ST. MARGARET SR. SEC. SCHOOL
MID TERM EXAMINATION 2023-24
Sample Paper
PHYSICS (042)
CLASS XII

Time: 3Hrs **M.M: 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)Use of calculators is not allowed.
(6)You may use the following values of physical constants where ever necessary

$$c = 3 \times 10^8 m/s$$
$$m_e = 9.1 \times 10^{-31}\ kg$$
$$e = 1.6 \times 10^{-19}\ C$$
$$\mu_0 = 4\pi \times 10^7 TmA^{-1}$$
$$h = 6.63 \times 10^{-34}\ Js$$
$$\varepsilon_0 = 8.854 \times 10^{-12}\ C^2N^{-1}m^{-2}$$

SECTION- A

1. The material which is not suitable for making a permanent magnet 1
a) Steel
b) Ticonal
c) lead
d) Alnico

2. If a magnetic substance is kept in a magnetic field, then which of the following substance is thrown out? 1
a) Paramagnetic
b) Ferromagnetic
c) Diamagnetic
d) None of these

3. The coil of a moving coil galvanometer is wound over a metal frame in order to 1
a) Reduce hysteresis
b) Increase sensitivity
c) Increase moment of inertia
d) Provide electromagnetic damping

4. The temperature coefficient of the resistance of an alloy used for making resistors is 1
(a) Small and positive (b) Small and negative
(c) Large and positive (d) Large and negative

5. **An electric dipole of moment p is placed parallel to the uniform electric field. The amount of work done in rotating the dipole by 90° is-** 1

a) 2pE b) pE c) pE/2 d) Zero

6. **An electric charge q is placed at the centre of a cube of side a. The electric flux on one of its faces will be** 1

a) $\frac{q}{6\varepsilon_o}$ b) $\frac{q}{\varepsilon_o a^2}$ c) $\frac{q}{4\pi\varepsilon_o a^2}$ d) $\frac{q}{\varepsilon_o}$

7. **What is angle between electric field and equipotential surface?** 1

a) 90° always b) 0° always c) 0° to 90° d) 0° to 180°

8. **The induced emf in a conductor is:** 1

a) Inversely proportion to the rate of change of flux
b) Directly proportional to the total flux associated with the conductor
c) Directly proportional to the rate of change of flux
d) It is not inversely or directly proportion to the rate of change of flux

(a)

9. **What is the effect on capacitive inductance X_c, if the separation between the two plates increases (all other parameters are same for capacitor) :** 1

a) Decreases b) same c) Increases d) None of these

10. **The an ac circuit, voltage V and current I are given by** 1

$$V = 100 \sin 100t \ volt$$

$$i = 100 \ \sin\left(100t + \frac{\pi}{3}\right) mA$$

The power dissipated in the circuit is

a) $10^4 W$ b) $10W$ c) $2.5W$ d) 5W

11. **To reduce the resonant frequency in an LCR series circuit with a generator** 1

a) Input voltage cannot be ac voltage, but a dc voltage
b) Maximum input voltage is 220V
c) The meter reads not V but $<V^2>$ and is calibrated to read $\sqrt{<V^2>}$
d) The pointer of the meter is stuck by some mechanical defect

12. A capacitor of capacitance 700 pF is charged by 100V battery. The electrostatic energy store) d by the capacitor is : 1

a) 3.5μJ b)4.5 μC c) 5.5 μJ d)6.5μJ

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**: Diamagnetic substances exhibit magnetism 1

Reason: Diamagnetic materials do not have permanent magnetic dipole moment

14 **Assertion**: A capacitor can be given only a limited amount of charge 1

Reason: After a limited value of charge, the dielectric strength of dielectric between the capacitor planes breaks down.

15. **Assertion:** A magnetic field interacts with a moving electric charge but not with a stationary charge 1

Reason: only a moving charge produces a magnetic field

16. **Assertion**: in our electric circuit an electric bulb glows immediately when the switch is put in ON mode. 1

Reason: The drift velocity of electrons in metal wires is very high

SECTION-B

17. A short bar magnet placed with its axis at 60° with a uniform external magnetic field of 0.50T experiences a torque of magnetic equal to 4.5×10^{-2}J. What is the magnitude of magnetic moment of the magnet? 2

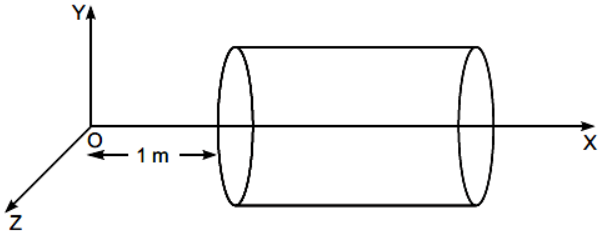
18. Prove that the current density of metallic conductor is directly proportional to the drift speed of electrons 2

19. State the underlying principle of a transformer. How is the large scale transmission of electric energy over long distance done with the use of transformer? 2

20. A hollow cylindrical box of length 1 m 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 $\vec{E} = 50x\hat{\imath}$, where E is in NC^{-1} and x is in metres. Find 2

a) Net flux through the cylinder.

b) Charge enclosed by the cylinder.



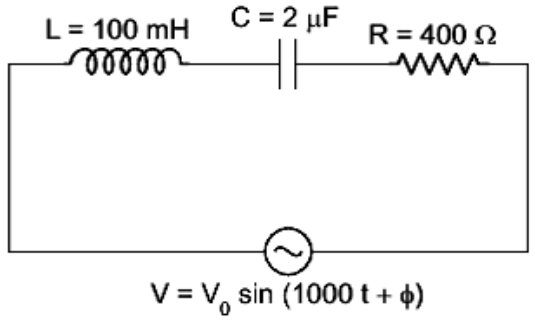
21. A jet plane is travelling towards west at a speed of 1800 km/h. estimate voltage difference developed between the ends of the wing having a span of 25m if the earth's magnetic field at the location has a magnitude of $5.0 \times 10^{-4}T$ and dip angle is 30°. 2

OR

A wheel with 8 metallic spokes each 50 cm long is rotated with a speed of 120 rev/min in a plane normal to the horizontal component of the earth's magnetic field. The Earth's magnetic field at the place is 0.4G and the angle of dip is 60°. Calculate the emf induced between the axle and rim of the wheel. How will the value of the emf be affected if the number of spokes were increased?

SECTION-C

22. Find the value of phase difference between current and voltage in the series LCR circuit shown below. Which one leads in phase: current or voltage? What will you do in this circuit to make the power factor unity? 3



23. Three identical specimens of magnetic materials, Nickel, Antimony, Aluminium are kept in a non uniform magnetic field. Draw the modification in the field lines in each case. Justify your answer. 3

24. Define the term conductivity of a metallic wire. Write its SI unit. 3
Using the concept of free electrons in a conductor, derive the expression for the conductivity of a wire in terms of number density and relaxation time. Hence obtain the relation between current density and the applied electric field E

25. (i) What is Root mean square current? Show that average power in ac inductive circuit is zero. 3
(ii)What is the phase difference between the voltages across inductor and the capacitor at resonance in the LCR circuit?

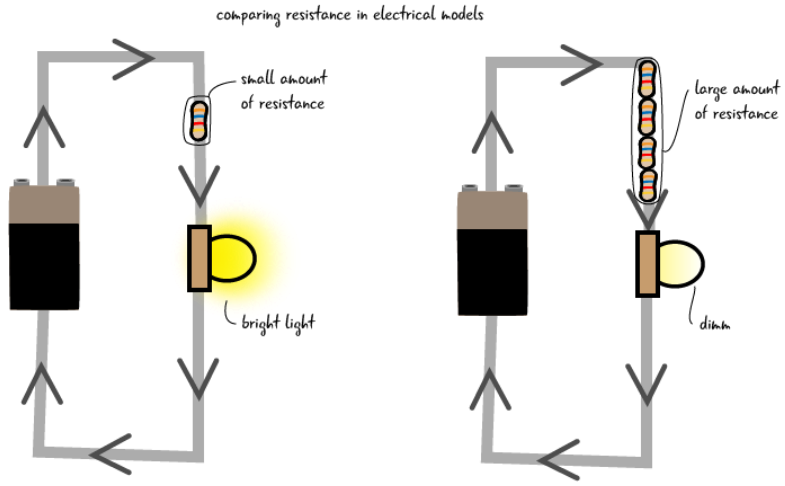
26. Define mutual inductance. 3
Starting from the expression for the energy $W = \frac{1}{2}LI^2$, stored in a solenoid of self-inductance L to build up the current I, obtain the expression for the magnetic energy in terms of the magnetic field B, area A and length l of the solenoid having n number of turns per unit length. Hence, show that the energy density is given by $B^2/2\mu_o$.

27. State Gauss law in electrostatics. use Gauss's theorem to find the electric field due to a uniformly charged infinitely large plane thin sheet with surface charge density σ 3

28. A slab of material of dielectric constant K has the same area as the plates of a parallel plete capacitor but has a thickness (3/4)d, where d is the separation of the plates. How is the capacitance changed when the slab is inserted between the plates? 3

SECTION-D

29. Resistance is a measure of the opposition to current flow in an electrical circuit. Resistance is measured in ohms. Also Resistivity, the electrical resistance of a conductor of unit cross-sectional area, and unit length. … A characteristic property of each material, resistivity is useful in comparing various materials on the basis of their ability to conduct electric currents. 4



i) Resistivity is independent of:
   a) nature of material
   b) temperature
   c) dimensions of material
   d) none of the above

ii) As compare to short wires, long wires have _____ resistance.
   a) more
   b) less
   c) same
   d) zero

iii) As compare to thin wires, thick wires have _____ resistance.
   a) more
   b) less
   c) same
   d) zero

iv) A copper wire having the same size as steel wire have:
   a) more resistance
   b) less resistance
   c) same resistance
   d) none of the above

30. A Faraday cage or Faraday shield is an enclosure made of a conducting material. The fields within a conductor cancel out with any external fields, so the electric field within the enclosure is zero. These Faraday cages act as big hollow conductors you can put things in to shield them from electrical fields. Any electrical shocks the cage receives pass harmlessly around the outside of the cage. 4

i) Example of a real-world Faraday cage is
a) car b) plastic box c) lightning rod d) metal rod

ii) What is the electrical force inside a Faraday cage when it is struck by lightning?
a) The same as the lightning b) Half that of the lightning
c) Zero d) A quarter of the lightning

iii) An isolated point charge +q is placed inside the Faraday cage. Its surface must have charge equal to
a) Zero b) +q c) −q d) +2q

iv) Which of the following material can be used to make a Faraday cage?
a)Plastic b)Glass c) Copper d)Wood

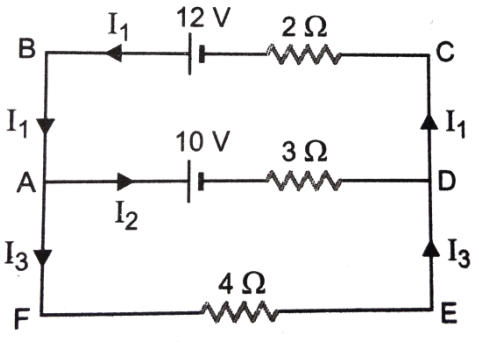
SECTION-E

31. (A) Define Mutual inductance and its SI units. 5
(B) Derive an expression for the mutual inductance of two long co-axial solenoid of the same length wound over the other.
(C) In an experiment, two coils $C_1$and $C_2$are placed close to each other. Find out the expression for emf induced in the coil C_1due to a change in the current through the coil C_2.
OR
(D) Draw a labelled diagram of a step-up transformer. State its working principle. Write any two energy loss in this device and the method used for reducing it.
(E) A step up transformer converts a low input voltage into a high output voltage. Does it violate law of conservation of energy? Explain

32. (A) State the principle of working of a galvanometer. 5
(B) A Galvanometer of resistance G is connected into a voltmeter to measure upto V volts by connecting a resistance R1 in series with the coil. If a resistance R2 is connected inseries with it, then it can measure upto V/2 volts. Find the resistance in terms of R1 and R2, required to be connected to convert it into a voltmeter that can read upto 2V. Also find the resistance G of the galvanometer in terms of R1 and R2.
OR
(C) Two identical circular coils P and Q each of radius R, carrying currents 1A and $\sqrt{3}$ A respectively are placed concentrically and perpendicular to each other lying in XY and YZ planes. Find the magnitude and the direction of net magnetic field at the centre.
(D) How will you convert a galvanometer into a ammeter? Show it by labeled diagram.

33. A) Draw a circuit diagram showing balancing of Wheatstone Bridge. Use Kirchhoff's rules to obtain the balance condition. 5

B) In the electric network shown in figure, use Kirchhoff’s laws to calculate the value of current in branch.



OR

(C) Define drift velocity of electrons in a conductor. Derive a relationship between current through conductor and drift velocity and deduce ohm's law.

(D) I-V graph for a metallic wire at two different temperatures T_1 and T_2 is shown in the figure. Which of the two temperature is lower and why? (2)