CBSE EXAMINATION PAPER-2023

PHYSICS

(Solved)

Time allowed : 3 hours | Maximum Marks : 75

General Instructions :

Read the following instructions carefully and follow them :

i. This question paper contains **42 questions.** All questions are **compulsory.**

ii. This question paper is divided into **4 sections.**

iii. **Section A** – questions number **1 to 18** are multiple choice questions Each question carries **1 marks.**

iv. **Section B** – questions number **19 to 27** are very short answer Each question carries **2 marks.**

v. **Section C** – questions number **28 to 40** are short answer Each question carries **3 marks.**

vi. **Section D** – questions number **41 to 42** are case based questions

vii. There is no overall choice given in the question paper. However, an internal choice has been provided in few questions.

viii. Use of calculator is NOT allowed.

Section A

Question 1.

An electric dipole of length 2 cm is placed at an angle of 30° with an electric field 2 x 10^5 N/C. If the dipole experiences a torque of 8 x 10^$^{-}$3 Nm, the magnitude of either charge of the dipole, is:

[1 Marks]

(A) 8 mC

(B) 7 µC

(C) 2 mC

(D) 4 µC

Question 2.

Two long parallel wires kept 2 m apart carry 3A current each, in the same direction. The force per unit length on one wire due to the other is:

[1 Marks]

(A) 9×10^{-7} N/m, repulsive

(B) 4.5×10^{-7} N/m, repulsive

(C) 9 x 10^-5 N/m, attractive

(D) 4.5 x 10^-5 N/m, attractive

Question 3.

Which of the following has its permeability less than that of free space?

[1 Marks]

(A) Aluminium

(B) Copper chloride

(C) Nickel

(D) Copper

Question 4.

A square shaped coil of side 10 cm, having 100 turns is placed perpendicular to a magnetic field which is increasing at 1 T/s. The induced emf in the coil is:

[1 Marks]

(A) 0.5 V

(B) 1 V

(C) 0.75 V

(D) 0.1 V

Question 5. Which one of the following electromagnetic radiation has the least wavelength?

[1 Marks]

(A) Microwaves

(B) Gamma rays

(C) Visible light

(D) X-rays

Question 6.

In a Young's double-slit experiment, the screen is moved away from the plane of the slits. What will be its effect on the following?

(A) Angular separation of the fringes.

(B) Fringe-width.

[1 Marks]

(A) Both (A) and (B) increase.

(B) Both (A) and (B) remain constant.

(C) (A) remains constant, but (B) increases.

(D) (A) remains constant, but (B) decreases.

Question 7.

The energy of a photon of wavelength λ is:

[1 Marks]

(A) λ/hc

(B) hc λ

(C) λh/c

(D) hc/λ

Question 8.

The ratio of the nuclear densities of two nuclei having mass numbers 64 and 125 is:

[1 Marks]

(A) 0.8

(B) 0.512

(C) 1

(D) 1.25

Question 9.

During the formation of a p-n junction:

[1 Marks]

(A) Drift current remains constant.

(B) Both the diffusion current and drift current remain constant.

(C) Diffusion current remains almost constant but drift current increases till both currents become equal.

(D) Diffusion current keeps increasing.

Question 10.

The diagram shows four energy levels of an electron in the Bohr model of hydrogen atom. Identify the transition in which the emitted photon will have the highest energy.

[1 Marks]

(A) I

(B) III

(C) IV

(D) II

Question 11.

Which of the following graphs correctly represents the variation of a particle's momentum with its associated de-Broglie wavelength?

[1 Marks]

(A) Step function

(B) Inversely proportional

(C) Quadratic

(D) Linear

Question 12.

The capacitors, each of 4 μF are to be connected in such a way that the effective capacitance of the combination is 6 μF. This can be achieved by connecting

[1 Marks]

(A) Two of them connected in series and the combination in parallel to the third.

(B) All three in series

(C) All three in parallel

(D) Two of them connected in parallel and the combination in series to the third.

Question 13.

Assertion (A): The resistance of an intrinsic semiconductor decreases with increase in its temperature.

Reason (R): The number of conduction electrons as well as holes increase in an intrinsic semiconductor with a rise in its temperature.

[1 Marks]

(A) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of Assertion (A).

(B) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).

(C) Both Assertion (A) and Reason (R) are false.

(D) Assertion (A) is true, but Reason (R) is false.

Question 14.

Assertion (A): The equivalent resistance between points A and B in the given network is 2R.
Reason (R): All the resistors are connected in parallel.

[1 Marks]

(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).

(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of Assertion (A).

(C) Assertion (A) is true, but Reason (R) is false.

(D) Both Assertion (A) and Reason (R) are false.

Question 15.

Assertion (A): The deflecting torque acting on a current carrying loop is zero when its plane is perpendicular to the direction of the magnetic field.

Reason (R): The deflecting torque acting on a loop of magnetic moment m in a magnetic field B is given by the dot product of m and B.

[1 Marks]

(A) Both Assertion (A) and Reason (R) are false.

(B) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).

(C) Assertion (A) is true, but Reason (R) is false.

(D) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of Assertion (A).

Question 16. According to Huygens principle, the amplitude of secondary wavelets is:

[1 Marks]

(A) Maximum in the forward direction and zero in the backward direction.

(B) Equal in both the forward and the backward directions.

(C) Small in the forward direction and large in the backward direction.

(D) Large in the forward direction and small in the backward direction.

Question 17. The radius of the nth orbit in the Bohr model of the hydrogen atom is proportional to:

[1 Marks]

(A) n^2

(B) $1/n^2$

(C) n

(D) 1/n

Question 18.

Which of the following statements about a series LCR circuit connected to an ac source is correct ?

[1 Marks]

(A) If the frequency of the source is increased, the impedance of the circuit first decreases and then increases.

(B) If the net reactance (XL -XC) of circuit becomes equal to its resistance, then the current leads the voltage by 45°.

(C) At resonance, the voltage drop across the inductor is more than that across the capacitor.

(D) At resonance, the voltage drop across the capacitor is more than that across the inductor.

Section B

Question 19.

(a) How will the de Broglie wavelength associated with an electron be affected when (i) the velocity of the electron decreases? and (ii) accelerating potential is increased ? Justify your answer.

[2 Marks]

Question 20.

Identify the electromagnetic wave whose wavelength range is from about

(a) 10^-12 m to about 10^-8 m.

(b) 10^-3 m to about 10^-1 m.

Write one use of each.

[2 Marks]

Question 21.

Depict the orientation of an electric dipole in (a) stable and (b) unstable equilibrium in an external uniform electric field. Write the potential energy of the dipole in each case.

[2 Marks]

Question 22.

(b) A long straight wire AB carries a current I. A particle (mass m and charge q) moves with a velocity v, parallel to the wire, at a distance d from it as shown in the figure. Obtain the expression for the force experienced by the particle and mention its directions.

[2 Marks]

Question 23.

Draw a graph showing the variation of potential energy of a pair of nucleons as a function of their separation. Indicate the region in which the nuclear force is (a) attractive and (b) repulsive.

[2 Marks]

Question 24.

The potential difference applied across a given conductor is doubled. How

will this affect (i) the mobility of electrons and (ii) the current density in

the conductor ? Justify your answers.

[2 Marks]

Question 25.

Two coils C1, and C2, are placed close to each other. The magnetic flux φ2 linked with the coil C2, varies with the current I1, flowing in coil C1, as

shown in the figure. Find

(i) the mutual inductance of the arrangement, and

(ii) the rate of change of current (dI1/dt) that will induce an emf of 100 V

in coil C2.

[2 Marks]

Question 26.

(b) How would the stopping potential for a given photosensitive surface change if (i) the frequency of the incident radiation were increased ? and (i) the intensity of incident radiation were decreased ? Justify your answer.

[2 Marks]

Question 27.

(a) Write the expression for the Lorentz force on a particle of charge q moving with a velocity V in a magnetic field B. When is the magnitude of this force maximum ? Show that no work is done by

this force on the particle during its motion from a point r1, to point r2.

[2 Marks]

Section C

Question 28.

(a) A plane wave-front propagating in a medium of refractive index 'μ1, is incident on a plane surface making an angle of incidence (i). It enters into a medium of refractive index μ2(μ2>μ1).

Use Huygen's construction of secondary wavelets to trace the retracted wave-front. Hence verify Snell's law of refraction.

[3 Marks]

Question 29.

An alternating voltage of 220 V is applied across a device X. A current of 0.22 A flows in the circuit and it lags behind the applied voltage in phase

by π/2 radian. When the same voltage is applied across another device Y,

the current in the circuit remains the same and it is in phase with the

applied voltage.

(i) Name the devices X and Y and,

(ii) Calculate the current flowing in the circuit when the same voltage is

applied across the series combination of X and Y.

[3 Marks]

Question 30.

State the basic principle behind the working of an ac generator. Briefly describe its working and obtain the expression for the instantaneous value of emf induced.

[3 Marks]

Question 31.

(a) Briefly describe how the current sensitivity of a moving coil galvanometer can be increased.

(b) A galvanometer shows full scale deflection for current Ig,. A resistance

R1, is required to convert it into a voltmeter of range (0 — V) and a

resistance R2, to convert it into a voltmeter of range (0 — 2V). Find the

resistance of the galvanometer.

[3 Marks]

Question 32.

(a) (i) Differentiate between 'distance of closest approach' and 'impact

parameter'.

(ii) Determine the distance of closest approach when an alpha particle of kinetic energy 3.95 MeV approaches a nucleus of Z = 79, stops and reverses its directions.

[3 Marks]

Question 33.

(a) (i) Explain how free electrons in a metal at constant temperature attain an average velocity under the action of an electric field. Hence obtain an expression for it.

(ii) Consider two conducting wires A and B of the same diameter but made of different materials joined in series across a battery. The number density of electrons in A is 1.5 times that in B. Find the ratio of drift velocity of electrons in wire A to that in wire B.

[3 Marks]

Question 34.

(a) Draw the circuit arrangement for studying V-I characteristics of a p-n junction diode in (i) forward biasing and (ii) reverse biasing. Draw the typical V-I characteristics of a silicon diode. Describe briefly the following terms : (i) minority carrier injection in forward biasing and (ii) breakdown voltage in reverse biasing.

[3 Marks]

Question 35.

(a) (i) Draw a ray diagram to show the working of a compound microscope. Obtain the expression for the total magnification for the final image to be formed at the near point.

(ii) In a compound microscope an object is placed at a distance of 1.5 cm from the objective of focal length 1.25 cm. If the eye-piece has a focal length of 5 cm and the final image is formed at the near point, find the magnifying power of the microscope.

[3 Marks]

Question 36.

(b) Using Huygen's construction, show how a plane wave is reflected from a surface. Hence verify the law of reflection.

[3 Marks]

Question 37.

(b) (i) State three postulates of Bohr's theory of hydrogen atom.

(ii) Find the angular momentum of an electron revolving in the second orbit in Bohr's hydrogen atom.

[3 Marks]

Question 38.

(b) (i) A cell emf of (E) and internal resistance (r) is connected across a variable load resistance (R). Draw plots showing the variation of terminal voltage V with (i) R and (ii) the current (I) in the load.

(ii) Three cells, each of emf E but internal resistances 2r, 3r and 6r

are connected in parallel across a resistor R.

Obtain expressions for (i) current flowing in the circuit, and (ii) the terminal potential difference across the equivalent cell.

[3 Marks]

Question 39.

(b) Name two important processes involved in the formation of a p-n

junction diode. With the help of a circuit diagram, explain the working of junction diode as a full wave rectifier. Draw its input and output waveforms. State the characteristic property of a junction diode that makes it suitable for rectification.

[3 Marks]

Question 40.

(b) (i) Draw a ray diagram for the formation of image of an object by an astronomical telescope, in normal adjustment. Obtain the expression for its magnifying power.

(ii) The magnifying power of an astronomical telescope in normal adjustment is 2.9 and the objective and the eyepiece are separated by a distance of 150 cm. Find the focal lengths of the two lenses.

[3 Marks]

Section D

Question 41.

Question 42.

A capacitor is a system of two conductors separated by an insulator. The two conductors have equal and opposite charges with a potential difference between them. The capacitance of a capacitor depends on the geometrical configuration (shape, size and separation) of the system and also on the nature of the insulator separating the two conductors. They are used to store charges. Like resistors, capacitors can be arranged in series or parallel or a combination of both to obtain desired value of capacitance.