CBSE EXAMINATION PAPER-2023

PHYSICS

(Solved)

Time allowed : 3 hours | Maximum Marks : 87

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 **5 sections.**

iii. **Section A** – questions number **1 to 2** are case based questions

iv. **Section B** – questions number **3 to 20** are multiple choice questions

v. **Section C** – questions number **21 to 29** are very short answer

vi. **Section D** – questions number **30 to 36** are short answer

vii. **Section E** – questions number **37 to 42** are long answer

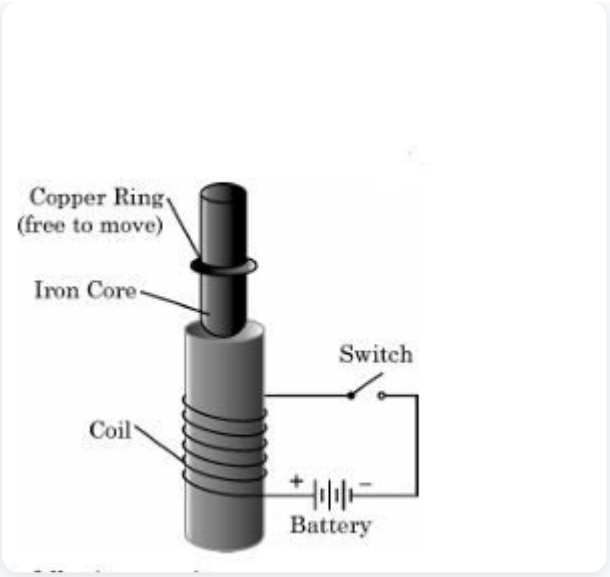
viii. There is no overall choice given in the question paper. However, an internal choice has been provided in few questions.

ix. Use of calculator is NOT allowed.

Section A

Question 1.

(a) Consider the experimental set up shown in the figure. This jumping ring experiment is an outstanding demonstration of some simple laws of Physics. A conducting non-magnetic ring is placed over the vertical core of a solenoid. When current is passed through the solenoid, the ring is thrown off.



(1)

(a) (ii) What will happen if the terminals of the battery are reversed and the switch is closed? Explain.

[4 Marks]

(2)

(a) (i) Explain the reason of jumping of the ring when the switch is closed in the circuit.

(3)

(a) (iii) Explain the two laws that help us understand this phenomenon.

(4)

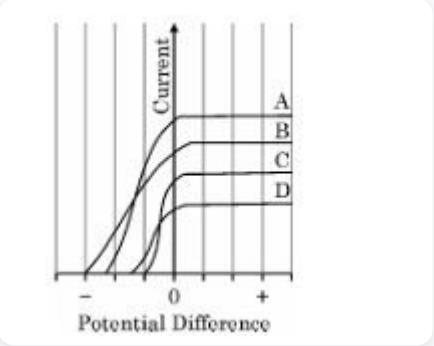
(b) Briefly explain various ways to increase the strength of magnetic field produced by a given solenoid.

[4 Marks]

Question 2.

(a) Figure shows the variation of photoelectric current measured in a photo cell circuit as a function of the potential difference between the plates of the photo cell when light beams A, B, C, and D of

different wavelengths are incident on the photo cell. Examine the given figure and answer the following questions :



(1)

(a) (ii) Which light beam has the longest wavelength and why?

[4 Marks]

(2)

(a) (i) Which light beam has the highest frequency and why?

(3)

(a) (iii) Which light beam ejects photoelectrons with maximum momentum and why?

(4)

(b) What is the effect on threshold frequency and stopping potential on increasing the frequency of incident beam of light ? Justify your answer.

[4 Marks]

Section B

Question 3.

The magnitude of the electric field due to a point charge object at a distance of 4.0 m is 9 N/C. From the same charged object, the electric field of magnitude 16 N/C will be at a distance of:

[1 Marks]

(A) 6 m

(B) 1 m

(C) 2 m

(D) 3 m

Question 4.

A point P lies at a distance x from the midpoint of an electric dipole on its axis. The electric potential at point P is proportional to:

[1 Marks]

(A) $1/x^4$

(B) $1/x$

(C) $1/x^2$

(D) $1/x^3$

Question 5. A current of 0.8 A flows in a conductor of 40 Ω for 1 minute. The heat produced in the conductor will be:

[1 Marks]

(A) 1440 J

(B) 1536 J

(C) 1610 J

(D) 1569 J

Question 6.

A cell of emf E is connected across an external resistance R. When current I is drawn from the cell, the potential difference across the electrodes of the cell drops to V. The internal resistance r of the cell is:

[1 Marks]

(A) (E - V/E)/ R

(B) (E - V)/R

(C) (E-V/V) *R

(D) E-V*R/I

Question 7.

Beams of electrons and protons move parallel to each other in the same direction. They:

[1 Marks]

(A) Neither attract nor repel

(B) Repel each other

(C) Force of attraction or repulsion depends upon speed of beams

(D) Attract each other

Question 8.

A long straight wire of radius ‘a’ carries a steady current ‘I’. The current is uniformly distributed across its area of cross-section. The ratio of magnitude of magnetic field B1 at a/2 and B2, at distance 2a is

[1 Marks]

(A) 1

(B) 2

(C) 4

(D) 1/2

Question 9.

E and B represent the electric and the magnetic field of an electro magnetic wave respectively. The direction of propagation of the wave is along

[1 Marks]

(A) B*E

(B) E

(C) E*B

(D) B

Question 10.

A ray of monochromatic light propagating in air, is incident on the surface of water. Which of the following will be the same for the reflected and refracted rays ?

[1 Marks]

(A) Energy carried

(B) Frequency

(C) Speed

(D) Wavelength

Question 11.

A beam of light travels from air into a medium. Its speed and wavelength in the medium are 1.5 x 10^8 ms^-1 and 230 nm respectively. The wavelength of light in air will be

[1 Marks]

(A) 230 nm

(B) 460 nm

(C) 345 nm

(D) 690 nm

Question 12.

Which one of the following metals does not exhibit emission of electrons from its surface when irradiated by visible light ?

[1 Marks]

(A) Rubidium

(B) Sodium

(C) Cadmium

(D) Caesium

Question 13.

A hydrogen atom makes a transition from n = 5 to n = 1 orbit. The wavelength of photon emitted is λ. The wavelength of photon emitted when it makes a transition from n = 5 to n = 2 orbit is

[1 Marks]

(A) 8/7*λ

(B) 24/7*λ

(C) 16/7*λ

(D) 32/7*λ

Question 14.

The curve of binding energy per nucleon as a function of atomic mass number has a sharp peak for helium nucleus. This implies that helium

nucleus is

[1 Marks]

(A) more stable nucleus than its neighbours

(B) easily fissionable

(C) unstable

(D) radioactive

Question 15.

In an extrinsic semiconductor, the number density of holes is 4 x 10^20 m-3. If the number density of intrinsic carriers is 1.2 x 10^15 m-3, the number density of electrons in it is

[1 Marks]

(A) 1.8x 10^9 m-3

(B) 3.6x10^9 m-3

(C) 3.2x10^10m-3

(D) 2.4x 10^10 m-3

Question 16.

Pieces of copper and of silicon are initially at room temperature. Both are heated to temperature T. The conductivity of

[1 Marks]

(A) copper decreases and silicon increases.

(B) both increases.

(C) copper increases and silicon decreases.

(D) both decreases.

Question 17.

The formation of depletion region in a p-n junction diode is due to

[1 Marks]

(A) movement of dopant atoms

(B) drift of electrons only

(C) drift of holes only

(D) diffusion of both electrons and holes

Question 18.

Assertion (A) : Diamagnetic substances exhibit magnetism.

Reason (R) : Diamagnetic materials do not have permanent magnetic dipole moment.

[1 Marks]

(A) Assertion (A) is true and Reason (R) is false.

(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 true and Reason (R) is NOT the correct explanation of Assertion (A).

(D) Assertion (A) is false and Reason (R) is also false.

Question 19.

Assertion (A) : Work done in moving a charge around a closed path, in an electric field is always zero.

Reason (R) : Electrostatic force is a conservative force.

[1 Marks]

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

(B) Assertion (A) is true and Reason (R) is false.

(C) Assertion (A) is false and Reason (R) is also false.

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

Question 20.

Assertion (A) : In Young's double slit experiment all fringes are of equal width.

Reason (R) : The fringe width depends upon wavelength of light (A) used, distance of screen from plane of slits (D) and slits separation (d).

[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 and Reason (R) is NOT the correct explanation of Assertion (A).

(C) Assertion (A) is true and Reason (R) is false.

(D) Assertion (A) is false and Reason (R) is also false.

Section C

Question 21. Briefly explain why and how a galvanometer is converted into an ammeter.

[2 Marks]

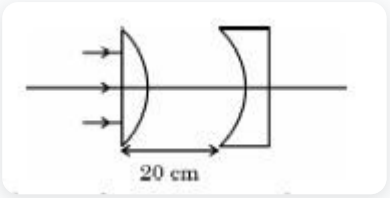
Question 22.

(a) How are infrared waves produced? Why are these waves referred to as heat waves? Give any two uses of infrared waves.

[2 Marks]

Question 23. In the given figure the radius of curvature of curved face in the plano-convex and the plano-concave lens is 15 cm each. The refractive index of the material of the lenses is 1.5. Find the final position of the image formed.

[2 Marks]



Question 24.

(a) What is meant by ionisation energy? Write its value for the hydrogen atom.

[2 Marks]

Question 25.

What happens to the interference pattern when two coherent sources are

(a) infinitely close, and

(b) far apart from each other

[2 Marks]

Question 26.

Draw energy band diagram for an n-type and p-type semiconductor at

T>0K.

[2 Marks]

Question 27.

Answer the following giving reasons :

i) A p-n junction diode is damaged by a strong current.

ii) Impurities are added in intrinsic semiconductors.

[2 Marks]

Question 28.

(b) How are X-rays produced? Give any two uses of these.

[2 Marks]

Question 29.

(b) Define the term, mass defect. How is it related to stability of the nucleus?

[2 Marks]

Section D

Question 30.

(a) Two charged conducting spheres of radii a and b are connected to each other by a wire. Find the ratio of the electric fields at their surfaces.

[3 Marks]

Question 31.

Define current density and relaxation time. Derive an expression for

resistivity of a conductor in terms of number density of charge carriers in

the conductor and relaxation time.

[3 Marks]

Question 32.

A series CR circuit with R = 200 Ω and C = (50/π) μF is connected across

an ac source of peak voltage ¢, = 100 V and frequency v = 50 Hz. Calculate

(a) impedance of the circuit (Z), (b) phase angle (φ), and (c) voltage across

the resistor.

[3 Marks]

Question 33.

Define critical angle for a given pair of media and total internal reflection.

Obtain the relation between the critical angle and refractive index of the

medium.

[3 Marks]

Question 34.

(a) (i) Distinguish between nuclear fission and fusion giving an example of each.

(ii) Explain the release of energy in nuclear fission and fusion on the basis of binding energy per nucleon curve.

[3 Marks]

Question 35.

(b) A parallel plate capacitor (A) of capacitance C is charged by a battery to voltage V. The battery is disconnected and an uncharged capacitor (B) of capacitance 2C is connected across A. Find the ratio of

(i) final charges on A and B.

(ii) total electrostatic energy stored in A and B finally and that

stored in A initially.

[3 Marks]

Question 36.

(b) (i) How is the size of a nucleus found experimentally ? Write the relation between the radius and mass number of a nucleus.

(ii) Prove that the density of a nucleus is independent of its mass number.

[3 Marks]

Section E

Question 37.

(b) (i) Consider two identical point charges located at points (0, 0) and (a, 0).

(1) Is there a point on the line joining them at which the electric field is zero ?

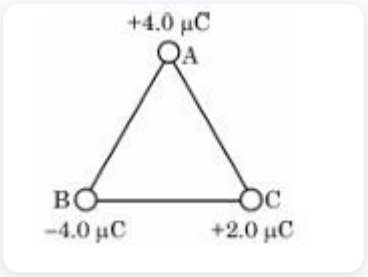
(2) Is there a point on the line joining them at which the electric potential is zero ?

Justify your answers for each case.

(ii) State the significance of negative value of electrostatic potential energy of a system of charges.

Three charges are placed at the corners of an equilateral triangle ABC of side 2.0 m as shown in figure. Calculate the electric potential energy of the system of three charges.

[5 Marks]



Question 38.

(a) (i) Define coefficient of self-induction. Obtain an expression for self-inductance of a long solenoid of length l, area of cross-section A having N turns.

(ii) Calculate the self-inductance of a coil using the following data obtained when an AC source of frequency (200/π) Hz and a DC source is applied across the coil.

[5 Marks]

AC Source		
S.No.	V (Volts)	I (A)
1	3.0	0.5
2	6.0	1.0
3	9.0	1.5

DC Source		
S.No.	V (Volts)	I (A)
1	4.0	1.0
2	6.0	1.5
3	8.0	2.0

Question 39.

(a) (i) State Huygen's principle. With the help of a diagram, show how a plane wave is reflected from a surface. Hence verify the law of reflection.

(ii) A concave mirror of focal length 12 cm forms a three times magnified virtual image of an object. Find the distance of the object from the mirror.

[5 Marks]

Question 40.

(a) (i) Use Gauss' law to obtain an expression for the electric field due to an infinitely long thin straight wire with uniform linear charge density λ.

(ii) An infinitely long positively charged straight wire has a linear charge density λ. An electron is revolving in a circle with a constant speed v such that the wire passes through the centre, and is

perpendicular to the plane, of the circle. Find the kinetic energy of the electron in terms of magnitudes of its charge and linear charge density λ on the wire.

(iii) Draw a graph of kinetic energy as a function of linear charge density λ

[5 Marks]

Question 41.

(b) (i) With the help of a labelled diagram, describe the principle and working of an ac generator. Hence, obtain an expression for the instantaneous value of the emf generated.

(ii) The coil of an ac generator consists of 100 turns of wire, each of area 0.5 m^2. The resistance of the wire is 100 Ω. The coil is rotating in a magnetic field of 0.8 T perpendicular to its axis of

rotation, at a constant angular speed of 60 radian per second. Calculate the maximum emf generated and power dissipated in the coil.

[5 Marks]

Question 42.

(b) (i) Draw a labelled ray diagram showing the image formation by a refracting telescope. Define its magnifying power. Write two limitations of a refracting telescope over a reflecting telescope.

(ii) The focal lengths of the objective and the eye-piece of a compound microscope are 1.0 cm and 2.5 cm respectively. Find the tube length of the microscope for obtaining a magnification

of 300.

[5 Marks]