ROLL NUMBER					

CODE NUMBER	042/1/1
SET NUMBER	1

INDIAN SCHOOL MUSCAT
FIRST PRE BOARD EXAMINATION 2023
PHYSICS(042)

CLASS : XII
DATE: 10-12-2023

TIME ALLOTED : 3 HRS.
MAXIMUM MARKS: 70

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) All the sections are compulsory.

(4) **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.

(5) 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 case based question in Section D and all three questions in Section E. You have to attempt only one of the choices in such questions.

(6) Use of calculators is not allowed.

(7) You may use the following values of physical constants where ever necessary

i. $c = 3 \times 10^8$ m/s

ii. $m_e = 9.1 \times 10^{-31}$ kg

iii. $e = 1.6 \times 10^{-19}$ C

iv. $\mu_0 = 4\pi \times 10^{-7}$ TmA^{-1}

v. $h = 6.63 \times 10^{-34}$ Js

vi. $\varepsilon_0 = 8.854 \times 10^{-12}$ $C^2N^{-1}m^{-2}$

vii. Avogadro's number = 6.023×10^{23} per gram mole

SECTION A

1. Equipotential surface associated with an electric field, which is increasing in magnitude along the X -direction are 1

(a) plane parallel to YZ plane

(b) plane parallel to XZ plane

(c) plane parallel to XY plane

(d) coaxial cylinder of increasing radii around the X axis

2. The charges on two spheres are $+7\mu C$ and $-5\mu C$ respectively. They experience a force F. If each of them is given an additional charge of $-2\mu C$, the new force of attraction will be 1

(a) F (b) F/2 (c) $F/\sqrt{3}$ (d) 2F

3. The slope of graph drawn between stopping potential and frequency of incident light for a given surface will be 1

(a) h (b) h/e (c) eh (d) e

4. The ratio of the energies of the hydrogen atom in its first to second excited states is 1

(a) 1/4 (b) 4/9 (c) 9/4 (d) 4

5. A very high magnetic field is applied to a stationary charge. Then the charge experiences 1

(a) a force in the direction of magnetic field

(b) no force

(c) a force perpendicular to the magnetic field

(d) a force in an arbitrary direction

6. The relative magnetic permeability of a substance X is slightly less than unity and that of substance Y is slightly more than unity, then 1

(a) X is paramagnetic and Y is ferromagnetic

(b) X is diamagnetic and Y is ferromagnetic

(c) X and Y both are paramagnetic

(d) X is diamagnetic and Y is paramagnetic

7. A circular coil of radius 4 cm and 20 turns carries a current of 3 amperes. It is placed in a magnetic field of intensity of 0.5 Wbm^{-2}. The magnetic dipole moment of the coil is 1

(a)0.15 Am^2

(b) 0.6 Am^2

(c) 0.45 Am^2

(d) 0.3 Am^2

8. A long solenoid carrying a current produces a magnetic field B along its axis. If the current is doubled and the number of turns per cm is doubled, then new value of the magnetic field is 1

(a) 2B (b) 4B (c) B (d) B^2

9. In an ac circuit, voltage V and current I are given by 1

V = 100 sin 100 t volt

I = 100 sin (100t + π/3) mA

The power dissipated in the circuit is

(a) 104W (b) 10 W (c) 2.5 W (d) 5 W.

10. The ratio of amplitude of magnetic field to the amplitude of electric field for an electromagnetic wave propagating in vacuum is equal to 1

(a) the speed of light in vacuum

(b) reciprocal of speed of light in vacuum

(c) the ratio of magnetic permeability to the electric susceptibility of vacuum

(d) unity

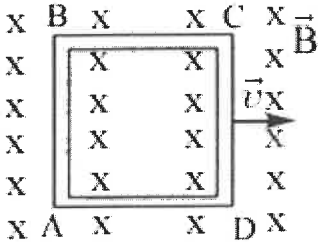
11. A conducting square loop of side L and resistance R moves in its plane with a uniform velocity v perpendicular to one of its sides. A magnetic induction B constant in time and space, pointing perpendicular and into the plane of the loop exists everywhere. The current induced in the loop is 1

(a) Blv/R clockwise

(b) Blv/R anticlockwise

(c) 2Blv/R anticlockwise

(d) Zero



12. The radius of the innermost electron orbit of a hydrogen atom is 5.3×10^{-11} m. The radius of n =3 orbit is 1

(a)1.01×10^{-10}m

(b)1.59×10^{-10}m

(c)2.12×10^{-10}m

(d)4.77×10^{-10}m

For Questions 13 to 16, two statements are given –one labelled Assertion (A) and other labelled Reason (R). Select the correct answer to these questions from the options as given below.

a) If both Assertion and Reason are true and Reason is correct explanation of Assertion.

b) If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

c) If Assertion is true but Reason is false.

d) If both Assertion and Reason are false.

13. Assertion(A): Photoelectric effect demonstrates the wave nature of light. 1
Reason(R): The number of photoelectrons is proportional to the frequency of light.

14. Assertion(A): The electrical conductivity of a semiconductor increases on doping. 1
Reason(R): Doping always increases the number of electrons in the semiconductor.

15. Assertion(A): The interior of a conductor can have no excess charge in the static situation 1
Reason(R): Electrostatic potential is constant throughout the volume of the conductor and has the same value (as inside) on its surface.

16. Assertion (A): Propagation of light through an optical fibre is due to total internal reflection taking place at the core-cladding interface. 1
Reason (R): Refractive index of the material of the cladding of the optical fibre is greater than that of the core.

SECTION B

17. (a)Draw a labelled circuit diagram of a junction diode as a full wave rectifier 2
(b) Name the two important processes that occur during the formation of a p-n junction.

18. (a)Name the phenomenon which shows the quantum nature of electromagnetic radiation. 2
(b)The stopping potential in an experiment is 1.5 V. What is the maximum K.E. of photoelectrons emitted?

19. A double convex lens is made of a glass of refractive index 1.55, with both faces of the same radius of curvature. Find the radius of curvature required, if the focal length is 20 cm. 2

20. A copper wire of radius 0.1mm and resistance 1 k Ω is connected across a power supply of 20V. (a) How many electrons are transferred per second between the supply and the wire at one end? (b) Calculate the current density in the wire. 2

21. Draw a labelled ray diagram for the formation of image by a compound microscope in normal adjustment. 2

OR

(a)Write any two necessary conditions to obtain sustained interference fringes.

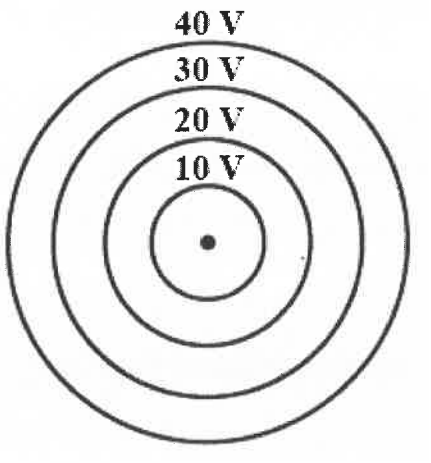
(b) In the Young's double slit experiment, how does the fringe width get affected if the entire experimental apparatus is immersed in water?

SECTION C

22. (a)Draw a plot of binding energy per nucleon (B.E/A) as a function of mass number A. 3

(b)Use this graph to explain the release of energy in both the processes of nuclear fission and fusion.

23. (a)Concentric equipotential surfaces due to a charged body placed at the centres are shown. 3
Identify the polarity of the charge and draw the electric field lines due to it.



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

(i)Is there a point on the line joining them at which the electric field is zero? Justify your answers.

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

24. (a)What is Impact parameter? 3

(b)What is the significance of impact parameter?

(c)State Bohr postulate of hydrogen atom that gives the relationship for the frequency of emitted photon in emission lines of hydrogen spectrum.

25. On the basis of electron drift, derive an expression for resistivity of a conductor in terms of number density of free electrons and relaxation time. On what factors does resistivity of a conductor depend? 3

26. Derive an expression for the force experienced by a current carrying straight conductor placed in a magnetic field. Under what condition is this force maximum? 3

27. (a)Why are microwaves found useful for the radar systems in aircraft navigation? 3

(b)Name the radiations which are next to infrared radiations in the electromagnetic spectrum having (i) shorter wavelength (ii) longer wavelength.

(c) Write the expression for speed of electromagnetic waves in a medium of electrical permittivity ε and magnetic permeability μ.

28. (a)Define mutual inductance and write its SI unit. 3

(b)Two circular loops, one of small radius r and other of larger radius R, such that R >> r, are placed coaxially with centres coinciding. Obtain the mutual inductance of the arrangement.

OR

Two long straight parallel current carrying conductors are kept 'a' distant apart in air. The direction of current in both the conductors is same. Find the magnitude of force per unit length and direction of the force between them. Hence define one ampere.

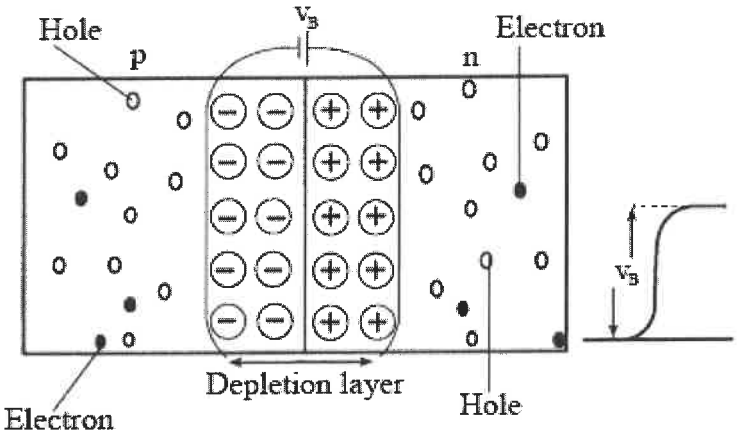
SECTION D
Case Study Based Questions

29. Read the following paragraph and answer the questions that follow. 4

Motions Of the Majority Carriers

A p-n junction is a single semiconductor crystal that has been selectively doped so that one region is n-type material and the adjacent region is p-type material.

If you burst a helium-filled balloon. helium atoms will diffuse (spread) outward into the surrounding air. This happens because there are very few helium atoms in normal air. In more formal language, there is a helium density gradient at the balloon-air interface (the number density of helium atoms varies across the interface); the helium atoms move so as to reduce the gradient. In the same way. electrons on the n- side of that are close to the junction plane tend to diffuse across it (from right to left in the figure) and into the side. where there are very few free electrons. Similarly, holes on the p side that are close to the junction plane tend to diffuse across that plane (from left to right) and into then side, where there are very few holes. The motions of both the electrons and the holes contribute to a diffusion current.



(i)Germanium is doped with which of the following to obtain p-type semiconductor?

(a)Phosphorus (b)Gallium (c) Silicon (d)Bismuth

(ii)In an unbiased p-n junction, holes diffuse from the p-region to n-region because

(a)free electrons in the n-region attract them.

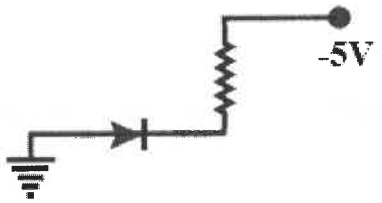
(b) they move across the junction by the potential difference.

(c)hole concentration in p-region is more as compared to n-region.

(d)All the above.

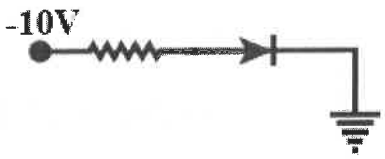
(iii)Which is reverse biased diode?

(a)

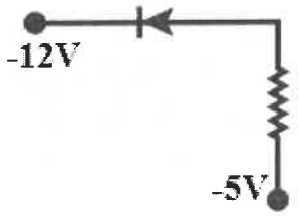


(b)

(c)



(d)



(iv) The cut-in voltage for silicon diode is approximately

(a) 0.2 V (b) 0.7 V (c) 1.1 V (d) 1.4 V

OR

The dominant mechanisms for the motion of charge carriers in forward and reverse biased germanium p-n junctions are

(a)diffusion in both forward and reverse bias

(b)diffusion in forward bias and drift in reverse bias

(c)drift in forward bias and diffusion in reverse bias

(d)drift in both forward and reverse bias

30. Read the following paragraph and answer the questions that follow. 4

Total Internal Reflection(TIR)

Total internal reflection will not take place unless the incident light is traveling within the more optically denser medium towards the less optically denser medium. TIR will happen for light traveling from water towards air, but it will not happen for light traveling from air towards water. TIR would happen for light traveling from water towards air, but it will not happen for light traveling from water (n=1.333) towards crown glass (n=1.52). TIR occurs because the angle of refraction reaches a 90-degree angle before the angle of incidence reaches a 90-degree angle. The only way for the angle of refraction to be greater than the angle of incidence is for light to bend away from the normal. Since light only bends away from the normal when passing from a denser medium into a rarer medium, then this would be a necessary condition for total internal reflection.

Prisms designed to bend light by 90° or by 180° make use of total internal reflection. Such a prism is also used to invert images without changing their size.

(i) The speed of light in a medium whose critical angle is 30° is

(a)3×10^8 m/s (b) 2×10^8 m/s (c) 1.5×10^8 m/s (d) 2.5×10^8m/s

(ii) The necessary conditions for total internal reflection is

(a) the angle of incidence in denser medium must be smaller than the critical angle for two media

(b) the angle of refraction in denser medium must be greater than the critical angle for two media

(c) the angle of incidence in denser medium must be greater than the critical angle for two media

(d) the angle of refraction in denser medium must be smaller than the critical angle for two media

(iii)Which of the following is true if the refractive index of inner core and outer cladding of an optical fibre is n_1 and n_2 respectively?

(a)$n_1 > n_2$

(b)$n_1 = n_2$

(c)$n_1 < n_2$

(d)$n_1 << n_2$

(iv)You are given four sources of light each one providing a light of a single colour red, blue, green and yellow. Suppose the angle of refraction for a beam of yellow light corresponding to a particular angle of incidence at the interface of two media is 90^0. Which of the following statements is correct, if the source of yellow light is replaced with that of other lights without changing the angle of incidence?

(a) The beam of red light would undergo total internal reflection.

(b) The beam of red light would bend towards normal while it gets refracted through the second medium.

(c) The beam of blue light would undergo total internal reflection.

(d) The beam of green light would bend away from the normal as it gets refracted through the second medium.

OR

The main requirement in fabricating optical fibres is that .....

(a)there should be very little absorption of light as it travels for long distances inside them

(b)they should be fabricated with low quality composite glass fibres.

(c)Light reflected at one side of inner surface strikes the other at an angle smaller than the critical angle.

(d)Light does not undergo repeated total internal reflections along the fibre and finally comes out at the other end.

SECTION E

31. (a)Draw a ray diagram to show the refraction of light through a triangular glass prism. 5

(b)Draw a graph to show the variation of angle of deviation δ with the angle of incidence *i* for a monochromatic ray of light passing through a prism of refracting angle A.

(c)Hence derive the relation for the refractive index μ in terms of angle of prism A and angle of minimum deviation δ_m.

OR

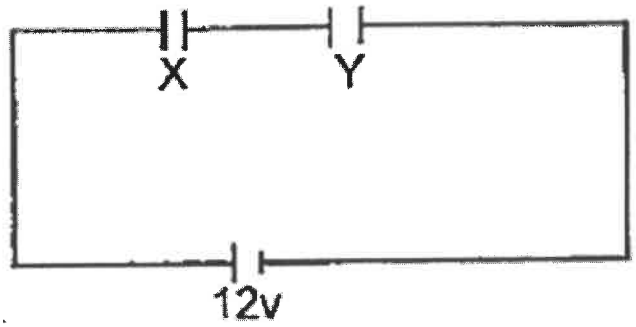
(a)With the help of a ray diagram, show the formation of image of a point object due to refraction of light at a spherical surface separating two media of refractive indices n_1 and n_2 ($n_2 > n_1$) respectively. Using this diagram, derive the relation $n_2/v - n_1/u = (n_2-n_1)/R$.

(b)Write the sign conventions used.

(c)What happens to the focal length of convex lens when it is immersed in water?

32. (a) What is a capacitor? Derive an expression for the capacitance of a parallel plate capacitor, whose plates are separated by a medium. 5

(b)Two parallel plate capacitors X and Y, have the same area of plates and same separation between them. X has air between the plates while Y contains a dielectric medium of K = 4.



(i) Calculate capacitance of each capacitor if equivalent capacitance of the combination is 4μF.

(ii) Calculate the potential difference between the plates of X and Y.

OR

(a)Derive an expression for the electric potential at a point along the axial line of an electric dipole.

(b) Define the term 'dielectric strength'.

(c)In a parallel plate capacitor with air between the plates, each plate has an area of 5×10^{-3} m^2 and the separation between the plates is 2.5 mm.

(i) Calculate the capacitance of the capacitor.

(ii) If this capacitor is connected to 100 V supply, what would be the charge on each plate?

33. (a)State the condition for resonance to occur in series LCR ac circuit and derive an expression for resonant frequency. 5

(b)Plot a graph showing the variation of electric current with frequency in a series LCR circuit.

(c) Define quality factor.

OR

(a)Draw a schematic diagram of a step-up transformer. State its working principle.

(b)Derive the expression for the secondary to primary voltage in terms of the number of turns in the two coils.

(c) How is the transformer used in large scale transmission and distribution of electrical energy over long distances?

******END OF THE QUESTION PAPER******

ROLL NUMBER				

CODE NUMBER	042/1/2
SET NUMBER	2

INDIAN SCHOOL MUSCAT
FIRST PRE BOARD EXAMINATION 2023
PHYSICS(042)

CLASS : XII
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i. $c = 3 \times 10^8$ m/s

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vi. $\varepsilon_0 = 8.854 \times 10^{-12}$ $C^2N^{-1}m^{-2}$

vii. Avogadro's number = 6.023×10^{23} per gram mole

SECTION A

1. In an ac circuit, voltage V and current I are given by 1

V = 100 sin 100 t volt

I = 100 sin (100t + $\pi/3$) mA

The power dissipated in the circuit is

(a) 104W (b) 10 W (c) 2.5 W (d) 5 W.

2. A long solenoid carrying a current produces a magnetic field B along its axis. If the current is doubled and the number of turns per cm is doubled, then new value of the magnetic field is 1

(a) 2B (b) 4B (c) B (d) B^2

3. The ratio of amplitude of magnetic field to the amplitude of electric field for an electromagnetic wave propagating in vacuum is equal to 1

(a) the speed of light in vacuum

(b) reciprocal of speed of light in vacuum

(c) the ratio of magnetic permeability to the electric susceptibility of vacuum

(d) unity

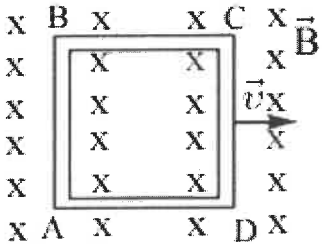
4. A conducting square loop of side L and resistance R moves in its plane with a uniform velocity v perpendicular to one of its sides. A magnetic induction B constant in time and space, pointing perpendicular and into the plane of the loop exists everywhere. The current induced in the loop is 1

(a) Blv/R clockwise

(b) Blv/R anticlockwise

(c) 2Blv/R anticlockwise

(d) Zero



5. The radius of the innermost electron orbit of a hydrogen atom is 5.3×10^{-11} m. The radius of n =3 orbit is 1

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7. A very high magnetic field is applied to a stationary charge. Then the charge experiences 1

(a) a force in the direction of magnetic field

(b) no force

(c) a force perpendicular to the magnetic field

(d) a force in an arbitrary direction

8. Equipotential surface associated with an electric field, which is increasing in magnitude along the X -direction are 1

(a) plane parallel to YZ plane

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(a) F (b) F/2 (c) $F/\sqrt{3}$ (d) 2F

10. The slope of graph drawn between stopping potential and frequency of incident light for a given surface will be 1

(a) h (b) h/e (c) eh (d) e

11. The relative magnetic permeability of a substance X is slightly less than unity and that of substance Y is slightly more than unity, then 1

(a) X is paramagnetic and Y is ferromagnetic

(b) X is diamagnetic and Y is ferromagnetic

(c) X and Y both are paramagnetic

(d) X is diamagnetic and Y is paramagnetic

12. A circular coil of radius 4 cm and 20 turns carries a current of 3 amperes. It is placed in a magnetic field of intensity of 0.5 Wbm^{-2}. The magnetic dipole moment of the coil is 1

(a)0.15 Am^2

(b) 0.6 Am^2

(c) 0.45 Am^2

(d) 0.3 Am^2

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b) If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

c) If Assertion is true but Reason is false.

d) If both Assertion and Reason are false.

13. Assertion(A): The interior of a conductor can have no excess charge in the static situation 1
Reason(R): Electrostatic potential is constant throughout the volume of the conductor and has the same value (as inside) on its surface.

14. Assertion (A): Propagation of light through an optical fibre is due to total internal reflection taking place at the core-cladding interface. 1
Reason (R): Refractive index of the material of the cladding of the optical fibre is greater than that of the core.

15. Assertion(A): Photoelectric effect demonstrates the wave nature of light. 1
Reason(R): The number of photoelectrons is proportional to the frequency of light.

16. Assertion(A): The electrical conductivity of a semiconductor increases on doping. 1
Reason(R): Doping always increases the number of electrons in the semiconductor.

SECTION B

17. A beam of monochromatic radiation is incident on a photosensitive surface. Answer the following questions giving reasons 2
(a) Does the kinetic energy of the emitted electrons depend on the intensity of incident radiation?
(b) On what factors does the number of emitted photoelectrons depend?

18. A double convex lens is made of a glass of refractive index 1.55, with both faces of the same radius of curvature. Find the radius of curvature required, if the focal length is 20 cm. 2

19. (a)Draw a labelled circuit diagram of a junction diode as a full wave rectifier 2
(b) Name the two important processes that occur during the formation of a p-n junction.

20. Draw a labelled ray diagram to show the image formation by an astronomical telescope in normal adjustment. 2

OR

Derive Snell's law on the basis of Huygen's wave theory when light is travelling from a denser to a rarer medium

21. A copper wire of radius 0.1mm and resistance 1 k Ω is connected across a power supply of 20V. (a) How many electrons are transferred per second between the supply and the wire at one end? (b) Calculate the current density in the wire. 2

SECTION C

22. (a)Draw a plot of potential energy of a pair of nucleons as a function of their separations. 3

(b)Write two important conclusions that can be drawn from the graph.

(c)What is the significance of negative potential energy in the graph drawn?

23. Derive an expression for the force experienced by a current carrying straight conductor placed in a magnetic field. Under what condition is this force maximum? 3

24. (a)State Bohr's quantization condition for defining stationary orbits 3

(b)The K. E. of alpha-particle incident on gold foil is doubled. How does the distance of closest approach change?

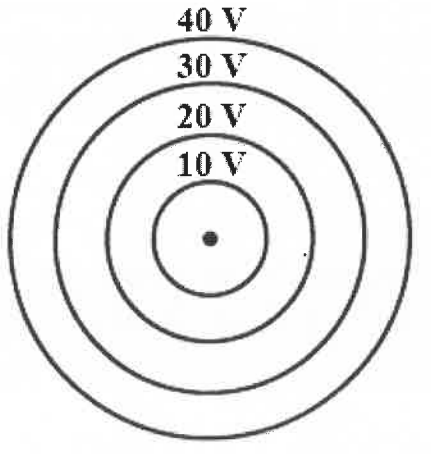
(c)Write two important limitations of Rutherford nuclear model of the atom.

25. (a)Derive Ohm's law using the concept of drift velocity. 3

(b)How does the electron mobility change if

(i) temperature is increased, (ii) potential difference is doubled?

26. (a)Concentric equipotential surfaces due to a charged body placed at the centres are shown. Identify the polarity of the charge and draw the electric field lines due to it. 3



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

(i)Is there a point on the line joining them at which the electric field is zero? Justify your answers.

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

27. (a)How are infrared rays produced? Why are these referred to as "heat waves? 3

(b)What is meant by displacement current? Write the expression for displacement current in terms of the rate of change of electric flux.

28. (a)Define self inductance and write its SI unit. 3

(b)Derive the expression for the self-inductance of a long solenoid of cross-sectional area A, length *l*, and having 'n' turns per unit length.

OR

Using Biot-Savart law, derive the expression for the magnetic field at a point (x) on the axis of a circular current carrying loop of radius R. How is the direction of the magnetic field determined at this point?

SECTION D

Case Study Based Questions

29. Read the following paragraph and answer the questions that follow. 4

Total Internal Reflection(TIR)

Total internal reflection will not take place unless the incident light is traveling within the more optically dense medium towards the less optically dense medium. TIR will happen for light traveling from water towards air, but it will not happen for light traveling from air towards water. TIR would happen for light traveling from water towards air, but it will not happen for light traveling from water (n=1.333) towards crown glass (n=1.52). TIR occurs because the angle of refraction reaches a 90-degree angle before the angle of incidence reaches a 90-degree angle. The only way for the angle of refraction to be greater than the angle of incidence is for light to bend away from the normal. Since light only bends away from the normal when passing from a denser medium into a rarer medium, then this would be a necessary condition for total internal reflection.

Prisms designed to bend light by 90° or by 180° make use of total internal reflection. Such a prism is also used to invert images without changing their size.

(i) The speed of light in a medium whose critical angle is 30° is

(a)3×10^8 m/s (b) 2×10^8 m/s (c) 1.5×10^8 m/s (d) 2.5×10^8m/s

(ii) The necessary conditions for total internal reflection is

(a) the angle of incidence in denser medium must be smaller than the critical angle for two media

(b) the angle of refraction in denser medium must be greater than the critical angle for two media

(c) the angle of incidence in denser medium must be greater than the critical angle for two media

(d) the angle of refraction in denser medium must be smaller than the critical angle for two media

(iii)Which of the following is true if the refractive index of inner core and outer cladding of an optical fibre is n_1 and n_2 respectively?

(a)$n_1 > n_2$

(b)$n_1 = n_2$

(c)$n_1 < n_2$

(d)$n_1 << n_2$

(iv)You are given four sources of light each one providing a light of a single colour red, blue, green and yellow. Suppose the angle of refraction for a beam of yellow light corresponding to a particular angle of incidence at the interface of two media is 90^0. Which of the following statements is correct, if the source of yellow light is replaced with that of other lights without changing the angle of incidence?

(a) The beam of red light would undergo total internal reflection.

(b) The beam of red light would bend towards normal while it gets refracted through the second medium.

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OR

The main requirement in fabricating optical fibres is that .....

(a)there should be very little absorption of light as it travels for long distances inside them

(b)they should be fabricated with low quality composite glass fibres.

(c)Light reflected at one side of inner surface strikes the other at an angle smaller than the critical angle.

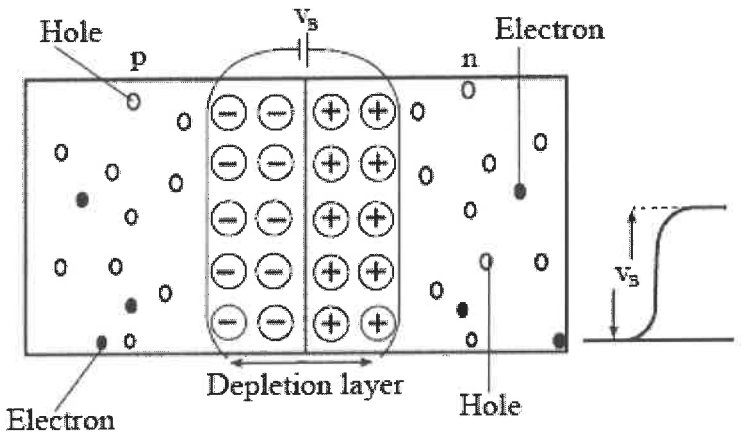
(d)Light does not undergo repeated total internal reflections along the fibre and finally comes out at the other end.

30. Read the following paragraph and answer the questions that follow. 4

Motions Of the Majority Carriers

A p-n junction is a single semiconductor crystal that has been selectively doped so that one region is n-type material and the adjacent region is p-type material.

If you burst a helium-filled balloon. helium atoms will diffuse (spread) outward into the surrounding air. This happens because there are very few helium atoms in normal air. In more formal language, there is a helium density gradient at the balloon-air interface (the number density of helium atoms varies across the interface); the helium atoms move so as to reduce the gradient. In the same way. electrons on the n- side of that are close to the junction plane tend to diffuse across it (from right to left in the figure) and into the side. where there are very few free electrons. Similarly, holes on the p side that are close to the junction plane tend to diffuse across that plane (from left to right) and into then side, where there are very few holes. The motions of both the electrons and the holes contribute to a diffusion current.



(i)Germanium is doped with which of the following to obtain n-type semiconductor?

(a)Aluminium (b)Gallium (c) Silicon (d)Antimony

(ii) In an unbiased p-n junction, holes diffuse from the p-region to n-region because

(a)free electrons in the n-region attract them.

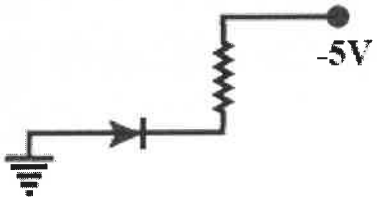
(b)they move across the junction by the potential difference.

(c)hole concentration in p-region is more as compared to n-region.

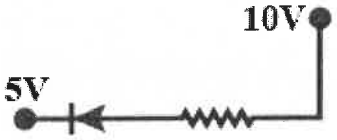
(d) All the above.

(iii)Which is reverse biased diode?

(a)



(b)



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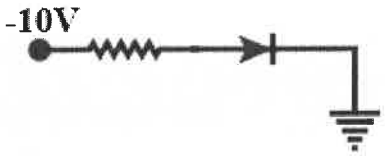
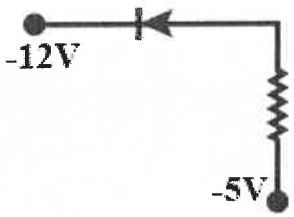


(d)



(iv) The cut-in voltage for Germanium diode is approximately

(a) 0.2 V (b) 0.7 V (c) 1.1 V (d) 1.4 V

OR

The dominant mechanisms for the motion of charge carriers in forward and reverse biased germanium p-n junctions are

(a)diffusion in both forward and reverse bias

(b)diffusion in forward bias and drift in reverse bias

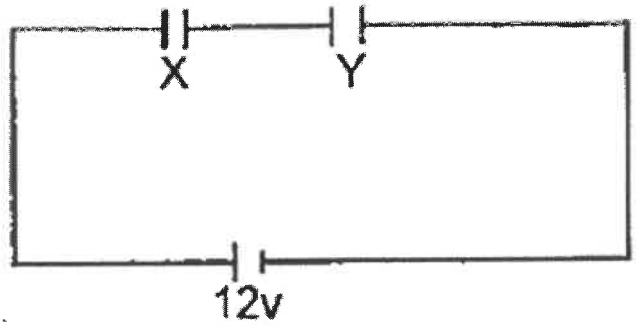
(c)drift in forward bias and diffusion in reverse bias

(d)drift in both forward and reverse bias

SECTION E

31. (a) What is a capacitor? Derive an expression for the capacitance of a parallel plate capacitor, whose plates are separated by a medium. 5

(b)Two parallel plate capacitors X and Y, have the same area of plates and same separation between them. X has air between the plates while Y contains a dielectric medium of K = 4.



(i) Calculate capacitance of each capacitor if equivalent capacitance of the combination is 4μF.

(ii) Calculate the potential difference between the plates of X and Y.

OR

(a)Derive an expression for the electric potential at a point along the axial line of an electric dipole.

(b) Define the term 'dielectric strength'.

(c)In a parallel plate capacitor with air between the plates, each plate has an area of 5×10^{-3} m^2 and the separation between the plates is 2.5 mm.

(i) Calculate the capacitance of the capacitor.

(ii) If this capacitor is connected to 100 V supply, what would be the charge on each plate?

32. (a)State the condition for resonance to occur in series LCR ac circuit and derive an expression for resonant frequency. 5

(b)Plot a graph showing the variation of electric current with frequency in a series LCR circuit.

(c) Define quality factor.

OR

(a)Draw a schematic diagram of a step-up transformer. State its working principle.

(b)Derive the expression for the secondary to primary voltage in terms of the number of turns in the two coils.

(c) How is the transformer used in large scale transmission and distribution of electrical energy over long distances?

33. (a)Draw a ray diagram to show the refraction of light through a triangular glass prism. 5

(b)Draw a graph to show the variation of angle of deviation δ with the angle of incidence *i* for a monochromatic ray of light passing through a prism of refracting angle A.

(c)Hence derive the relation for the refractive index μ in terms of angle of prism A and angle of minimum deviation δ_m.

OR

(a)With the help of a ray diagram, show the formation of image of a point object due to refraction of light at a spherical surface separating two media of refractive indices n_1 and n_2 ($n_2 > n_1$) respectively. Using this diagram, derive the relation $n_2/v - n_1/u = (n_2-n_1)/R$.

(b)Write the sign conventions used.

(c)What happens to the focal length of convex lens when it is immersed in water?

******END OF THE QUESTION PAPER******

ROLL NUMBER				

CODE NUMBER	042/1/3
SET NUMBER	3

INDIAN SCHOOL MUSCAT
FIRST PRE BOARD EXAMINATION 2023
PHYSICS(042)

CLASS : XII
DATE: 10-12-2023

TIME ALLOTED : 3 HRS.
MAXIMUM MARKS:70

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) All the sections are compulsory.

(4) **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.

(5) 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 case based question in Section D and all three questions in Section E. You have to attempt only one of the choices in such questions.

(6) Use of calculators is not allowed.

(7) You may use the following values of physical constants where ever necessary

i. $c = 3 \times 10^8$ m/s

ii. $m_e = 9.1 \times 10^{-31}$ kg

iii. $e = 1.6 \times 10^{-19}$ C

iv. $\mu_0 = 4\pi \times 10^{-7}$ TmA^{-1}

v. $h = 6.63 \times 10^{-34}$ Js

vi. $\varepsilon_0 = 8.854 \times 10^{-12}$ $C^2N^{-1}m^{-2}$

vii. Avogadro's number = 6.023×10^{23} per gram mole

SECTION A

1. A circular coil of radius 4 cm and of 10 turns carries a current of 3 amperes. It is placed in a magnetic field of intensity of 0.5 Wbm^{-2}. The magnetic dipole moment of the coil is 1

(a)0.15 Am^2

(b) 0.6 Am^2

(c) 0.45 Am^2

(d) 0.3 Am^2

2. A long solenoid carrying a current produces a magnetic field B along its axis. If the current is doubled and the number of turns per cm is halved, then new value of the magnetic field is 1

(a) 2B (b) 4B (c) B (d) B^2

3. In an ac circuit, voltage V and current I are given by 1

V = 100 sin 100 t volt

I = 200 sin (100t + π/3) mA

The power dissipated in the circuit is

(a) 104W (b) 10 W (c) 2.5 W (d) 5 W.

4. The ratio of amplitude of electric field to the amplitude of magnetic field for an electromagnetic wave propagating in vacuum is equal to 1

(a) the speed of light in vacuum

(b) reciprocal of speed of light in vacuum

(c) the ratio of magnetic permeability to the electric susceptibility of vacuum

(d) unity

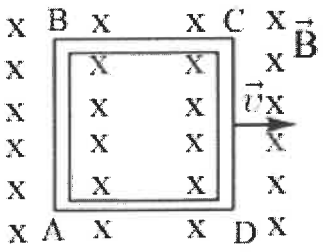
5. A conducting square loop of side L and resistance R moves in its plane with a uniform velocity v perpendicular to one of its sides. A magnetic induction B constant in time and space, pointing perpendicular and into the plane of the loop exists everywhere. The current induced in the loop is 1

(a) Blv/R clockwise

(b) Blv/R anticlockwise

(c) 2Blv/R anticlockwise

(d) Zero



6. The radius of the innermost electron orbit of a hydrogen atom is 5.3×10^{-11} m. The radius of n =2 orbit is 1

(a)1.01×10^{-10}m

(b)1.59×10^{-10}m

(c)2.12×10^{-10}m

(d)4.77×10^{-10}m

7. The potential of a charged spherical conductor of radius r is 10 V. The potential at a point r/2 from its centre is 1

(a) 20 V (b) 0 V (c) 10 V (d) 40 V

8. The charges on two spheres are +7mC and –5mC respectively. They experience a force F. If each of them is given an additional charge of –2mC, the new force of attraction will be 1

(a) F (b) F/2 (c) F/$\sqrt{3}$ (d) 2F

9. The slope of graph drawn between stopping potential and frequency of incident light for a given surface will be 1

(a) h (b) h/e (c) eh (d) e

10. The ratio of the energies of the hydrogen atom in its first to second excited states is 1

(a) 1/4 (b) 4/9 (c) 9/4 (d) 4

11. A very high magnetic field is applied to a stationary charge. Then the charge experiences 1

(a) a force in the direction of magnetic field

(b) no force

(c) a force perpendicular to the magnetic field

(d) a force in an arbitrary direction

12. The relative magnetic permeability of a substance X is slightly less than unity and that of substance Y is slightly more than unity, then 1

(a) X is paramagnetic and Y is ferromagnetic

(b) X is diamagnetic and Y is ferromagnetic

(c) X and Y both are paramagnetic

(d) X is diamagnetic and Y is paramagnetic

For Questions 13 to 16, two statements are given –one labelled Assertion (A) and other labelled Reason (R). Select the correct answer to these questions from the options as given below.

a) If both Assertion and Reason are true and Reason is correct explanation of Assertion.

b) If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

c) If Assertion is true but Reason is false.

d) If both Assertion and Reason are false.

13. Assertion (A): Propagation of light through an optical fibre is due to total internal reflection taking place at the core-cladding interface. 1

Reason (R): Refractive index of the material of the cladding of the optical fibre is greater than that of the core.

14. Assertion(A): Photoelectric effect demonstrates the wave nature of light. 1

Reason(R): The number of photoelectrons is proportional to the frequency of light.

15. Assertion(A): The electrical conductivity of a semiconductor increases on doping. 1

Reason(R): Doping always increases the number of electrons in the semiconductor.

16. Assertion(A): The interior of a conductor can have no excess charge in the static situation 1

Reason(R): Electrostatic potential is constant throughout the volume of the conductor and has the same value (as inside) on its surface.

SECTION B

17. A convex lens has 20 cm focal length in air. What is focal length in water? (Refractive index of air-water = 1.33, refractive index for air-glass = 1.5, refractive index of air = 1) 2

18. A copper wire of diameter 0.2mm and resistance 2 k Ω is connected across a power supply of 20V. (a) How many electrons are transferred per second between the supply and the wire at one end? (b) Calculate the current density in the wire. 2

19. (a)Draw a labelled circuit diagram of a junction diode as a full wave rectifier 2

(b) Name the two important processes that occur during the formation of a p-n junction.

20. Draw a labelled ray diagram of an astronomical telescope when the final image is formed at least distance of distinct vision. 2

OR

Derive Snell's law on the basis of Huygen's wave theory when light is travelling from a rarer to a denser medium.

21. (a)Plot a graph showing the variation of photoelectric current with intensity of incident radiation. 2

(b) The stopping potential in an experiment is 1.5 V. What is the maximum K.E. of photoelectrons emitted?

SECTION C

22. On the basis of electron drift, derive an expression for resistivity of a conductor in terms of number density of free electrons and relaxation time. On what factors does resistivity of a conductor depend? 3

23. Derive an expression for the force experienced by a current carrying straight conductor placed in a magnetic field. Under what condition is this force maximum? 3

24. (a)Why are microwaves found useful for the radar systems in aircraft navigation? 3
(b)Name the radiations which are next to infrared radiations in the electromagnetic spectrum having (i) shorter wavelength (ii) longer wavelength.
(c) Write the expression for speed of electromagnetic waves in a medium of electrical permittivity ε and magnetic permeability μ.

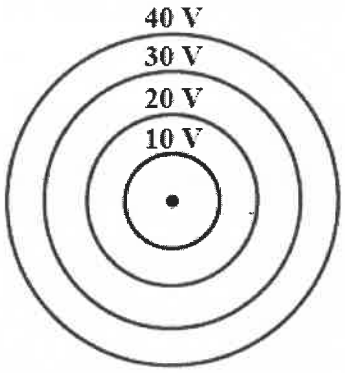
25. (a)Define mutual inductance and write its SI unit. 3
(b)Two circular loops, one of small radius r and other of larger radius R, such that R >> r, are placed coaxially with centres coinciding. Obtain the mutual inductance of the arrangement.

OR

Two long straight parallel current carrying conductors are kept 'a' distant apart in air. The direction of current in both the conductors is same. Find the magnitude of force per unit length and direction of the force between them. Hence define one ampere.

26. (a)What is Impact parameter? 3
(b)What is the significance of impact parameter?
(c)State Bohr postulate of hydrogen atom that gives the relationship for the frequency of emitted photon in emission lines of hydrogen spectrum.

27. (a)Concentric equipotential surfaces due to a charged body placed at the centres are shown. Identify the polarity of the charge and draw the electric field lines due to it. 3



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

(i)Is there a point on the line joining them at which the electric field is zero? Justify your answers.

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

28. (a)Draw a plot of binding energy per nucleon (B.E/A) as a function of mass number A. 3

(b)Use this graph to explain the release of energy in both the processes of nuclear fission and fusion.

SECTION D

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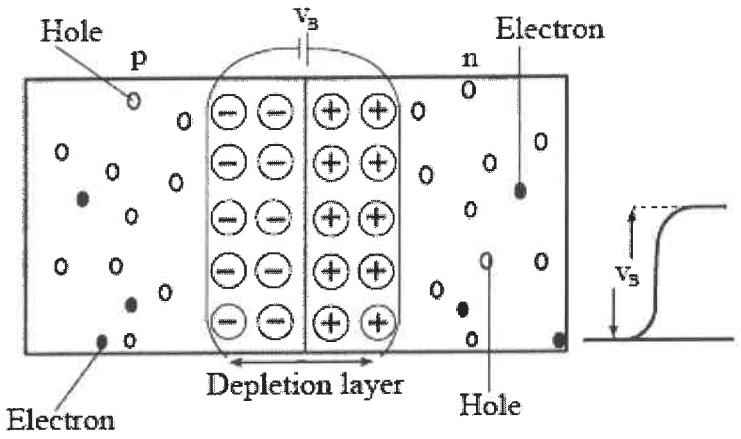

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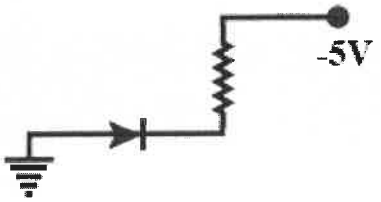
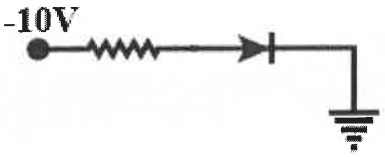


(b)

(c)



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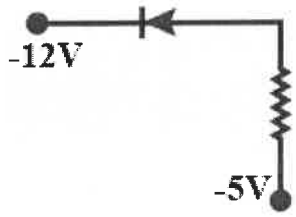

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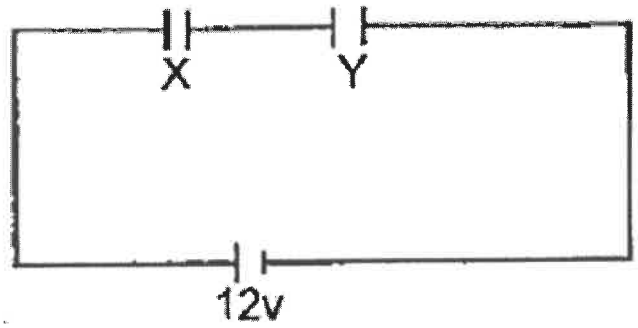

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******END OF THE QUESTION PAPER******