Bhavan's Tripura Vidyamandir
1st Terminal Examination: (2025-2026)

Class:- 12 **Subject:- Physics**
Time:- 3 Hours Total :- 70 Marks
Roll: Sec:
Name of the student:

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. All the sections are compulsory.

(3) Section A contains twelve MCQ & four Assertion-reason question 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-based questions of 4 marks each, section E contains three long questions of five marks each.

(4) There is no overall choice. However, an internal choice has been provided in section B, C, D. You have to attempt only one of the choices in such questions.

(5) Use of calculators is not allowed.

SECTION-A

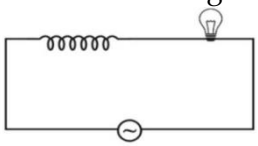
***Each of the following carries 1 mark*:** [1x16=16]

1. The magnetic flux linked with a coil is given by, $\phi = 5t^2 + 3t + 16$ unit. At $t = 4$ second, the induced emf in the coil is-
   (a) -27 V (b) -43 V (c) -108 V (d) 210 V
2. A dipole is placed parallel to the electric field. If W is the work done in rotating the dipole by 60° then work done in rotating it by 180° is-
   a) 2W b) 3W c) 4W d) W/2
3. An alternating current in a circuit is given by, $I = 20\sin(100\pi t + 0.05\,\pi)\ A$. What is the ***RMS*** value of current?
   a) $20\sqrt{2}$ A b) $10\sqrt{2}$ A c) $3.14\sqrt{2}$ A d) None of these.
4. Two identical circular coils A and B are kept in a horizontal tube side without touching each other. If the current in the coil A increases with time, in response, the coil B-
   a) Is attracted by A b) remains stationary c) is repelled d) rotates
5. What happens to the inductive reactance when the frequency of the AC supply is increased?
   a) Increases b) Decreases c) Remains the same d) Decreases inversely
6. The magnetic field at the centre of a current carrying circular loop of radius R is B_1. The magnetic field at a point on its axis at distance R from the center of the loop B_2. Then the ratio (B_1/B_2) is:
   a) $2\sqrt{2}$ b) $\frac{1}{\sqrt{2}}$ c) $\sqrt{2}$ d) 2
7. In a pure inductive circuit, the current
   a) Lags behind the applied emf by an angle π
   b) Lags behind the applied emf by an angle $\pi/2$
   c) Leads the applied emf by an angle $\pi/2$
   d) Applied emf are in same phase
8. A magnet of magnetic moment M is cut in to two equal parts the resultant magnetic moment is-
   a) $\sqrt{2}$ m b) $\frac{m}{\sqrt{2}}$ c) $\sqrt{3}$ m d) $\frac{m}{\sqrt{3}}$
9. For a fixed potential difference applied across a conductor, the drift speed of free electrons does not depend upon
   a) free electron density in the conductor b) mass of the electrons.
   c) length of the conductor d) temperature of the conductor

10. SI unit of permittivity of free space is-

a) Farad b) Weber c) $C^2N^{-1}m^{-2}$ d) $C^2N^{-1}m^{-2}$

11. An iron cored coil is connected in series with an electric bulb with an AC source as shown in figure. When iron piece is taken out of the coil, the brightness of the bulb will



(a) decrease (b) increase

(c) remain unaffected (d) fluctuate

12. Lenz's law is consequence of the law of conservation of

(a) Charge (b) Momentum (c) Mass (d) Energy

Question number (13-16) these questions consist of two statements-
Assertion(A) and Reason(R). Answer the question selecting the appropriate option given below:

(a) Both A and R are true and R is the correct explanation of A.

(b) Both A and R are true and R is not the correct explanation of A.

(c) A is true but R is false

(d) A is false but R is true

13. **Assertion(A):** Only a change in magnetic flux will maintain an induced current in the coil
Reason(R): The presence of large magnetic flux through a coil maintains a current in the coil if the circuit is continuous.
14. **Assertion(A):**If the path of a charged particle in a region of uniform electric and magnetic field is not a circle, then its kinetic energy will not remain constant.
Reason(R): In a combined electric and magnetic field region, a moving charge experiences a net force F = q**E**+ q(**v** × **B**), where symbols have their usual meanings.
15. **Assertion(A):** When charges are shared between any two bodies, no charge is really lost but some loss of energy does occur.
Reason(R): Some energy disappears in the form of heat, sparking etc.
16. **Assertion(A):** In series LCR circuit the resonance occurs at one frequency only.
Reason(R): At resonance the inductive reactance is equal and opposite to the capacitive reactance.

SECTION-B [2x5=10]

17. A battery of emf 12 V and internal resistance 4Ω 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.
18. How can the tuning mechanism of a radio or TV set can be made more selective?
19. State Ampere's circuital law. Write it's mathematical expression.
20. What is the magnitude of an electric field intensity that will balance the weight of an electron?
$(given: e = 1.6 \times 10^{-19}C, m = 9 \times 10^{-31}\ kg)$

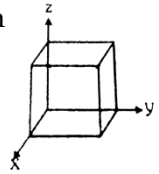
OR

What is the area of plates of a 1.5 F parallel plate capacitor? Given that the separation between the plates is 0.25 cm.

21. What is Current sensitivity and voltage sensitivity of galvanometer? Write their expression.

SECTION- C [3x7=21]

22. An electric dipole of length 2cm is placed with its axis making an angle of 60^0 with respect to uniform electric field of 10^5 N/C. If it experiences a torque of $8\sqrt{3}$ Nm, calculate the magnitude of charge on the dipole, and its potential energy.
23. A cube of side 20 cm is kept in a region as shown in the figure. An electric field $\vec{E}$ exists in the region such that the potential at a point is given by V=10x + 5, where V is in volt and x is in m. Find the-



a) electric field, and

b) total electric flux through the cube.

24. 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. A narrow beam of protons and deutrons, each having the same momentum, enters a region of uniform magnetic field directed perpendicular to their direction of momentum. What would be the ratio of the radii of the circular paths described by them?
26. A small flat search coil of area 5 cm^2 with 140 closely wound turns is placed between the poles of a powerful magnet producing magnetic field 0.09 T and then quickly removed out of the field region, time taken $7x10^{-2}$ sec. Calculate-
    (a) Change of magnetic flux through the coil, and (b) emf induced in the coil.
27. A series CR circuit with R=200Ω and C=(50/π)μF is connected across an ac source of peak voltage ε_0=100 V and frequency υ=50 Hz. Calculate (a) impedance of the circuit (Z), (b) phase angle (ϕ), and (c) voltage across the resistor.
28. What is electromagnetic waves? Identify the electromagnetic waves and write their two uses whose wavelengths vary as

$(a) 10^{-12}m < \lambda < 10^{-8}m$ $(b) 10^{-3}m < \lambda < 10^{-1}m$

OR

Derive an expression for the torque on a magnetic dipole placed in a uniform magnetic field.

SECTION-D [4X2=8]

Case Study-

29) A moving charged particle or a current carrying conductor in a magnetic field experiences Lorentz force. The work done by a force on a body depends on its component in the direction of motion of the body. When the force on a charged particle in a magnetic field is perpendicular to its direction of motion, no work is said to be done. Hence the particle keeps the same speed and kinetic energy which it had while moving in the field, even though it is deflected. On the other hand, the speed and energy of a charged particle in an electrical field is always affected due to the force by the field on the particle. A charged particle moving perpendicular to a magnetic field follows a circular path because it experience a force at right angles to the direction of motion at every position.

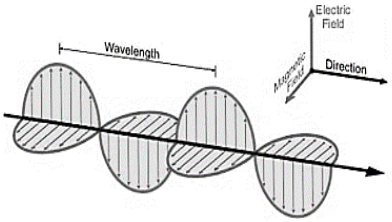
i) If a velocity has both perpendicular and parallel components while moving through a magnetic field, what is the path followed by a charged particle?
    (a) Linear (b) Circular (c) Helical (d) Elliptical

ii) Lorentz Force is-
    (a) the vector sum of electrostatic and magnetic force acting on a moving charged particle.
    (b) the vector sum of gravitational and magnetic force acting on a moving charged particle.
    (c) electrostatic force acting on a charged particle.
    (d) magnetic force acting on a moving charged particle

iii) A charged particle is moving with velocity v in a magnetic field of induction B . The force on the particle will be maximum when:
    (a) v and B are at an angle of 45°. (b) v and B are perpendicular.
    (c) v and B are in the same directions. (d) v and B are in opposite directions .

iv) How does the (i) pole strength and (ii) magnetic moment of each part of a bar magnet change if it is cut into two equal pieces transverse to length?
    (a) Unchanged, half (b) half, Unchanged (c) half, half (d) Unchanged, Unchanged

30) A typical example of a plane electromagnetic wave propagating along the z direction (the fields are shown as a function of the z coordinate, at a given time t). The electric field Ex is along the x-axis, and varies sinusoidally with z, al a given time. The magnetic field By is along the y-axis, and again varies sinusoidally with z. The electric and magnetic fields Ex and By are perpendicular to each other, and to the direction z of propagation. We can write Ex and By as follows:



$E_x = E_0 \sin(kz-\omega t)$

$B_y = B_O \sin(kz-\omega t)$

i) The electric field 'E' and magnetic field 'B' in electromagnetic waves are:

(a) parallel to each other (b) inclined at an angle of 45^0

(c) perpendicular to each other (d) opposite to each other

ii) The energy of photon of electromagnetic radiation of wavelength 2000 Armstrong is:

(a) 1.76×10^{-18} J (b) 0.99×10^{-18} J (c) 54×10^{-18} J (d) 0.63×10^{-18} J

iii) The speed of light in air, if an electromagnetic wave is travelling in air whose dielectric constant is k = 1.006 will be:

(a) 3×10^8 m/s (b) 3.88×10^8 m/s (c) 2.5×10^8 m/s (d) 4.6×10^8 m/s

iv) An object is placed at some distance from a radio station. If the interval between transmission and reception of pulses is 2.66×10^{-2} sec, then the distance is:

(a) 4000 km (b) 2000 km (c) 3000 km (d) 2500 km

SECTION-E

[5x3=15]

31) i) Draw graphs showing the variations of inductive reactance and capacitive reactance with frequency of applied ac source.

ii) Draw the phasor diagram for a series LCR circuit connected to an AC source.

iii) An LCR circuit is connected to an AC source having voltage $V=V_0 \sin\omega t$. Derive an expression for impedance. [1+1+3]

OR

i) The instantaneous current and voltage of an a.c. circuit are given by i = 10 sin300t ampere and V = 200 sin300t Volt. What is the power dissipation in the circuit?

ii) Write down the working principle of an ideal transformer. Hence show the condition of step-up and step-down transformer. [2+(2+1)]

32) i) Find out capacitance of a capacitor with a dielectric slab of thickness 't' between the capacitor plates having separation 'd'.

ii) What happens when the dielectric slab is replaced by a conducting slab of same thickness? [3+2]

OR

i) Calculate the electric potential at the center of a square of side $\sqrt{2}$m, having charges 100μc,−50μC,20μC and −60μC at the four corners of the square.

ii) A capacitor of unknown capacitance is connected across a battery of V volts. The charge stored in it is 360 μC. When potential across the capacitor is reduced by 120V. the charge stored in it becomes 120 μC. Calculate:-

(a) The potential V and the unknown capacitance C.

(b) What will be the charge stored in the capacitor, if the voltage applied had increased by 120 V? [3+2]

33. i) Define the term mutual inductance. Write its SI unit.

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

OR

i) Define self-inductance of a coil. Write its SI unit.

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