION-B

19. Write the expression, in a vector form, for the Lorentz magnetic force F due to a charge moving with velocity v in a magnetic field B . What is the direction of the magnetic force ?
20. Why cannot two magnetic lines of forces due to a bar magnet cross each other?
21. Find the wavelength of electromagnetic waves of frequency 6×10^{12} Hz in free space. Give its two applications.

OR

- (a) Mention two applications of UV rays.
(b) Why cannot one get tanned or sunburned through glass windows?
22. Draw a neat diagram of Cassegrain telescope. Mention two of its advantages over refracting telescope.
23. What changes be observed in the interference pattern of Young's double slit experiment when
(a) light of smaller frequency is used?
(b) if the apparatus is immersed in water?
24. A difference of 2.3 eV separates two energy levels in an atom. What is the frequency of radiation emitted when the atom makes a transition from the upper level to the lower level?
radius of its fifth orbit?

25. The V I- characteristic of a silicon diode is as shown in the figure.
Calculate the resistance of the diode
at (a) $I = 15$ mA
(b) $V = -10$ V



SECTION-C

26. What is polarization of charge? With the help of a diagram show why the electric field between the plates of a capacitor reduces on introducing a dielectric slab. Define the dielectric constant on the basis of these fields.
27. When an ideal capacitor is charged AC by a DC battery, no current flows. However, when an AC source is used, the current flows continuously. How does one explain this, based on the concept of displacement current?
28. How does a combination of lenses affect the size, position and nature of the image?

OR

Use mirror equation to show that a convex mirror always produces a virtual image independent of the location of the object.

29. State the important properties of neutrons.

OR

Answer the following:

- (a) Why is the binding energy per nucleon found to be constant for nuclei in the range of mass number A lying between 30 and 170?
- (b) When a heavy nucleus with mass number $A = 240$ breaks into two nuclei, $A = 120$, energy is released in the process. Explain why.
30. Draw the circuit diagram of a full-wave rectifier using a p-n junction diode. Explain its working and show the output input waveforms.

SECTION-D

31. (a) State Gauss's theorem.
(b) Apply this to obtain the expression for the electric field intensity at a point due to an infinitely long, thin, uniformly charged straight wire.

OR

State Biot-Savart's law and apply it to find the magnetic field at a point due to a long straight conductor carrying current.

32. Derive an expression for the force between two long parallel conductors carrying constant current and hence define one ampere.

OR

Describe the principle, construction and working of a moving coil galvanometer. Prove that the current flowing in the coil is directly proportional to its deflection. What is the importance of the radial field?

33. Using Huygen's principle, draw a diagram to show the propagation of a wavefront originating from a monochromatic point source. Explain diffraction of light due to a single slit and explain the formation of fringes on a screen and plot the variation of intensity of light with angle θ in single slit diffraction.

OR

What are coherent sources of light? State two conditions for light sources to be coherent. With the help of a neat diagram explain Young's double slit experiment. What is the condition for the formation of bright and dark fringes? What is the expression for bandwidth?

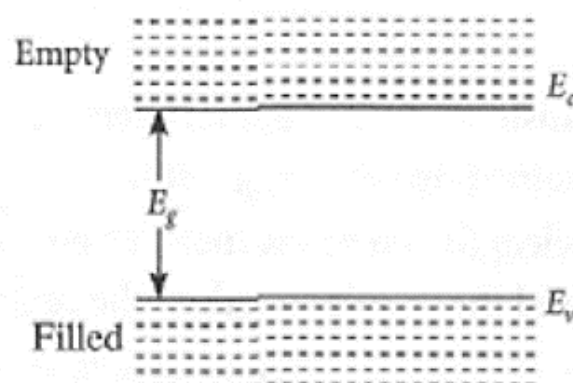
SECTION-E

34. An astronomical telescope is an optical instrument which is used for observing distinct images of heavenly bodies like stars, planets etc. It consists of two lenses. In normal adjustment of telescope, the final image is formed at infinity. Magnifying power of an astronomical telescope in normal adjustment is defined as the ratio of the angle subtended at the eye by the angle subtended at the eye by the final image to the angle subtended at the eye, by the object directly, when the final image and the object both lie at infinite distance from the eye. It is given by $m = (f_o/f_e)$. To increase magnifying power of an astronomical telescope in normal adjustment, focal length of objective lens should be large and focal length of eye lens should be small.

- (i) What is the condition for the focal lengths of objective lens and eye-piece, for large magnifying power of astronomical telescope.
- (ii) An astronomical telescope of magnifying power 7 consists of the two thin lenses 40 cm apart, in normal adjustment. Find the focal lengths of the lenses.
- (iii) An astronomical telescope has a magnifying power of 10. In normal adjustment, distance between the objective and eye piece is 22 cm. Find the focal length of objective lens.

OR

- (iv) A telescope has large diameter of the objective. Then is its resolving power high or low? Explain.
35. From Bohr atomic model, we know that the electrons have well defined energy levels in an isolated atom. But due to interatomic interactions in a crystal, the electrons of the outer shells are forced to have energies different from those in isolated atoms. Each energy level splits into a number of energy levels forming a continuous band. The gap between top of valence band and bottom of the conduction band in which no allowed energy levels for electrons can exist is called energy gap.



- (i) What is the value of energy band gap in an insulator?
- (ii) What is the order of separation between conduction and valence band in a semiconductor.
- (iii) Carbon, silicon and germanium have four valence electrons each. At room temperature what will be the number of free electrons for conduction in all three materials?

OR

- (iv) Among conductors, insulators and semiconductors, which one has the smallest forbidden gap according to band theory?