PHYSICS (042) / MID TERM
It 3 hours

i) $m_e = 9.1 \times 10^{-31}$ kg

ii) $e = 1.6 \times 10^{-19}$ C

iii) $\mu_0 = 4\pi \times 10^{-7}$ Tm A^{-1}

iv) $h = 6.63 \times 10^{-34}$ Js

v) $\varepsilon_0 = 8.85 \times 10^{-12}$ F/m

vi) Avogadro's number $= 6.023 \times 10^{23}$ per gram mole

viii) $c = 3 \times 10^8$ m/s

SECTION-A

(16x1=16)
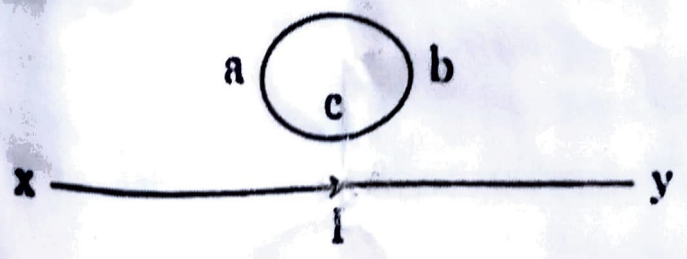
The magnetic flux linked with coil, in weber is given by the equation, $\phi = 5t^2 + 3t + 16$. The induced emf in the coil at $t=4$ seconds will be:

a) -27V   b)   -43V   c)   -108V   d)   -210V

The direction of induced current in the loop abc is:

a) Along abc if I decreases

b) Along acb if I increases

c) Along abc if I is constant

d) Along abc if I increases

3. The relative magnetic permeability of a substance X is slightly less than unity and that of substance Y is slightly more than unity

a) X is paramagnetic and Y is ferromagnetic
b) X is diamagnetic and Y is ferromagnetic
c) X & Y are both paramagnetic
d) X is diamagnetic and Y is paramagnetic

4. Which of the following I-V graph represents ohmic conductors?

(a)
(b)
(c)
(d)
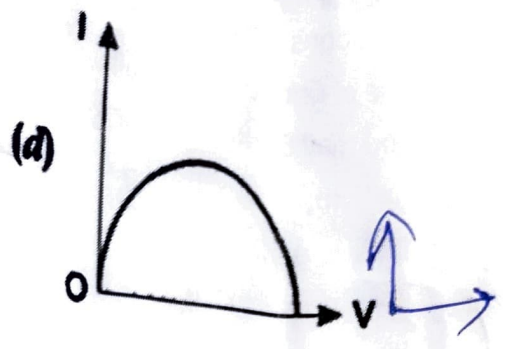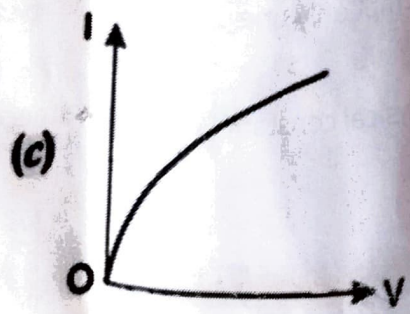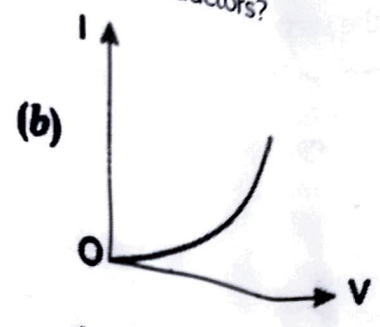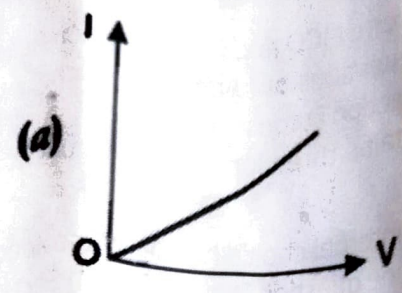
5. In a Wheatstone bridge if the battery and galvanometer are interchanged then the deflection in galvanometer will

a) change in previous direction
b) not change
c) change in opposite direction
d) None of these.

6. The total flux through the faces of the cube with side of length "a" if a charge q is placed at corner A of the cube is
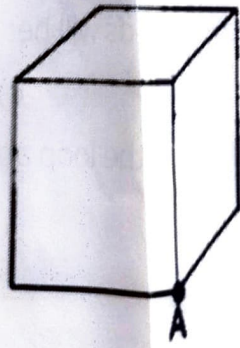
a) $\dfrac{q}{8\varepsilon_0}$
b) $\dfrac{q}{4\varepsilon_0}$
c) $\dfrac{q}{2\varepsilon_0}$
d) $\dfrac{q}{\varepsilon_0}$

7. The Electromagnetic waves used in RADAR system:
    a) Infrared Waves
    b) Microwaves
    c) Gamma Ray
    d) Ultraviolet

8. The electric potential inside a conducting sphere
    a) Zero
    b) Increase from centre to surface
    c) Decrease from centre to surface
    d) Remains constant centre to surface

9. A beam of protons, projected along + x-axis, experiences a force due to a magnetic field along the positive y-axis. What is the direction of the magnetic field?
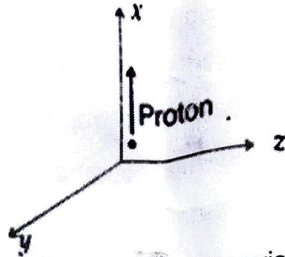
    a) The direction of the magnetic field is towards positive direction of y-axis.
    b) The direction of the magnetic field is towards negative direction of Y – axis.
    c) the direction of the magnetic field is towards positive z - axis .
    d) the direction of the magnetic field is towards negative z - axis

10. An electron is moving along 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

11 An electric dipole placed in an electric field of intensity 2×10^5 N/C at an angle of 30° experiences a torque equal to 4 Nm. The charge on the dipole of dipole length 2 cm is
    a) 7 µC
    b) 8 mC
    c) 2 mC
    d) 5 mC

12. Which of the following is not the property of an equipotential surface?
    a) They do not cross each other.
    b) The work done in carrying a charge from one point to another on an equipotential surface is zero.
    c) For a uniform electric field, they are concentric spheres.
    d) They can be imaginary spheres.

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.

-4-

c) If Assertion is true but Reason is false.
d) If Assertion is false but Reason is true.

13. Assertion : Diamagetic substances exhibit magnetism.
    Reason : Diamagnetic material do not have permanent magnetic dipole moment

14. Assertion: The electric flux of the electric field $\oint E.dA$ is zero. The electric field is zero everywhere on the surface.
    Reason : The charge inside the surface is zero.

15. Assertion : Electromagnetic Radiation exerts pressure
    Reason : Electromagnetic Waves carry momentum & Energy

16. Assertion : Faraday's laws are consequence of conservation of energy.
   Reason : In a purely resistive ac circuit, the current lags behind the emf in phase.

SECTION –B   (5x2=10)

17. An AC source of emf $V=V_0 \sin wt$ is connected to a capacitor of capacitance C . Deduce the expression for the current(I) flowing in it.Plot the phasor diagram for current and emf.

OR

State the condition under which the phenomenon of resonance occours in a series LCR circuit. And derive the expression for resonant frequency.

18. The given graph shows the variation of charge q versus potential difference V for two capacitors Q and P. In which capacitor is more electrostatic energy stored? Give reason for your answer.
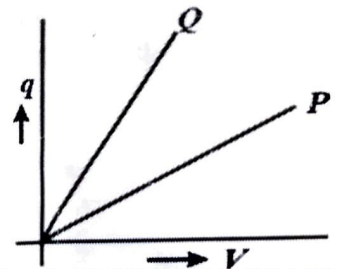
19. Given a uniform electric field $E=5\times10^{-3} \hat{i}$ N/C, find the flux of this field through a square of 10 cm on a side whose plane is parallel to the y-z plane. What could be the flux through the same square if the plane makes 30° angle with the x-axis?

20. A 10 v battery of negligible internal resistance is connected across a 200 V battery and a resistance of 38 Ω as shown in the figure. Find the value of the current in circuit.
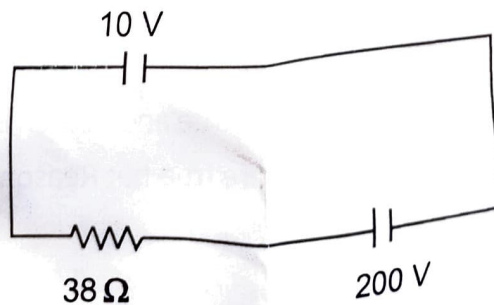
21. Use Lenz's law to determine the direction of induced current in the situations described by figures.

(a)

(b)
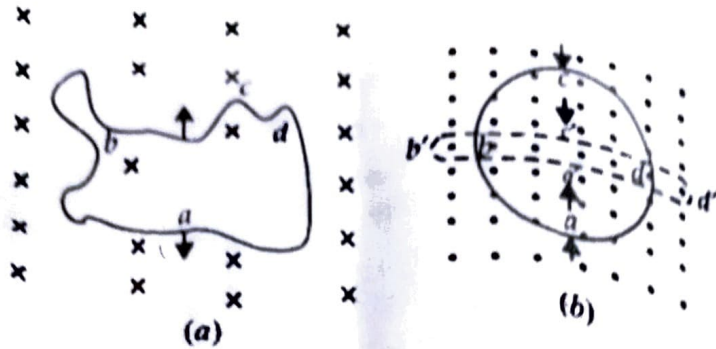
(a) A wire of irregular shape turning into a circular shape:

(b) A circular loop being deformed into a narrow straight wire.

SECTION – C

(7x3=21)

22. Two slabs of dielectric constants 2K and K fill the space between the plates of a parallel plate capacitor of plate area A and plate separation d as shown in figure. Find an expression for capacitance of the system.
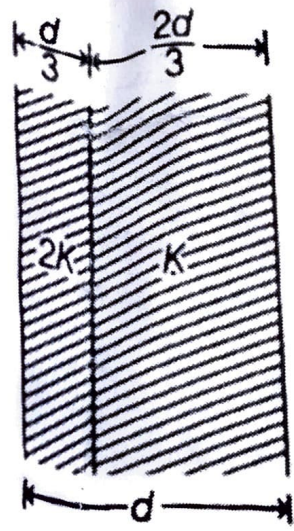
23. A capacitor 'C', a variable resistor 'R' and a bulb 'B' are connected in series to the ac mains in a circuit as shown. The bulb glows with some brightness. How will the glow of the bulb change if
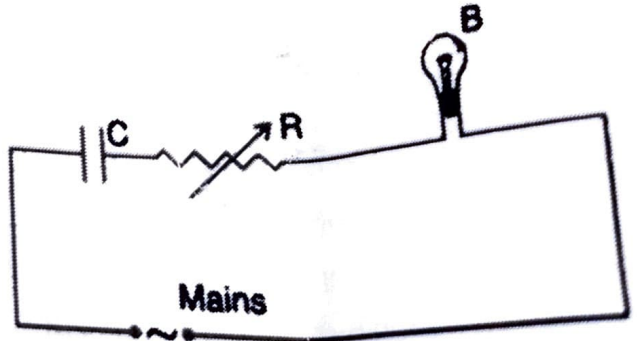
(i) A dielectric slab is introduced between the plates of the capacitor, keeping resistance
R to be th

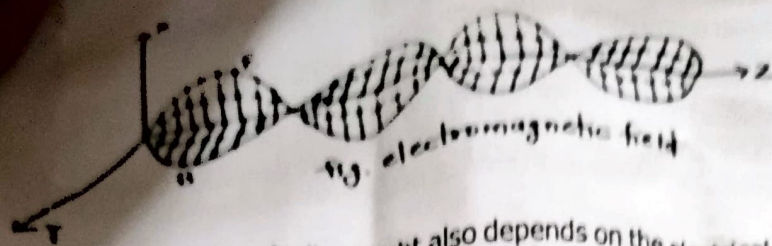n_j electromagnetic field

In this way, we proved that velocity of light also depends on the electrical and magnetic properties of that medium through which it is traveling. The velocity of light which is constant everywhere is having value as 3×10^n m/s. The most technological importance of electromagnetic waves is that they are having strong capacity to take energy from one place to another place. The best examples are radio waves, TV signals which also carry energy from their broadcasting stations. Also, life is possible on the earth only because of the sunlight coming from the sun to the earth which also carry energy and it is nothing but the electromagnetic waves. Due to which electromagnetic waves are considered as the transverse waves.

1. The ratio of permittivity of the medium to the permittivity of vacuum is called as_____.

    a) permeability
    b) permittivity of free space
    c) dielectric constant
    d) electric intensity

2. The pressure exerted by the electromagnetic waves is called as

    a) light pressure
    b) electric pressure
    c) magnetic pressure
    d) radiation pressure

3. What is the relationship between magnitude of magnetic field and electric field in case of electromagnetic waves from the Maxwell's equations?

    OR

    What is mean by the permittivity and permeability of the medium?

4. Nature of electromagnetic waves is-

    a) Longitudinal nature
    b) Transverse Nature
    c) Both Longitudinal and transverse
    d) Neither longitudinal nor transverse

30. In a rod of a paramagnetic substance the individual constituent particle has a dipole moment of its own due to the spin motion of electrons. This is because the constituent particle has one (or more) unpaired electron.
The net dipole moment of the rod is zero as the dipoles are oriented randomly.
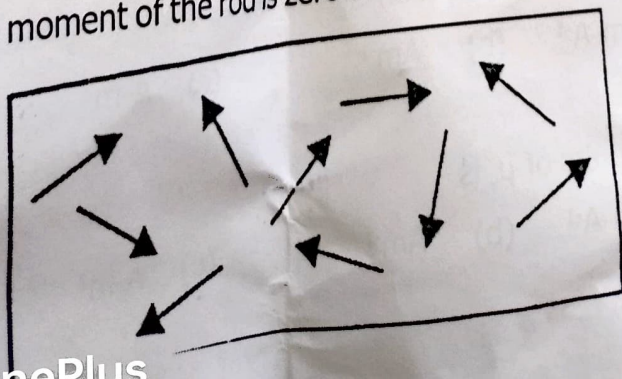
c) What is average power transferred to the capacitor.

d) What is average power transferred to the inductor

) Write the principle and explain the working of moving coil galvanometer. Also define the sensitivity of galvanometer.

Two moving coil Galvanometer, M_1 and M_2 have the following particulars:

$R_1 = 10 \ \Omega$, $N_1 = 30$, $A_1 = 3.6 \times 10^{-3} \ m^2$, $B_1 = 0.25 \ T$

$R_2 = 14 \ \Omega$, $N_2 = 42$, $A_2 = 1.8 \times 10^{-3} \ m^2$, $B_2 = 0.50T$

(The spring constants are identical for the two meters).

Determine the ratio of (a) current sensitivity and (b) voltage sensitivity of M_2 and M_1.

OR

Derive an expression for magnetic field on the axis of current carrying circular loop. Using Biot savartz law.

Two coaxial circular loops L_1 and L_2 of radii 3 cm and 4 cm are placed as shown in Figure. What should be the magnitude and direction of current in loop L_2 so that net magnetic field at point O is zero?

SECTION – E

(3×5=15)
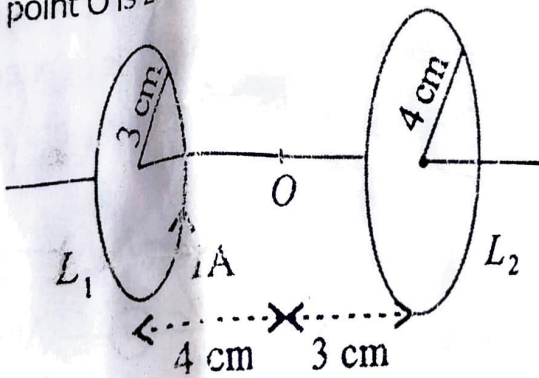
... the equation of balanced state in Wheatstone Bridge using Kirchhoff's Laws.

... circuit given alongside if I is the current entering the network of resistors of resistances, Using Kirchhoff's rules, prove that current through the arm AC is to that in the arm CE. Show the distribution of the current diagrammatically.

OR
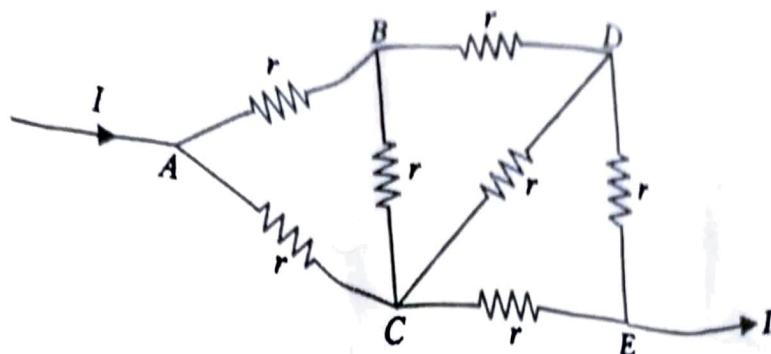
... the two Kirchhoff's Laws used in analysis of electric circuit and explain them.

... reading of the ideal ammeter in the circuit shown below is equal to:

I when key K_1, is closed but K_2, is opened.

I/2 when both the keys K_1, and K_2, are closed
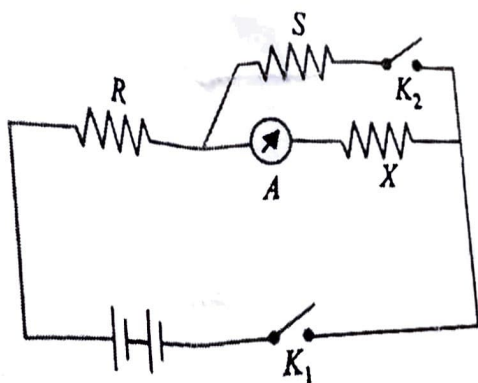
... expression of the resistance of X in terms of resistances R and S.

... rive an expression for the impedence of an ac circuit with capacitor, inductor and ... sistor in series.

... so obtain the expression for average power in LCR circuit.

OR

... circuit contain a 80mH inductor and a 60 µF capacitor in series connected to a ... 0V, 50Hz supply. The resistance of circuit is negligible

... otain the current amplitude and rms value.

... btain the rms value of potential drop across each element.

An arrow represents a magnetic dipole with the tail representing south pole and the arrow head representing north pole.

When such a rod is kept in a strong uniform magnetic field, the magnetic force creates a torque in each dipole forcing the dipole to orient in the direction of magnetic field. With sufficiently strong magnetic field and time interval, all the dipoles are oriented as shown below i.e., a saturation level of magnetism is attained.
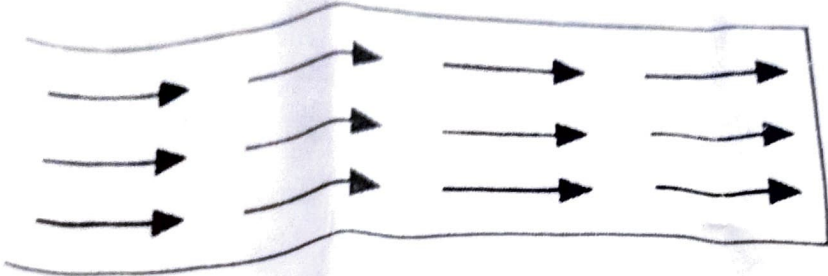
The rod now converts into a magnet.

Read the above passage and answer the following questions:

1. If a paramagnetic rod is heated

    (a) it starts losing its magnetic property

    (b) there is no effect on the magnetic property

    (c) the magnetic property increases

    (d) the magnetic property may increase or decrease depending on the end through which heating starts.

The magnetic susceptibility of a paramagnetic substance at $-73°C$ is 0.0075. What will be the magnetic susceptibility at $-173°C$?

(a) 0.005   (c) 0.025

(b) 0.015   (d) 0.055

The SI unit of magnetic susceptibility is

a) Tm A^{-1} (b) A-m^{-1} (c) Am^2 (d) no units

OR

e unit of magnetisation is

) Tm A^{-1} (b) Am^{-1} (c) A-m^2 (d) no units

e SI units of μ_r is

Tm A^{-1} (b) Am^{-1} (c) A-m^2 (d) no units

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