Adyasha

MANAVA BHARATI
INDIA INTERNATIONAL SCHOOL

CLASS XII: PHYSICS (042)
MIDTERM ASSESSMENT
SESSION 2024-25

Weightage: 70 marks.
Time Duration: 3 hrs

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 a few questions . You have to attempt only one of the choices in such questions.

(6) Use of calculators is not allowed.

SECTION - A (16X 1= 16M)

1.The magnetic field at the centre of a current carrying circular loop of radius R , is B1. The magnetic field at a point on its axis at a distance R from the centre of the loop is B2. Then the ratio B_1 / B_2 is

(a) $2\sqrt{2}$ (b) $1/\sqrt{2}$ (c) $\sqrt{2}$ (d) 2

2. The resistance of a resistor is reduced to half of its initial value. In doing so, if other parameters of the circuit remain unchanged, the heating effects in the resistor will become:

(a) two times (b) half (c) one-fourth (d) four times

3. If a charged spherical conductor of radius 10 cm has potential V at a point distant 5 cm from its centre, then the potential at a point distant 15 cm from the centre will be

(a) (2 / 3) V (b)(1 / 3) V (c) (3 / 2) V (d) 3 V

4.Two charges +5μC and -5μC are kept at 10 mm apart. The electric field at point P, on the axis of the dipole, 10 cm away from its centre O on the side of positive charge is

(a) 3×10^5 N/C (b) 2×10^5 N/C (c) 9×10^5 N/C (d) 8×10^5 N/C

5.Two capacitors C1 and C2 are charged to 120 V and 200 V, respectively. It is found that by connecting them together, the potential on each one of them can be made zero when

(a)5 C1 = 3 C2 (b) 3 C1 ± 5 C2 = 0 (c) 9 C1 = 4 C2 (d) None of these

6. A uniform electric & magnetic field is produced in the same direction . If an electron is projected with its velocity in the same direction
(a)the electron will turn to its right
(b)the electron will turn to its left
(c)the electron velocity will increase in magnitude
(d)the electron velocity will decrease in magnitude

7. The relative permeability of a substance X is slightly less than unity and that of substance Y is slightly more than unity, then
(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

8. A proton of energy 8 eV is moving in a circular path in a uniform magnetic field. The energy of an alpha particle moving in same magnetic field and along same path will be
(a) 4 eV (b) 2 eV (c) 8 eV (d) 6 eV

9. The deflection of a moving coil galvanometer is
(a)Directly proportional to torsional constant
(b)Directly proportional to the number of turns in the coil
(c)Inversely proportional to the area of the coil
(d)Inversely proportional to the current flowing

10. A long magnet is cut in two parts in such a way that the ratio of their lengths is 2: 1 . the ratio of pole strengths of both the sections is
(a) Equal
(b) In the ratio 2 : 1
(c)In the ratio 1 : 2
(d) In the ratio 4 : 1

11.An electron is moving along the positive x-axis in a magnetic field which is parallel to the positive Y-axis. In what direction, will the magnetic force be acting on the electron?
(a) Along – X-axis
(b) Along – Z-axis
(c) Along + Z-axis
(d) Along – Y-axis

12. An object has charge of 1 C and gains 5.0×10^{18} electrons. The net charge on the object becomes-
(a) –0.80 C (b) +0.80 C (c) +1.80 C (d) +0.20 C

For question number 13 -16 two statements are given-one labeled Assertion (A) and the other labeled Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below:

(a) Both A and R are true and R is the correct explanation of A.
(b) Both A and R are true but R is not the correct explanation of A.
(c) A is true but R is false.
(d) A is false and R is also false.

13. **Assertion(A) :** An electron has a higher potential energy, when it is at a location associated with a negative value of potential and has a lower potential energy when at a location associated with a positive potential.
Reason (R): Electrons move from a region of higher potential to a region of lower potential.

Assertion (A): The energy of a charged particle moving in a uniform magnetic field remains nstant.
eason (R): Work done by the magnetic field on the charge is zero.

15. Assertion (A): Electric field is always normal to equipotential surfaces & along the direction of decreasing order of potential .
Reason : Negative gradient of electric potential is electric field.

16. Assertion (A) : The conductivity of an intrinsic semiconductor depends on its temperature.
Reason (R):The conductivity of an intrinsic semiconductor is slightly higher than that of a lightly doped p-type semiconductor.

SECTION – B (5X 2= 10M)

17. Three point charges Q , -q & q are placed at three vertices (A , B , C) of an equilateral triangle of side L . What is i) the electrostatic potential energy of the arrangement
ii)the potential at point D which is the midpoint of side BC .

18. Answer the following
(i) Why manganin & copper are used for making standard resistances ?
(ii) On increasing the temperature of a conductor its resistance increases.
(iii) Heat produced by 100 W heater in 2 minutes is equal to _____ .

19. On what factors does sensitivity of galvanometer depend . The current sensitivity of a galvanometer increases by 20% . If its resistance also increases by 25% , how does the voltage sensitivity change in this case ?

20. State any two properties of equipotential surfaces.
Draw equipotential surfaces i)to represent uniform electric field ii) two identical positive charges

21. Consider a uniform electric field $E = 3 \times 10^3$ i^ N/C.
(i) What is the flux of this field through a square of 10 cm on a side whose plane is parallel to the YZ-plane?
(ii) What is the flux through the same square, if the normal to its plane makes a 60° angle with the X-axis?

SECTION - C (7X 3= 21M)

22. a)State Ampere's Circuital law.
b)Two long straight parallel wires separated by 20 cm , carry 5 A & 10 A current respectively , in the same direction . Find the magnitude & direction of the net magnetic field at a point midway between them.

23. A conductor of length l is connected to a DC source of potential V. If the length of the conductor is tripled by gradually stretching it, keeping V constant, how will
(i) drift speed of electrons is affected.
(ii) resistance of the conductor be affected? Justify your answer.
(iii) For wiring in the home, one uses Cu wires or Al wires. What considerations are involved in this?

24.a) A dielectric slab is inserted between the plates of a parallel plate capacitor. The electric field between the plates decreases. Explain.

b) A capacitor A of capacitance C, having charge Q is connected across another uncharged capacitor B of capacitance 2C. Find an expression for i) the potential difference across the combination and b) the charge lost by capacitor A.

25.a) A cell of emf E and internal resistance r is connected across a variable resistor R.
(i) Plot a graph showing the variation of terminal potential V with resistance R.
(ii) Predict from the graph, the condition under which V becomes equal to E.

b) A battery of emf 12V & internal resistance 4 ohm is connected to an external resistance R . If the current in the resistance is 0.5 A , calculate the value of i) R and ii) the terminal voltage of the battery.

26. Draw V-I characteristics of a p-n junction diode. Answer the following questions giving reasons.
(i) Why is the current under reverse bias almost independent of the applied potential up to a critical voltage?
(ii) Why does the reverse current show a sudden increase at the critical voltage?
(iii) Why energy is released, when a p-n junction diode is forward biased?

27.a) What is the work done in moving a charge from one point to another inside a uniformly charged conducting sphere?

b)How much work is required to separate the two charges infinitely away from each other for a system of two charges 7uc & -2uc placed at (-9 , 0 ,0) cm & (9 ,0 ,0) cm respectively.

28 a) Sketch the magnetic field for a bar magnet, clearly indicating the direction of the field
b) A wire AB carrying a steady current of 12 A and is lying on the table. Another wire CD carrying 5 A is held directly above AB at a height of 1 mm. Find the mass per unit length of the wire CD, so that it remains suspended at its position when left free. (Take, g = 10 m/s2)

SECTION – D (2X4= 8M)

Q29. **Case Study :P N junction**

A semiconductor diode is basically a p-n junction with metallic contacts provided at the ends for the application of an external voltage. It is a two terminal device. When an external voltage is applied across a semiconductor diode, such that p-side is connected to the positive terminal of the battery and n-side to the negative terminal, it is said to be forward biased. When an external voltage is applied across the diode, such that n-side is positive and p-side is negative, it is said to be reverse biased.

An ideal diode is one whose resistance in forward biasing is zero and the resistance is infinite in reverse biasing. When the diode is forward biased, it is found that beyond forward voltage called knee voltage, the conductivity is very high. When the biasing voltage is more than the knee voltage, the potential barrier is overcome and the current increases rapidly with increase in forward voltage. When the diode is reverse biased, the reverse bias voltage produces a very small current about a few microamperes which almost remains constant with bias. This small current is reverse saturation current.

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

(a) movement of dopant atoms
(b) diffusion of both electrons and holes
(c) drift of electrons only
(d) drift of holes only

(ii) Reverse bias applied to a junction diode

(a) lowers the potential barrier
(b) raises the potential barrier
(c) increases the majority carrier current
(d) increases the minority carrier current

(iii) A pure semiconductor S is connected in series with variable resistor R and a battery of V volt. Would you increase or decrease the value of R to keep the ammeter reading constant when S is heated? Justify your answer.

iv) Name & explain two important processes that occur during the formation of a pn junction.

Q30 **Case Study : Grouping of cells**

A single cell provides a feeble current. In order to get a higher current in a circuit, we often use a combination of cells. A combination of cells is called a battery, Cells can be joined in series, parallel or in a mixed way.

Two cells are said to be connected in series when the negative terminal of one cell is connected to the positive terminal of the other cell and so on. Two cells are said to be connected in parallel if the positive terminal of each cell is connected to one point and the negative terminal of each cell connected to the other point. In mixed grouping of cells, a certain number of identical cells are joined in series, and all such rows are then connected in parallel with each other.

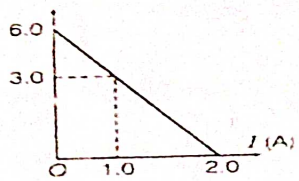
i) EMF of a cell is always greater than its terminal voltage, Why?

ii) Three cells, each of emf E but internal resistance 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 cells.

iii)The adjoining graph shows the variation of terminal potential difference V, across a combination of three cells in series to a resistor versus the current I.

(a) Calculate the emf of each cell.

(b) For what current I, will the power dissipation of the circuit be maximum?



SECTION – E (3X5= 15M)

31.(a) Two dielectric slabs 2K & K fill the space between the plates of a parallel plate capacitor of area A plate separation d with d/3 filled by 2K & 2d/3 by K respectively. Find an expression for capacitance of the system.

(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.

32.(a) Apply Biot-Savart's law to derive an expression for the magnetic field at the centre of a current carrying circular loop. Draw the magnetic field lines for the circular loop.

(b)Two identical coils P & Q each of radius R are lying in perpendicular planes ,such that they have a common centre . Find the magnitude & direction of the magnetic field at the common centre of the two coils , if they carry currents I & $\sqrt{3}$ I respectively.

33.(a)Use Gauss' law to derive the expression for the electric field between two uniformly charged parallel sheets with surface charge densities σ and $-\sigma$, respectively.

b) A molecule of a substance has a permanent electric dipole moment of magnitude 10^{-29} C-m. A mole of this substance is polarised (at low temperature) by applying a strong electrostatic field of magnitude 10^{6} V/m. The direction of the field is suddenly changed by an angle of 60°. Calculate the heat released by the substance in aligning its dipoles along the new direction of the field.

OR

33. (a) Define electric dipole moment. Is it scalar or vector? If vector, give its direction.

(b) Derive an expression for the torque experienced by an electric dipole in a uniform electric field. What is the net force acting on this dipole?

(c) An electric dipole of length 2 cm is placed with its axis making an angle of 60 degrees with respect to the uniform electric field of 10^{5} N/C. If it experiences a torque of $8\sqrt{3}$ Nm, calculate the (i) magnitude of charge on the dipole, and its potential energy.
