ST. VIVEKANAND MILLENNIUM SCHOOL
HMT Township, Pinjore
HALF YEARLY EXAMINATION, 2025
Level :Excellent

Subject: Physics (042) **Class: XII**
Time allowed: 03 hrs. **MM :70**

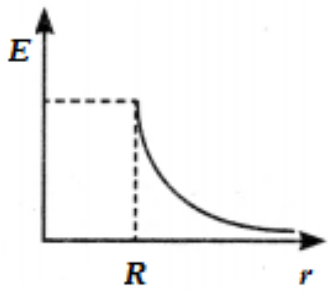
GENERAL INSTRUCTIONS:

1. All questions in all the sections are compulsory.
2. Marks for each question are indicated against it.

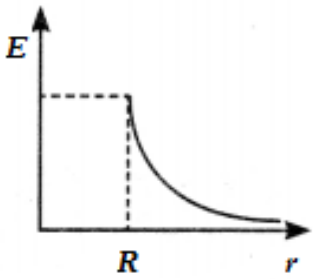
SECTION -A (Multiple Choice questions)

1 The variation of electric field E due to a hollow spherical conductor of radius R as a function of distance from the centre of the sphere is shown in which of the following graphs? 1

(a)



(b)



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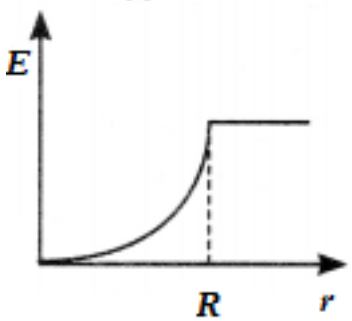
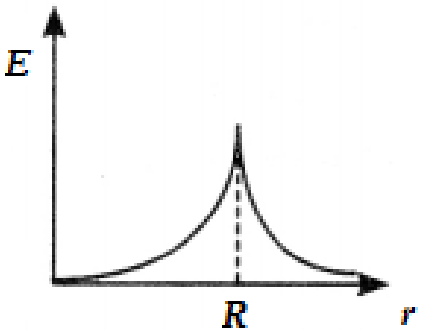


(d)



2 When air is replaced by a medium of dielectric constant 80, the force of attraction between two charges separated by a distance ‘r’: 1

(a)Decreases by 80 times (b) increases by 6400 times
(c)Increases by 80 times (d) remains unchanged

3 The electric charges are distributed in a small volume. The flux of the electric field through a spherical surface of radius 10 cm surrounding the total charge is 20 Vm. The flux over a concentric sphere of radius 20 cm will be 1

(a) 20 Vm (b) 25Vm (c) 40 Vm (d) 200 Vm

4 The net charge on a dielectric is 1

(a)+q (b) -q (c) 0 (d) none of these

5 An external resistance R is connected to a cell of internal resistance r, the maximum current flows in the external resistance, when 1

(a) R = r (b) R< r (c) R> r (d) none of these

6 The mobility of charge carriers decreases with 1

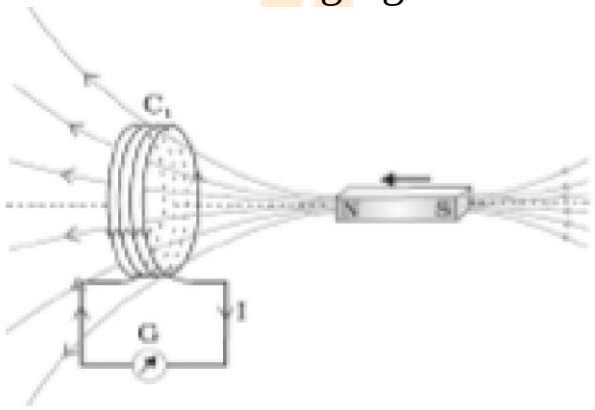
(a) Increase in the average collision time

(b)Increase in electric field

(c)Increase in the mass of the charge carriers

(d) none of these

7 Which of the variables, variation in which brings/induce/produce emf/voltage in a coil. Consider following fig. 1



(a)Current (b) Magnetic flux (c)Time (d)All of the above

8 A metallic wire coil is stationary in a non – uniform magnetic field. What is the emf. Induced in the coil? 1

(a) 0 (b) 5T (c) 10T (d) 100T

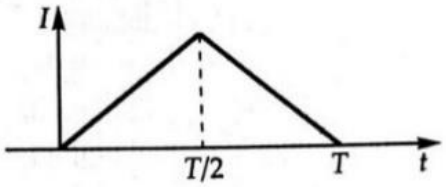
9 The reactance of a capacitance C is X. If both the frequency and capacitance be halved, then new reactance will be 1

(a) X (b) 2 X (c) 4X (d) X/4

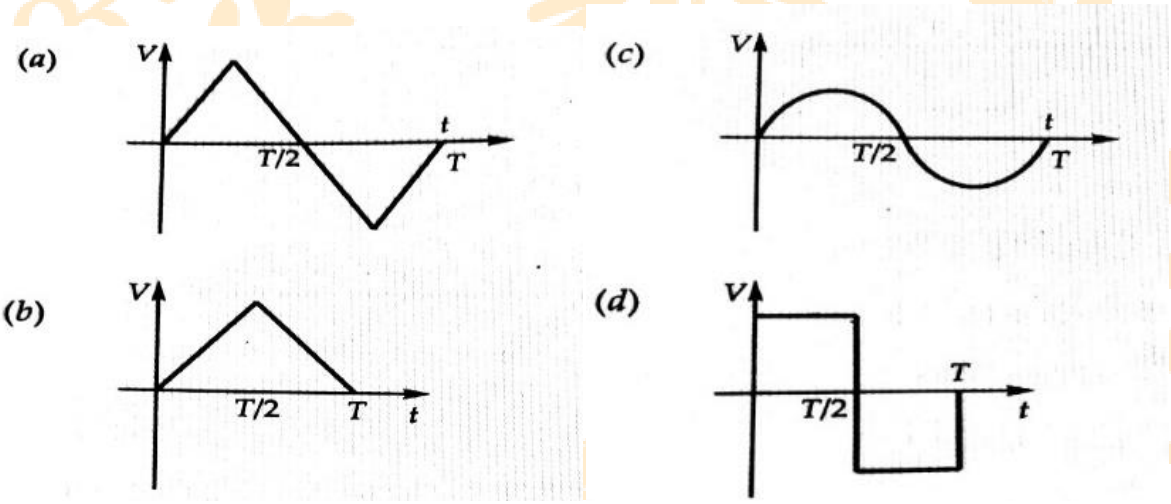
10 A bulb and a capacitor are connected in series to an a.c. source of variable frequency. How will the brightness of the bulb change on decreasing the frequency of the a.c. source? 1

(a)increase (b)first decreases then increases
(c)decrease (d) remains same

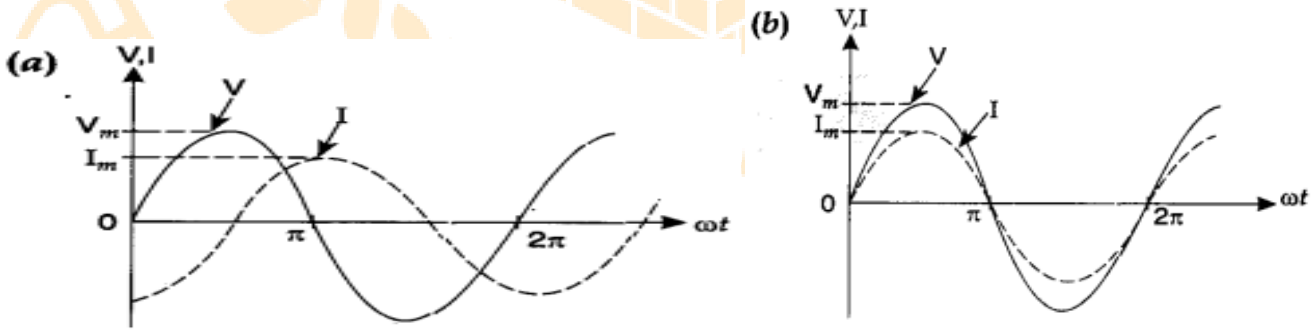
11 The current (I) in the capacitor is varying with time according to the plot 1

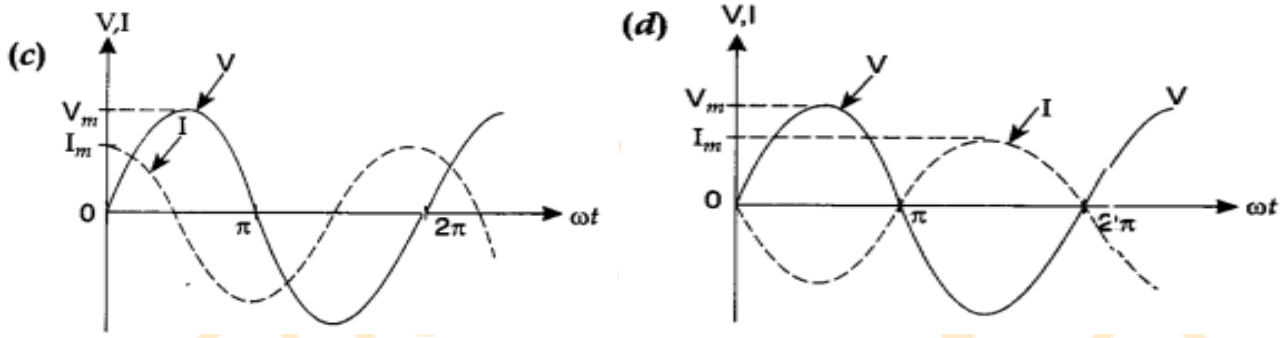


shown in the figure.
Which one of the following is the correct variation of voltage with time in the coil?



12 The phase relationship between current and voltage in a pure inductive circuit is best represented by 1





Q13- Q16 are Assertion Reason type questions.

The following question consists of two statements each, printed as Assertion and Reason.
While answering these questions, you are required to choose any one of the following 4 responses.
a) If both, Assertion and Reason are true and the Reason is the correct explanation of theAssertion.
b) If both, Assertion and Reason or true but Reason is not a correct explanation of the Assertion.
c) If Assertion is true but the Reason is false.
d) If both Assertion and Reason are false.

13 **ASSERTION:** With the increase in drift velocity, the current flowing through a conductor decreases.
REASON: The current is directly proportional to drift velocity.

14 **ASSERTION** The force experienced by a moving charge will be maximum when the charge is moving at right angle to the magnetic field. 1
REASON: The force also depends upon the sine of the angle between the charge and the magnetic field.

15 **ASSERTION:** An induced current has a direction such that the magnetic field due to the current opposes the change in the magnetic flux that induces the current. 1
REASON: Above statement is in accordance with conservation of energy.

16 **ASSERTION** The force experienced by a moving charge will be maximum when the charge is moving at right angle to the magnetic field.
REASON: The force also depends upon the cos of the angle between the

charge and the magnetic field.

SECTION -B (Very short answer type questions)

17 Draw a graph showing variation of resistivity versus temperature for Nichrome. 2

18 Define the term 'resistivity' of a metallic wire. Write its SI Unit. 2

19 State Gauss's law of magnetostatics. 2

20 Mention any two uses of gamma rays. 2

OR

The oscillating electric field of an em wave is given by

$$E_y = 30 \sin(2x10^{11}t+300\pi x)\ Vm^{-1}$$

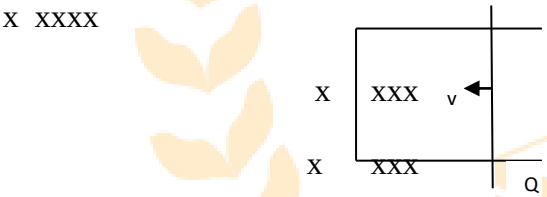
(i)Obtain the value of wavelength of the em wave.

(ii)Write down the expression for oscillating magnetic field.

21 Write a relation between peak and rms value of voltage in AC circuit. 2

OR

A conducting rod PQ, of le ᵖ th l, connected to a resistor R, is moved at a uniform speed v, normal to a uniform magnetic field B, as shown in the figure.



(i) Write the expression for the emf induced in the conductor.

(ii) Find the force required to move the rod in the magnetic field.

SECTION -C (Short answer type questions)

22 Derive an expression for equivalent resistance for cells in parallel combination. 3

23 Two straight long parallel conductors carry currents I_1 and I_2 in the opposite direction respectively. 3

(i)Derive the relation for the force per unit length between them.

(ii)Define 1 ampere.

24 Derive an expression for electric field due to a dipole at equatorial point. 3

25 Derive an expression for the magnetic field on the axis of circular current carrying loop. 3

26 Electromagnetic waves with wavelength : (1+1+1=3)

(i) λ_1 is used in satellite communication

(ii) λ_2 is used to kill germs in water purifier

(iii) λ_3 is use to detect leakage of oil in underground pipeline.

Name them and arrange these wavelengths in ascending order.

27 Suppose that the electric field part of an electromagnetic wave in vacuum **is E = {(3.1 N/C) cos [(1.8rad/m)** y **+ (**5.4×10^6 **rad/s)**t**]}** $\hat{i}$. (1+1+1=3)

a) Write down propagation vector.

b) What is the wavelength λ ?

c) What is the angular frequency ?

OR

An em wave is travelling in a medium with a velocity v = v $\hat{i}$. The electric field oscillations of this em wave are along y-axis.

(i) Identify the direction in which the magnetic field oscillations are taking place, of the emwave .

(ii)How are the magnitudes of the a)electric field and b) magnetic fields in the electromagnetic wave related to each other ?

28 A galvanometer of resistance G is converted into a voltmeter to measure upto V volts by connecting a resistance R_1, in series with the coil. If a resistance R_2, is connected in series with it, then it can measure upto V /2 volts. Find the resistance, in terms of R_1, and R_2, required to be connected to convert it into a voltmeter that can read upto 2 V. Also find the resistance G of the galvanometer in terms of R_1 and R_2. (2+1=3)

SECTION -D (Case study Question)

29 **ELECTRIC FLUX:** (1×4=4)

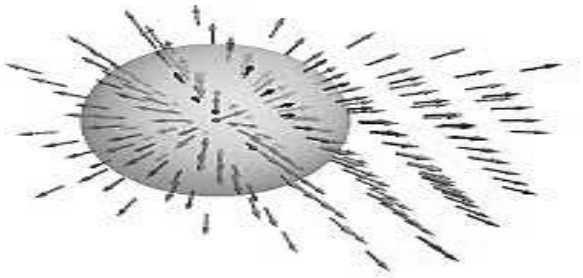
According to Gauss's theorem in electrostatics, total electric flux over a closed surface S in vacuum is $1/\varepsilon_0$ times the total charge Q contained inside S

$$\phi_E = \oint_{ss} \vec{E} \cdot \vec{ds} = \frac{Q}{\epsilon_0}$$

The charges enclosed may be distributed any way. If the medium

surrounding the charge has a dielectric constant K. then

$$\phi_E = \frac{Q}{\epsilon} = \frac{Q}{K\epsilon_0}$$



Charges situated outside the surface make no contribution to electric flux.

(i) Charges +6q, -2q and +3q are enclosed by a surface in vacuum. The total electric flux over the surface is

(a)6 q/ ε_0 (b) -2q/ ε_0 (c) 3q/ ε_0 (d) 7q/ ε_0

(ii) A charge -7q is situated outside the surface in the above question. What will be the total electric flux in that case?

(a) Zero (b) -7 q/ ε_0 (c) 7q/ ε_0 (d) 14 q/ ε_0

(iii) Charges +2 q, -5 q and 8 q are enclosed by a surface in a medium of dielectric constant 6. The total electric flux over the surface will be

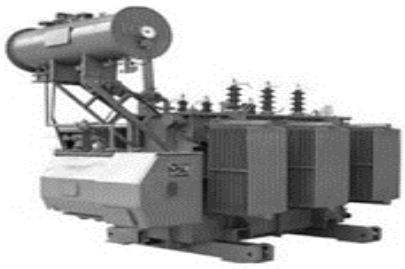
(a) 5q/6 ε_0 (b) 6q/5 ε_0 (c) zero (d) 15 q/6 ε_0

(iv) A cube of side 1 metre encloses a charge of 1 C in vacuum. What is the electric flux from any one surface of the cube?

(a) 1/ ε_0 (b) 1/6 ε_0 (c) 6/ ε_0 (d) ε_0/6

30 **A.C TRANSFORMER:** (1×4 =4)

A transformer is a device used in the power transmission of electric energy. The transmission current is AC. It is commonly used to increase or decrease the supply voltage without a change in the frequency of AC between circuits.



(i) Transformer is based on the principle of :

a) Mutual Induction b)Self Induction

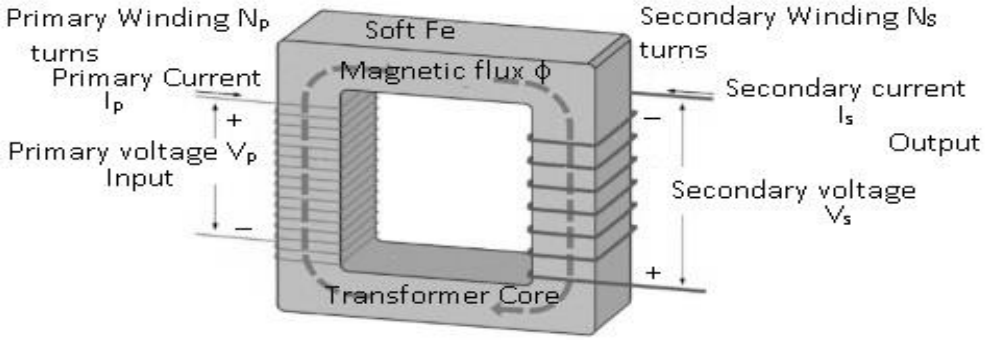
c)Faradays Laws d)Total Internal Reflection

(ii) In an ideal transformer, the primary and the secondary voltages always have_____

a) equal magnitude b) the same phase

c) a phase difference of 90° d) a phase difference of 180°

(iii) Name the type of transformer shown below



(iv)For an ideal Transformer:

a)Input power is less than the output power.

b)Input power is more than the output power.

c) Input power is equal to the output power.

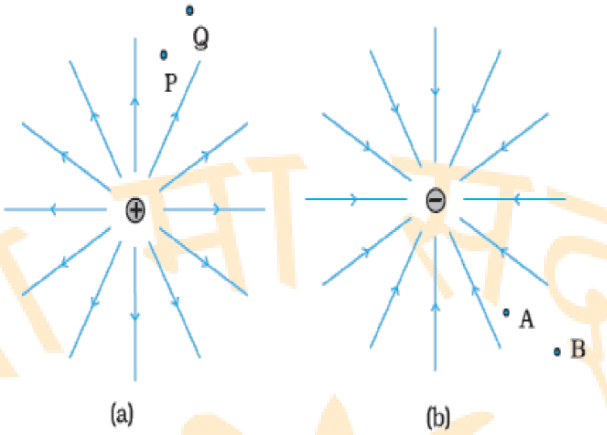
d)Output power is much higher than the Input power.

SECTION -E (Long answer type questions)

31 a) Define electric field. (1+3

b) Derive an expression for electric field due to a plane sheet. +1=5

c)Figures (a) and (b) show the field lines of a positive and negative point) charge respectively.



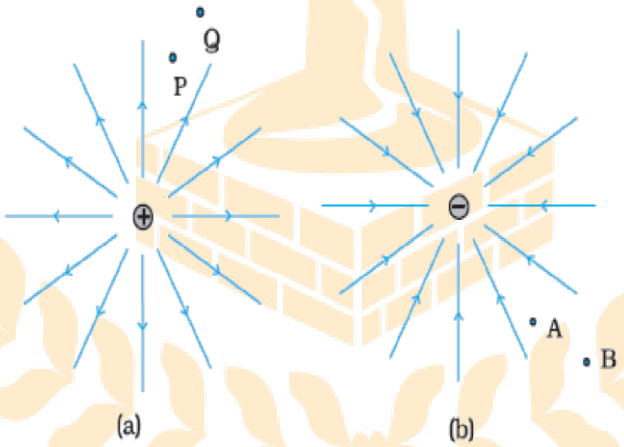
Give the signs of the potential difference $V_P - V_Q$

OR

a)Defineelectric flux.

b)Derive an expression for electric field due to a dipole at axial point of dipole.

c))Figures (a) and (b) show the field lines of a positive and negative point charge respectively.



Give the signs of the potential difference $V_B - V_A$.

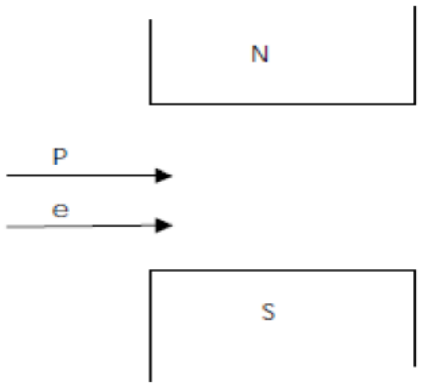
32 a) Draw the diagram for a moving coil galvanometer . (1+3

b) Derive an expression for current in moving coil galvanometer. +1=5

c) The deflection in the moving coil galvanometer is reduced to half when it is shunted with a 40 ohm coil. Find the resistance of the galvanometer.)

OR

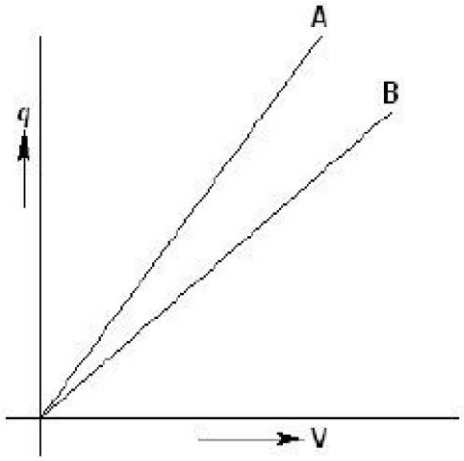
a)Draw the diagram explaining Lenz's law.
b)An electron and a proton ,moving parallel to each other in the same direction with equal momenta, enter into a uniform magnetic field ,which is at right angles to their velocities. Trace their trajectories in the magnetic field. (Trace the path such that Proton deflects into the paper and the electron deflects out of the paper.)



c) A straight wire of diameter 0.5 mm carrying a current of 1 A is replaced by another wire of 1mm diameter carrying the same current. What effect comes on the strength of the magnetic field far away?

33 a) Draw a diagram showing superposition principle of electric forces. (1+3
b) Derive an expression for electric field outside a charged spherical +1=5
shell of radius R.)

c)The given graph shows the variation of charge q versus potential difference V for two capacitors C_1 and C_2. The two capacitors have same plate separation but the plate area of C_2 is double than that of C_1. Which of the lines in the graph correspond to C_1 ?



OR

a) Draw a circuit diagram of three cells in series combination.

b)Derive an expression for equivalent resistance for cells in series combination.

c) Evaluate the equivalent emf for case (a).

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