NORTH-EX PUBLIC SCHOOL
(Senior Secondary, Affiliated To CBSE)
School Block, Jain Nagar, Sector-38, Rohini, Delhi – 81
HALF YEARLY EXAMINATION, 2023-24
SUBJECT – PHYSICS
CLASS - XII

TIME: 3 hrs. **MM: 70**

General Instructions

i. The question paper has five sections and 33 questions.
ii. All questions are compulsory.
iii. Section–A has 16 questions of 1 mark each; Section–B has 5 questions of 2 marks each; Section–C has 7 questions of 3 marks each; Section–D has 2 questions of 4 marks each and Section E has 3 questions of 5 marks each.
iv. There is no overall choice.

SECTION- A

1. If both the number of turns and core length of an inductor is doubled keeping other factors constant, then its self-inductance will be
   a) Unaffected b) doubled c) halved d) quadrupled
2. A coil having 500 sq. loops of side 10 cm is placed normal to magnetic flux which increases at a rate of 1 T/s. The induced emf is
   a) 0.1 V b) 0.5 V c) 1 V d) 5 V
3. The potential of a large liquid drop when eight liquid drops are combined is 20 V, then the potential of each single drop was
   a)10 V b) 7.5 V c) 5 V d) 2.5 V
4. An electric dipole of moment p is placed parallel to the uniform electric field. The amount of work done in rotating the dipole by 900 is
   a) 2pE b) pE c) pE/2 d) Zero
5. In a coil of self-induction 5 H, the rate of change of current is 2 As^{-1}. Then emf induced in the coil is
   a) 10 V b) -10 V c) 5 V d) -5 V
6. In a pure capacitive circuit, if frequency of AC source is doubled, then it's capacitive reactance will be
   a) Remains same b) Doubled c) Halved d) Zero
7. The algebraic sum of voltages around any closed path in a network is equal to
   a) infinity b) 1 c) 0 d) negative polarity
8. A circular coil of one turn and area A carrying a current has a magnetic dipole moment M. The current through coil is
   a) MA b) A/M c) M/A d) MA^2
9. The relative permeability of iron is 6200. Its magnetic susceptibility is
   a) 6099 b) 6021 c) 6199 d) 6200
10. In an ammeter, 10% of main current is passing through galvanometer. If the resistance of galvanometer is G, then shunt resistance will be
    a) 9G b) G/9 c) 90G d) G/90
11. To draw a maximum current from a combination of cells, how should the cells be grouped?
    a) Parallel b) Series c) Mixed grouping d) Depends upon the relative values of internal and external resistances.

12. Equipotential surfaces
    a) are closer in regions of large electric fields compared to regions of lower electric fields.
    b) will be more crowded near sharp edges of a conductor.
    c) will always be equally spaced.
    d) both (a) and (b) are correct.

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.

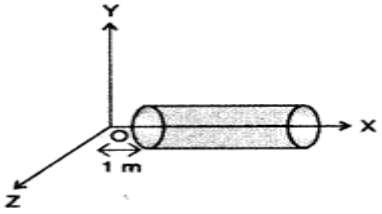
13. Assertion: The total charge stored in a capacitor is zero.
    Reason: The field just outside the capacitor is σ/ε_0 . (σ is the charge density).
14. Assertion: To convert a galvanometer into an ammeter a small resistance is connected in parallel with it.
    Reason: The small resistance increases the combined resistance of the combination.
15. Assertion: In series LCR resonance circuit, the impedance is equal to the ohmic resistance.
    Reason: At resonance, the inductive reactance exceeds the capacitive reactance.
16. Assertion: In a purely inductive or capacitive circuit, the current is referred to as wattless current.
    Reason: No power is dissipated in a purely inductive or capacitive circuit even though a current is flowing in the circuit.

SECTION- B

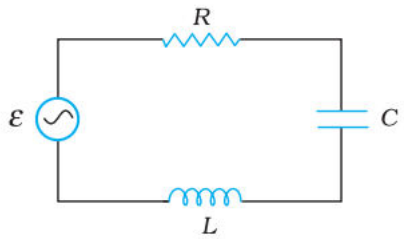
17. An alternating voltage given by V = 140 sin 314t is connected across a pure resistor of 50 **Ω**. Find
    a) The frequency of the source, and
    b) The rms current through the resistor.
18. An electric dipole of length 2 cm, when placed with its axis making an angle of 60° with a uniform electric field, experiences a torque of 8 √3 Nm. Calculate the potential energy of the dipole, if it has a charge of ± 4 nC.
19. Determine the electric field produced by a helium nucleus at a distance of 1 A^o from it.
20. Explain the term 'drift velocity' of electrons in a conductor. Hence obtain the expression for the current through a conductor in terms of 'drift velocity'.
21. The "Lenz's law is a consequence of the law of conservation of energy". Justify this statement.

SECTION- C

22. A hollow cylindrical box of length 1m and area of cross-section 25 cm^2 is placed in a three-dimensional coordinate system as shown in the figure. The electric field in the region is given by **E**=50x **i** where E is in NC^{-1} and x is in metres. Find a) Net flux through the cylinder, b) Charge enclosed by the cylinder.



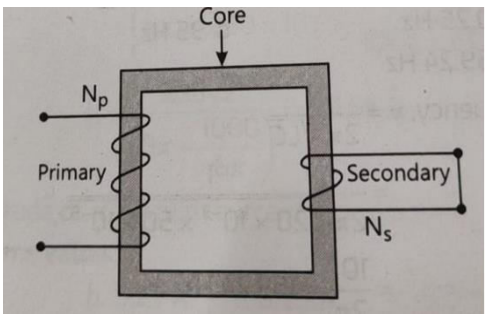
23. State the principle of moving coil galvanometer. Show that the current passing through the coil is directly proportional to the deflection of the coil.
24. If the current in the primary circuit of a pair of coils changes from 10 A to 0 A in 0.1 s, calculate
    a) The induced emf in the secondary if the mutual inductance between the two coils is 2 H, and
    b) The change of flux per turn in the secondary if it has 500 turns.
25. Figure shows a series LCR circuit connected to a variable frequency 230 V source. L= 5 H, C = 80μF and R = 40 Ω
    a) Determine the source frequency which drives the circuit in resonance.
    b) Obtain the impedance of the circuit and the amplitude of current at the resonating frequency.
    c) Determine the rms potential drops across the three elements of the circuit .



26. Derive an expression for the magnetic moment(**μ**) of an electron revolving around the nucleus in terms of its angular momentum(**l**). What is the direction of the magnetic moment of the electron with respect to its angular momentum?
27. Three identical cells each of emf 2 V and unknown internal resistance are connected in parallel. This combination is connected to a 5 Ω resistor. If the terminal voltage across the cell is 1.5 V, what is the internal resistance of each cell?
28. The plates of a parallel plate capacitor have an area of 90 cm^2 each and are separated by 2.5 mm. The capacitor is charged by connecting it to a 400 V supply.
    a) How much energy is stored by the capacitor?
    b) View this energy stored in the electrostatic field between the plates and obtain the energy per unit volume (u). Hence arrive at a relation between 'u' and the magnitude of electric field(E) between the plates.

SECTION- D

29. Step-down transformers are used to decrease or step-down voltages. These are used when voltages need to be lowered for use in homes and factories. A small town with a demand of 800 kW of electric power at 220 V is situated 15 km away from an electric plant generating power at 440 V. The resistance of the two-wire line carrying power is 0.5ohm per km. The town gets power from the line through a 4000-220 V step down transformer at a sub-station in the town.



i. The value of total resistance of the wire is

a) 25ohms b) 30ohms c) 35ohms d) 15ohms

ii. The line power loss in the form of heat is: (in kW)

a) 550 b) 650 c) 600 d) 700

iii. How much power must the plant supply, assuming there is negligible power loss due to leakage?

a) 600kW b) 1600kW c) 500W d) 1400kW

iv. The voltage drop in the power line is

a) 1700V b) 3000V c) 2000V d) 2800V

30. Electric flux through a closed surface S = q/ε_0

q = total charge enclosed by S. The law implies that the total electric flux through a closed surface is zero if no charge is enclosed by the surface.

Answer the following

i. A charge Q is enclosed by a Gaussian spherical surface of radius R. If the radius is doubled, then the outward electric flux will

(a) increase four times (b) be reduced to half (c) remain the same (d) be doubled

ii. What is the flux through a cube of side a if a point charge of q is at one of its corner?

(a) $2\ q/\varepsilon_0$ (b) $q/8\varepsilon_0$ (c) q/ε_0 (d) $(q/2\varepsilon_0)6a^2$

iii. A point charge + q is placed at the centre of a cube of side l. The electric flux emerging from the cube is

(a) $6ql^2/\varepsilon_0$ (b) $q/6l^2\varepsilon_0$ (c) zero (d) q/ε_0 .

iv. A charge Q μC is placed at the centre of a cube, the flux coming out from each face will be

(a) $Q/6\ \varepsilon_0 \times 10^{-6}$ (b) $Q/6\ \varepsilon_0 \times 10^{-3}$ (c) $Q/24\varepsilon_0$ (d) $Q/8\varepsilon_0$

SECTION- E

31. Answer the following

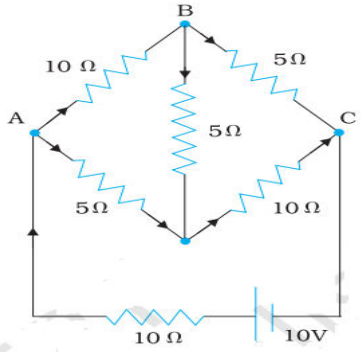
(i) Derive an expression for the force between two long parallel current carrying conductors.

(ii) Use this expression to define SI unit of current.

(iii) A rectangular loop of sides 25 cm and 10 cm carrying a current of 15 A is placed with its longer side parallel to a long straight conductor 2 cm apart carrying a current of 25 A. What is the net force on the loop?

32. Answer the following

(i) Determine the current in each branch of the network shown.



(ii) A silver wire has a resistance of 2.1 Ω at 27.5 °C, and a resistance of 2.7 Ω at 100 °C. Determine the temperature coefficient of resistivity of silver

33. Answer the following

(i) Derive an expression for mutual inductance of two long co-axial solenoids of same length 'l'.

(ii) A pair of adjacent coils has a mutual inductance of 1.5 H. If the current in one coil changes from 0 to 20 A in 0.5 s, what is the change of flux linkage with the other coil?

(iii) Write the dimensional formula of mutual inductance.