CBSE EXAMINATION PAPER-2025

PHYSICS

(Solved)

Time allowed : 3 hours | Maximum Marks : 82

General Instructions :

Read the following instructions carefully and follow them :

i. This question paper contains **38 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 18** are multiple choice questions

v. **Section C** – questions number **19 to 24** are very short answer

vi. **Section D** – questions number **25 to 32** are short answer

vii. **Section E** – questions number **33 to 38** 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 galvanometer is an instrument used to show the direction and strength of the current passing through it. In a galvanometer, a coil placed in a magnetic field experiences a torque and hence gets deflected when a current passes through it. The name is derived from the surname of Italian scientist L. Galvani, who in 1791 discovered that electric current makes a dead frog's leg jerk. A spring attached with the coil provides a counter torque. In equilibrium, the deflecting torque is balanced by the restoring torque of the spring and we have:

NBAI = k**φ**

where N is the total number of turns in the coil

A is the area of cross-section of each turn

B is the radial magnetic field

k is the torsional constant of the spring

φ is the angular deflection of the coil.

As the current (I_g) which produces full scale deflection in the galvanometer is very small, the galvanometer cannot as such be used to measure current in electric circuits. A small resistance, called shunt, of a suitable value is connected with the galvanometer to convert it into an ammeter of desired range. By using a higher resistance, a galvanometer can also be converted into a voltmeter.

(1)

The value of the current sensitivity of a galvanometer is given by:

(a) k/NBA (b) NBA/k

(c) kBA/N (d) kNB/A

[1 Marks]

(2)

A galvanometer of resistance 6 Ω shows full scale deflection for a current of 0.2 A. The value of shunt to be used with this galvanometer to convert it into an ammeter of range (0 - 5 A) is:

(A)0·25Ω (B) 0·30Ω

(C) 0·50Ω (D) 6·0Ω

[1 Marks]

(3)

The value of resistance of the ammeter in case (ii) will be:

(A) 0·20Ω (B) 0·24Ω (C) 6·0Ω (D) 6·25Ω

[1 Marks]

(4)

A galvanometer is converted into a voltmeter of range (0- V) by connecting with it, a resistance R_1. If R_1 is replaced by R_2, the range becomes (0- 2 V). The resistance of the galvanometer is:

(A) (R_2 -2R_1) (B) (R_2 -R_1)

(C) (R_1 + R_2) (D) (R_1 -2R_2)

[1 Marks]

(5)

A current of 5 mA flows through a galvanometer. Its coil has 100 turns, each of area of cross-section 18 cm² and is suspended in a magnetic field 0·20 T. The deflecting torque acting on the coil will be:

(A) 3·6 *10^{-3} Nm (B) 1·8* 10^{-4} Nm

(C) 2·4* 10^{-3} Nm (D) 1·2* 10^{-4} Nm

[1 Marks]

Question 2.

Einstein explained photoelectric effect on the basis of Planck's quantum theory, where light travels in the form of small bundles of energy called photons. The energy of each photon is hv, where v is the frequency of incident light and h is Planck's constant. The number of photons in a beam of light determines the intensity of the incident light. A photon incident on a metal surface transfers its total energy hv to a free electron in the metal. A part of this energy is used in ejecting the electron from the metal and is called its work function. The rest of the energy is carried by the ejected electron as its kinetic energy.

(1)

Which of the following graphs shows the variation of photoelectric current I with the intensity of light?

[1 Marks]

(2)

When the frequency of the incident light is increased without changing its intensity, the saturation current:

(A) increases linearly (B) decreases

(C) increases non-linearly (D) remains the same

[1 Marks]

(3)

Which of the following graphs can be used to obtain the value of Planck's constant?

(A) Photocurrent versus Intensity of incident light

(B) Photocurrent versus Frequency of incident light

(C) Cut-off potential versus Frequency of incident light

(D) Cut-off potential versus Intensity of incident light

[1 Marks]

(4)

Red light, yellow light and blue light of the same intensity are incident on a metal surface successively. K_R, K_Y and K_B represent the maximum kinetic energy of photoelectrons respectively, then :

(A) $K_R > K_Y > K_B$ (B) $K_Y > K_B > K_R$

(C) $K_B > K_Y > K_R$ (D) $K_R > K_B > K_Y$

[1 Marks]

(5)

Which of the following metals exhibits photoelectric effect with visible light?

(A) Caesium (B) Zinc

(C) Cadmium (D) Magnesium

[1 Marks]

Section B

Question 3.

A metal sheet is inserted between the plates of a parallel plate capacitor of capacitance C. If the sheet partly occupies the space between the plates, the capacitance :

[1 Marks]

(A) becomes less than C

(B) becomes greater than C

(C) remains C

(D) becomes zero

Question 4.

The electric field at a point in a region is given by □□=α □□/|□□|³ where α is a constant and r is the distance of the point from the origin. The magnitude of potential of the point is :

[1 Marks]

(A) -α/r

(B) α/r

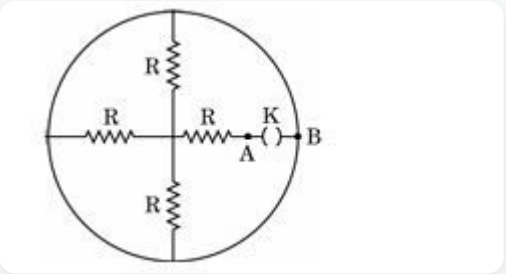
(C) $\alpha r^2 /2$

(D) $\alpha/2r^2$

Question 5.

Four resistors, each of resistance R and a key K are connected as shown in the figure. The equivalent resistance between points A and B when key K is open, will be :

[1 Marks]



(A) ∞

(B) 4R

(C) 4R/3

(D) R/4

Question 6.

A charged particle gains a speed of 10^6 ms $^{-1}$, when accelerated from rest through a potential difference 10 kV. It enters a region of magnetic field of 0·4 T such that □□ ⊥□□ . The radius of circular path described by it is :

[1 Marks]

(A) 10 cm

(B) 2·5 cm

(C) 8 cm

(D) 5 cm

Question 7.

A current of (10/**π)** is maintained in a circular loop of radius 14 cm. The value of dipole moment associated with the loop is :

[1 Marks]

(A) 0·14 Am²

(B) 0·019 Am²

(C) 0·196 Am^2

(D) 0·615 Am^2

Question 8.

The magnetic flux linked with a coil changes with time t as **φ**= (8t^2 + 5t + 7), where t is in seconds and **φ** is in Wb. The value of emf induced in the coil at t = 4 s is :

[1 Marks]

(A) 64 V

(B) 37 V

(C) 32 V

(D) 69 V

Question 9.

Which of the following rays coming from the Sun plays an important role in maintaining the Earth's warmth?

[1 Marks]

(A) Infrared rays

(B) Visible light rays

(C) UV rays

(D) γ rays

Question 10.

The dimensions of $(\mu\varepsilon)^{-1}$, where **ε** is permittivity and is permeability of a medium, are :

[1 Marks]

(A) $[M^0 L^1 T^{-1}]$

(B) $[M^1 L^{-1} T^1]$

(C) $[M^1 L^2 T^{-2}]$

(D) $[M^0 L^2 T^{-2}]$

Question 11.

Which of the following electromagnetic waves has photons of largest momentum ?

[1 Marks]

(A) X-rays

(B) TV waves

(C) AM radio waves

(D) Microwaves

Question 12.

A compound microscope has an objective and an eyepiece of focal lengths f_0 and f_e respectively. To obtain a large magnification of a small object, the microscope should have:

[1 Marks]

(A) f_0 and f_e large, and $f_e > f_0$

(B) f_0 and f_e large, and $f_0 > f_e$

(C) f_0 and f_e small, and $f_e > f_0$

(D) f_0 and fe small, and $f_0 > f_e$

Question 13.

Two coherent light waves, each having amplitude 'a' , superpose to produce an interference pattern on a screen. The intensity of light as seen on the screen varies between :

[1 Marks]

(A) 0 and $2a^2$

(B) 0 and $4a^2$

(C) $2a^2$ and $4a^2$

(D) a^2 and $2a^2$

Question 14.

The kinetic energy of an alpha particle is four times the kinetic energy of a proton. The ratio (**λa/λp)** of de Broglie wavelengths associated with them will be :

[1 Marks]

(A) 1/2

(B) 1/16

(C) 1/8

(D) 1/4

Question 15.

Assertion (A) : The impurities in p-type Si are not pentavalent atoms. Reason (R) : The hole density in valance band in p-type semiconductor is almost equal to the acceptor density.

[1 Marks]

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

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

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

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

Question 16.

Assertion (A) : During formation of a nucleus, the mass defect produced is the source of the binding energy of the nucleus.

Reason (R) : For all nuclei, the value of binding energy per nucleon increases with mass number.

[1 Marks]

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

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

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

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

Question 17.

Assertion (A) : The Balmer series in hydrogen atom spectrum is formed when the electron jumps from higher energy state to the ground state.

Reason (R) : In Bohr's model of hydrogen atom, the electron can jump between successive orbits only.

[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 the Assertion (A).

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

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

Question 18.

Assertion (A) : In Rutherford's alpha particle scattering experiment, the presence of only few alpha particles at angle of scattering led him to the discovery of nucleus.

Reason (R) : The size of nucleus is approximately 10 5 times the size of an atom and therefore only few alpha particles are rebounded.

[1 Marks]

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

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

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

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

Section C

Question 19. The threshold frequency for a given metal is 3.6×10^{14} Hz. If monochromatic radiations of frequency 6.8×10^{14} Hz are incident on this metal, find the cut-off potential for the photoelectrons.

[2 Marks]

Question 20.

A point object is placed in air at a distance R/3 in front of a convex surface of radius of curvature R, separating air from a medium of refractive index n (< 4). Find the nature and position of the image formed.

[2 Marks]

Question 21. A voltmeter of resistance 1000 Ω can measure up to 25 V. How will you convert it so that it can read up to 250 V?

[2 Marks]

Question 22. The resistance of a wire at 25°C is 10.0 Ω. When heated to 125°C, its resistance becomes 10.5 Ω. Find (i) the temperature coefficient of resistance of the wire, and (ii) the resistance of the wire at 425°C.

[2 Marks]

Question 23.

In Young's double slit experimental set-up, the intensity of the central maximum is I_0. Calculate the intensity at a point where the path difference between two interfering waves is λ/3.

[2 Marks]

Question 24.

When a neutron collides with $^{235}_{92}U$, the nucleus gives $^{140}_{54}Xe$ and $^{94}_{38}Sr$ as fission products and two neutrons are ejected. Calculate the mass defect and the energy released (in MeV) in the process. Given:

m ($^{235}_{92}U$) = 235·04393 u, m ($^{140}_{54}Xe$) = 139·92164 u

m ($^{94}_{38}Sr$) = 93·91536 u, $^{1}_{0}n$= 1·00866 u

1 u = 931 MeV/c^2

[2 Marks]

Section D

Question 25.

(a) Draw the energy-band diagrams for conductors, semiconductors and insulators at T = 0 K. How is an electron-hole pair formed in a semiconductor at room temperature?

(b) Carbon and silicon both, are members of the IV group of the periodic table and have the same lattice structure. Carbon is an insulator whereas silicon is a semiconductor. Explain.

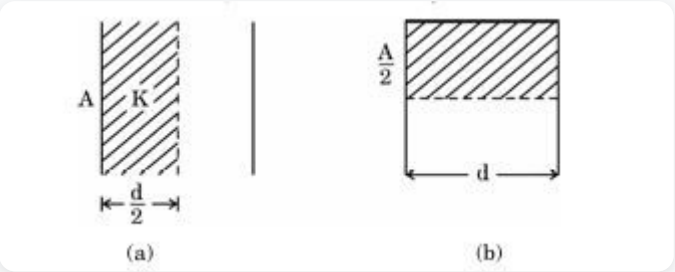
[3 Marks]

Question 26.

A parallel plate capacitor has plate area A and plate separation d. Half of the space between the plates is filled with a material of dielectric constant K in two ways as shown in the figure.

Find the values of the capacitance of the capacitors in the two cases.

[3 Marks]



Question 27.

In Young's double slit experiment, the separation between the two slits is 1·0 mm and the screen is 1·0 m away from the slits. A beam of light consisting of two wavelengths 500 nm and 600 nm is used to obtain interference fringes. Calculate :

(i) the distance between the first maxima for the two wavelengths.

(ii) the least distance from the central maximum, where the bright fringes due to both wavelengths coincide.

[3 Marks]

Question 28. Differentiate between half-wave and full-wave rectification. With the help of a circuit diagram, explain the working of a full-wave rectifier.

[3 Marks]

Question 29.

An electron of mass m and charge -e is revolving anticlockwise around the nucleus of an atom.

(a) Obtain the expression for the magnetic dipole moment (μ) of the atom.

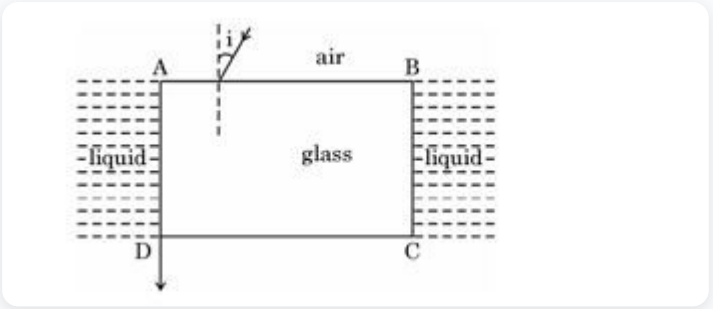
(b) If □□ is the angular momentum of electron, show that □□=-(e/2m) □□.

[3 Marks]

Question 30.

A rectangular glass slab ABCD (refractive index 1·5) is surrounded by a transparent liquid (refractive index 1·25) as shown in the figure. A ray of light is incident on face AB at an angle i such that it is refracted out grazing the face AD. Find the value of angle i.

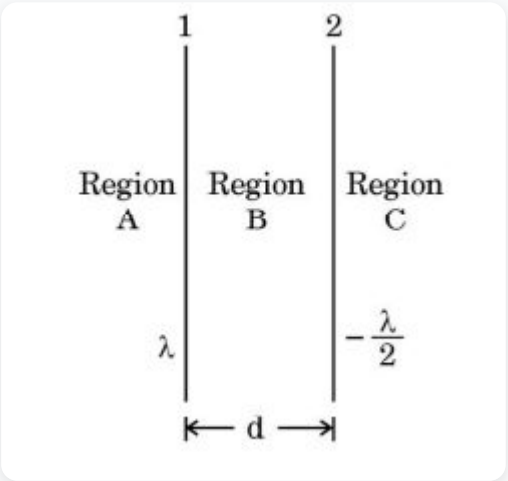
[3 Marks]



Question 31.

Two infinitely long straight wires '1' and '2' are placed d distance apart, parallel to each other, as shown in the figure. They are uniformly charged having charge densities λ and -λ/2 respectively. Locate the position of the point from wire '1' at which the net electric field is zero and identify the region in which it lies.

[3 Marks]



Question 32.

Two small solid metal balls A and B of radii R and 2R having charge densities 2σ and 3σ respectively are kept far apart. Find the charge densities on A and B after they are connected by a conducting wire.

[3 Marks]

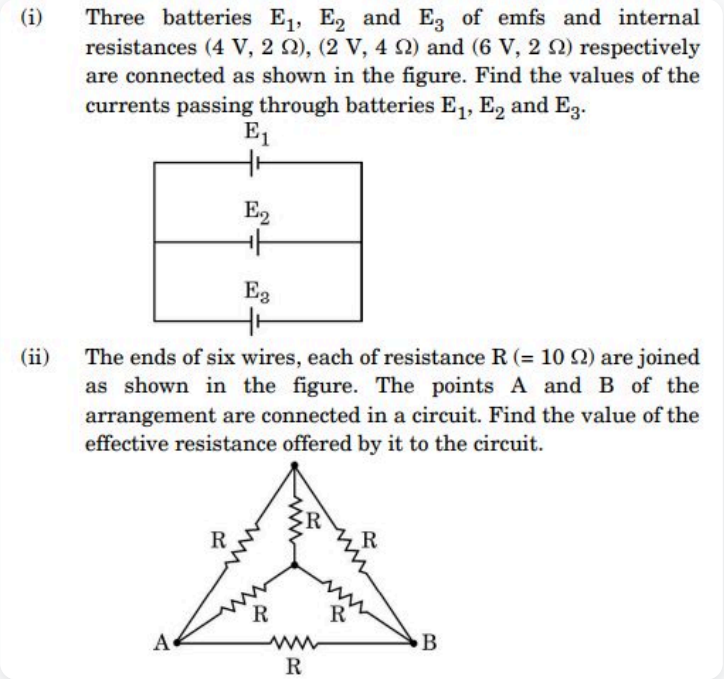
Section E

Question 33.

(i)Three batteries E_1, E_2 and E_3 of emfs and internal resistances (4 V, 2**Ω**), (2 V, 4**Ω**) and (6 V, 2**Ω**) respectively are connected as shown in the figure. Find the values of the currents passing through batteries E_1, E_2 and E_3.

(ii) The ends of six wires, each of resistance R (= 10) are joined as shown in the figure. The points A and B of the arrangement are connected in a circuit. Find the value of the effective resistance offered by it to the circuit.

[5 Marks]



Question 34.

(i) Current I (= 1A) is passing through a copper rod (n = 8·5 *10^{28} m^{-3}) of varying cross-sections as shown in the figure. The areas of cross-section at points A and B along its length are 1·0 10^{-7} m^2 and 2·0 10^{-7} m^2 respectively. Calculate :

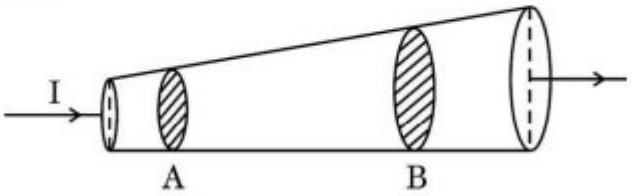
(I) the ratio of electric fields at points A and B.

(II) the drift velocity of free electrons at point B.

(ii) Two-point charges q_1 (= 16 **μ**C) and q_2 (= 1 **μ**C) are placed at points □□$_1$ = (3 m) $\hat{i}$ and □□$_2$ = (4 m) $\hat{j}$. Find the net electric field □□ at point □□$_1$ = (3 m) $\hat{i}$+(4 m) $\hat{j}$.

[5 Marks]

(i) Current I (= 1 A) is passing through a copper rod ($n = 8{\cdot}5 \times 10^{28}\ m^{-3}$) of varying cross-sections as shown in the figure. The areas of cross-section at points A and B along its length are $1{\cdot}0 \times 10^{-7}\ m^2$ and $2{\cdot}0 \times 10^{-7}\ m^2$ respectively. Calculate :



(I) the ratio of electric fields at points A and B.

(II) the drift velocity of free electrons at point B.

Question 35.

(i) Define self-inductance of a coil. Derive the expression for the energy required to build up a current I in a coil of self-inductance L.

(ii) The currents passing through two inductors of self-inductances 10 mH and 20 mH increase with time at the same rate.

Draw graphs showing the variation of :

(I) the magnitude of emf induced with the rate of change of current in each inductor.

(II) the energy stored in each inductor with the current flowing through it.

[5 Marks]

Question 36.

(i) Define the term mutual inductance. Deduce the expression for the mutual inductance of two long coaxial solenoids of the same length having different radii and different number of turns.

(ii) The current through an inductor is uniformly increased from zero to 2 A in 40 s. An emf of 5 mV is induced during this period. Find the flux linked with the inductor at t = 10 s.

[5 Marks]

Question 37.

(i) Draw a ray diagram of a reflecting telescope (Cassegrain) and explain the formation of image. State two important advantages that a reflecting telescope has over a refracting telescope.

(ii) In a refracting telescope, the focal length of the objective is 50 times the focal length of the eyepiece. When the final image is formed at infinity, the length of the tube is 102 cm. Find the focal lengths of the two lenses.

[5 Marks]

Question 38.

(i) Write any two advantages of a compound microscope over a simple microscope. Draw a ray diagram for the image formation at the near point by a compound microscope and explain it.

(ii) A thin planoconcave lens with its curved face of radius of curvature R is made of glass of refractive index n_1. It is placed coaxially in contact with a thin equiconvex lens of same radius of curvature of refractive index n_2. Obtain the power of the combination lens.

[5 Marks]