INDIAN SCHOOL SOHAR
TERM 1 EXAMINATION 2022-23
PHYSICS (THEORY)

No. of printed pages: 8

CLASS: XII
DATE: 2/10/2022

Max Marks: 70
Time allowed : 3 hours

General Instructions:

1. All questions are compulsory. There are 33 questions in all.
2. This question paper has five sections: **Section A**, **Section B**, **Section C**, **Section D** and **Section E**.
3. Section A contains ten very short answer questions and four assertion reasoning MCQs of **1 mark each**, Section B has two case based questions of 4 marks each, Section C contains nine short answer questions of **2 marks each**, **Section D** contains five short answer questions of **3 marks** each and Section E contains three long answer questions of **5 marks** each.
4. There is no overall choice. However internal choice is provided. You have to attempt only one of the choices in such questions.

Section – A

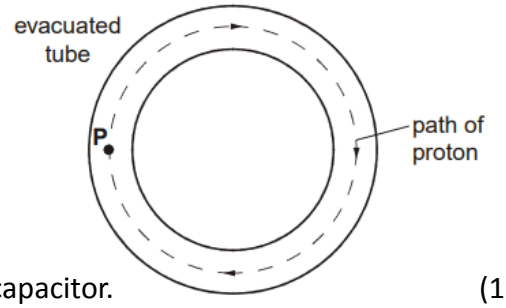
All questions are compulsory. In case of internal choices, attempt any one of them.

1. Name the physical quantity having unit $Kg\,A^{-1}S^{-2}$.
2. Mention one use of part of the electromagnetic spectrum to which a wavelength of 100 μm(absorbed by CO_2) belongs.

OR

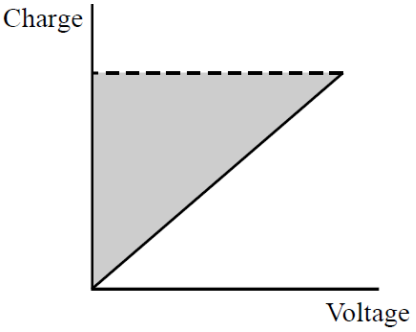
Give the ratio of velocity of the two em waves of wavelengths 600 nm and 300 nm travelling in vacuum. (1)

3. The figure below shows an evacuated circular tube in which charged particles can be accelerated. A uniform magnetic field of flux density B acts in a direction perpendicular to the plane of the tube. Protons move with a speed v along a circular path within the tube. (1)

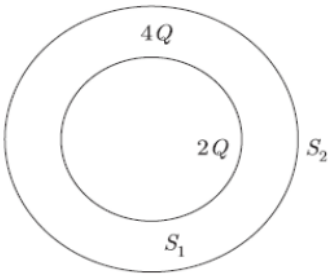


What is the amount of work done by the magnetic field?

4. The diagram shows a graph of charge against voltage for a capacitor. (1)
What quantity is represented by the shaded area?



5. Consider two hollow concentric spheres, S1 and S2, enclosing charges 2Q and 4Q respectively as shown in the figure.



What will be the ratio of the electric flux through S1 and S2 ? (1)

6. What is the power dissipated in an AC circuit in which voltage and current are given by **V** = 230 sin (ωt + π/2) and **I** = 10 sin ωt?

OR

An alternating current supply provides an output voltage of 12 V rms at a frequency of 50 Hz is connected to a 12 V 24 W lamp. The rms current in the lamp is. (1)

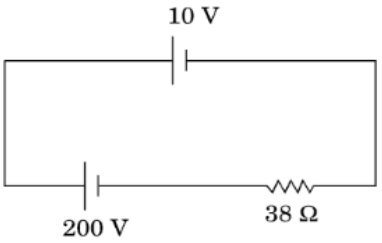
7. Modern crystallography is largely based on the analysis of the diffraction of em waves of wavelength 0.1 nm by crystals. Using this technique chemists are able to determine the internal structures and bonding arrangements of minerals and molecules, including the structures of large complex molecules, such as proteins and DNA. Identify the em wave. (1)

8. IF **E** and **B** denote electric and magnetic fields of an electromagnetic wave which travels through vacuum. What is the value of E/B ? (1)
9. Two solenoids of equal number of turns have their lengths and the radii in the ratio 1:2. What will be the ratio of their self inductance?

OR

The relative permeability of Iron is 6000. Its magnetic susceptibility is…… (1)

10. A 10 V cell of negligible internal resistance is connected in parallel across a battery of emf 200 V and internal resistance 38Ω as shown in the figure. Find the value of current in the circuit.



For question numbers 11, 12, 13 and 14, two statements are given-one labelled **Assertion (A)** and the other labelled **Reason (R)**. Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below.

a) Both A and R are true and R is the correct explanation of A
b) Both A and R are true but R is NOT the correct explanation of A
c) A is true but R is false
d) A is false and R is also false

11. **Assertion (A)**: The basic difference between magnetic lines of force and electric lines of force is electric lines of force are discontinuous and magnetic lines of force are continuous.
Reason (R): Magnetic lines of force exist in a magnet but no electric lines of force exists in a charged body.

(1)

12. **Assertion (A)**: Torque on a coil is maximum when it is suspended radially in a magnetic field.

    Reason (R): Torque tends to rotate a coil . (1)

13. **Assertion (A)**: Ferromagnetic substances are those which get strongly magnetised when placed in an external magnetic field. (1)

    Reason (R): domains in ferromagnetic substances have zero magnetisation.

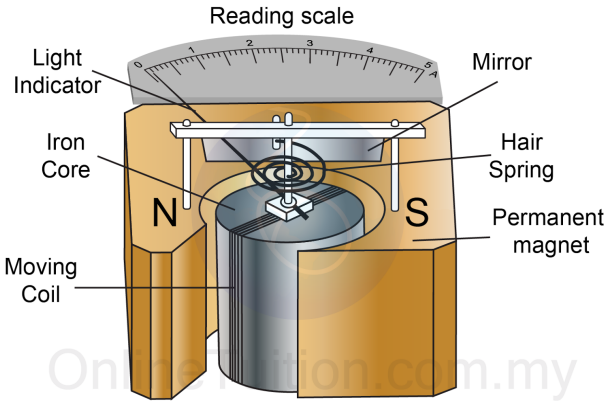
14. **Assertion (A)**: Mutual inductance becomes maximum when coils are wound on separate cores.
    Reason (R): Mutual inductance is independent of orientation of coils. (1)

Section B

Questions 15 and 16 are Case Study based questions and are compulsory. Attempt any 4 sub parts from each question. Each question carries 1 mark.

MOVING COIL GALVANOMETER

15. The galvanometer is a device used to detect the current flowing in a circuit or a small potential difference applied to it. It consists of a coil with many turns, free to rotate about a fixed axis, in a uniform radial magnetic field formed by using concave pole pieces of a magnet. When a current flows through the coil, a torque acts on it.



15.1.What is the principle of moving coil galvanometer?

(A) Torque acting on a current carrying coil placed in a uniform magnetic field.
(B) Torque acting on a current carrying coil placed in a non-uniform magnetic field.
(C) Potential difference developed in the current carrying coil.
(D) Electromagnetic induction (1)

15.2. If the field is radial, then the angle between magnetic moment of galvanometer coil and the magnetic field will be

(A) 0° (B) 30°
(C) 60° (D)90° (1)

15.3. The radial field in the moving coil galvanometer gives

(A) maximum torque. (B) strong magnetic field.
(C) minimum torque. (D) zero magnetisation to the core (1)

15.4. If the rectangular coil used in the moving coil galvanometer is made circular, then what will be the effect on the maximum torque acting on the coil in the magnetic field for the same area of the coil?

(A) remains the same (B) becomes less in circular coil

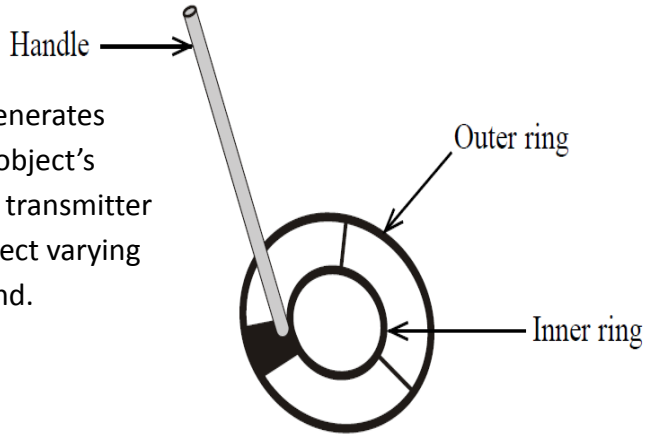
(C) becomes greater in circular coil (D) depends on the orientation of the coil (1)

15.5. How is a moving coil galvanometer converted into an ammeter of desired range?

(A) Connecting a shunt resistance in series.
(B) Connecting a shunt resistance in parallel.
(C) Connecting a large resistance in series.
(D) Connecting a large resistance in parallel. (1)

METAL DETECTOR

16. The diagram shows the bottom part of a hand-held metal detector. The outer ring contains the transmitter coil. Alternating current is passed through this coil creates a magnetic field which penetrates into the ground.
If the magnetic field encounters a metal object, a current is induced in the object. This current generates a magnetic field of its own. The direction of the object's magnetic field is opposite to the direction of the transmitter coil's magnetic field. The inner ring is able to detect varying magnetic fields coming from objects in the ground.

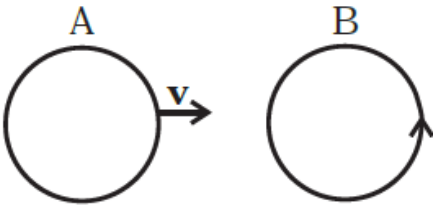


16.1. 'The direction of the object's magnetic field is opposite to the direction of the transmitter coil's magnetic field'. This is according to the
(A) Ampere's circuital law
(B) Lenz's law
(C) Biot-Savart law (1)
(D) Faraday's Law

16.2. Magnetic flux in a closed circuit varies with time t according to the equation $\varphi = (6t^2 - 5t + 1)$ Wb. If the resistance of the circuit is 10 Ω , what is the magnitude of induced current at t= 2s ?
(A) 1.2 A
(B) 6.5 A
(C) 0.2 A
(D) 1.9 A (1)

16.3. Lenz's law is a consequence of the law conservation of
(A) charge
(B) energy
(C) Induced emf (1)
(D) Induced current

16.4. There are two coils A and B as shown in Fig.

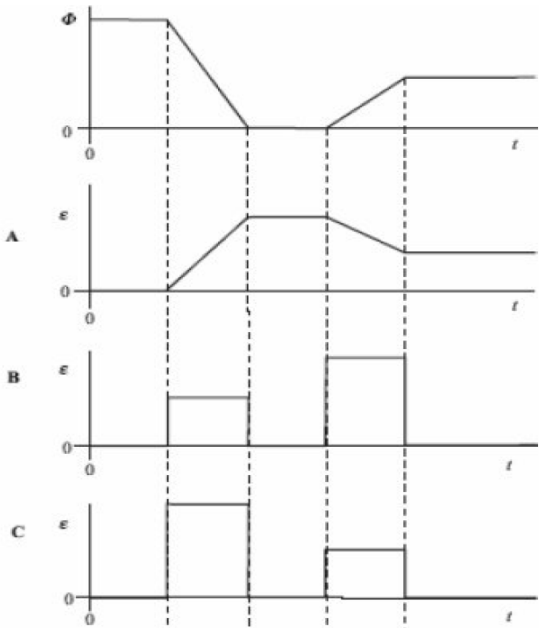


A current starts flowing in B as shown, when A is moved towards B and stops when A stops moving. B is kept stationary when A moves. We can infer that
(A) there is a constant current in the clockwise direction in A.
(B) there is a varying current in A.
(C) there is no current in A. (1)

(D) there is a constant current in the counterclockwise direction.

16.5. The magnetic flux, Φ, through a coil varies with time, t, as shown by the first graph. Which one of the following graphs, A to D, best represents how the magnitude, ε, of the induced emf varies in this same period of time? (1)

(A) Only A
(B) Only B
(C) Only C
(D) Both B and C



Section C

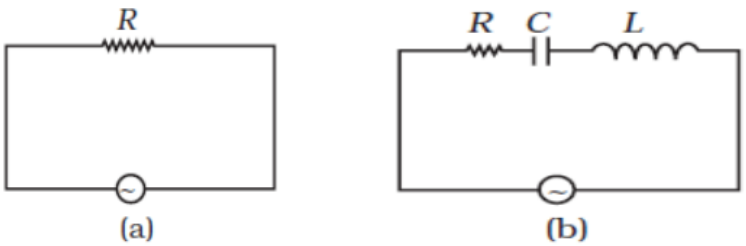
All questions are compulsory. In case of internal choices, attempt anyone.

17. What is an equi-potential surface? Draw equipotential surfaces due to a point charge.

OR

Derive the expression of the electric potential due to a point charge at a distance r from the charge. (2)

18. If the amount of electric flux entering and leaving a closed surface are ϕ_1 and ϕ_2 respectively. What is the electric charge inside the surface? (2)
19. Plot a graph showing the variation of current 'I' versus resistance 'R', connected to a cell of emf E and internal resistance 'r'. (2)
20. Two long straight parallel conductors carrying steady currents $\mathbf{I_a}$ and $\mathbf{I_b}$ along the same direction are separated by a distance d . What is the nature and magnitude of the force between the two conductors? (2)
21. Two identical loops , one of copper and other of constantan ,are removed from a magnetic field within the same time interval. In which loop will the induced emf be greater?In which loop will the induced current be greater? Justify. (2)
22. Study the circuits (a) and (b) shown in Fig and answer the following questions.



(a) (b)

(i) Under which conditions would the rms currents in the two circuits be the same?
(ii) Can the rms current in circuit (b) be larger than that in (a)?

OR

An inductor of 200 mH, capacitor of 100 μF and a resistor of 10 Ω are connected in series to ac source of 50 V of variable frequency. Calculate the angular frequency at which maximum power dissipation occurs in the circuit and the corresponding value of effective current. (2)

23. Electromagnetic waves with wavelength (i) λ1 is used in satellite communication. (ii) λ2 is used to kill germs in water purifiers. (iii) λ 3 is used to detect leakage of oil in underground pipelines. (iv) λ 4 is used to improve visibility in runways during fog and mist conditions. Identify these waves.

OR

The magnetic field of a beam emerging from a filter facing a floodlight is given by

$B_y = 2 \times 10^{-7} \sin (5 \times 10^4 x + 1.5 \times 10^{11} t)$ T .

(a) What is the wavelength of the wave?

(b) Write an expression for the electric field. (2)

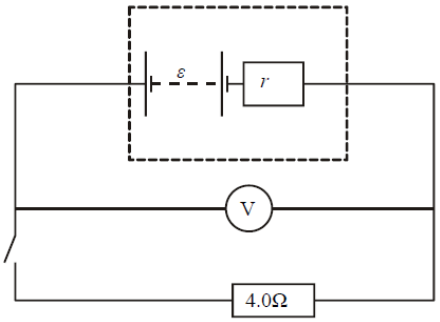
24. A variable frequency a.c source is connected to a capacitor. How will the displacement current and conduction current change with decrease in frequency? (2)

25. A bismuth rod is introduced in a solenoid carrying current , how do i) its self-inductance ii) emf induced in the solenoid change? Justify your answer. (2)

Section D

All questions are compulsory. In case of internal choices, attempt any one.

26. (i) A battery of e.m.f. ε and internal resistance r is connected into a circuit as shown below.



When the switch is open the voltmeter reads 12.0 V and when the switch is closed it reads 8.0 V. Calculate the current in the circuit when the switch is closed.

(ii) The switch remains closed. Calculate the power dissipated in the 4.0 Ω resistor.

(iii) Determine the internal resistance r.

OR

A storage battery is of emf 8V and internal resistance 0.5 ohm is being charged by d.c supply of 120 V using a resistor of 15.5 ohm.

a) Draw the circuit diagram.

b) Calculate the potential difference across the battery.

c) What is the purpose of having series resistance in this circuit? (3)

27. Distinguish between diamagnetic and ferromagnetic materials in respect of their (i) intensity of magnetization (ii) behaviour in non-uniform magnetic fields and (iii) susceptibility. (3)

28. An inductor 200 mH, capacitor 500 μF and resistor 10 Ω are connected in series with a 100 V, variable frequency ac source. Calculate the

(a) i) Frequency at which the power factor of the circuit is unity.

ii) Current amplitude at this frequency.

(b) What do you mean by wattless current? (3)

29. (a) Write an expression of magnetic moment associated with a current I carrying circular coil of radius R having N turns.

(b) Consider the above mentioned coil placed in the YZ plane with its centre at the origin. Derive expression for the value of the magnetic field due to it at point (x, 0, 0).

OR

(a) Define current sensitivity of a galvanometer. Write its expression.

(b) A galvanometer has resistance G and shows full scale deflection for current Ig.

(i) How can it be converted into an ammeter to measure current up to I_0 (I_0 > Ig) ?

(ii) What is the effective resistance of this ammeter ? (3)

30. (a) Differentiate between self inductance and mutual inductance.

(b) The mutual inductance of two coaxial coils is 2H. The current in one coil is changed uniformly from zero to 0.5A in 100 ms. Find the : (i) change in magnetic flux through the other coil.

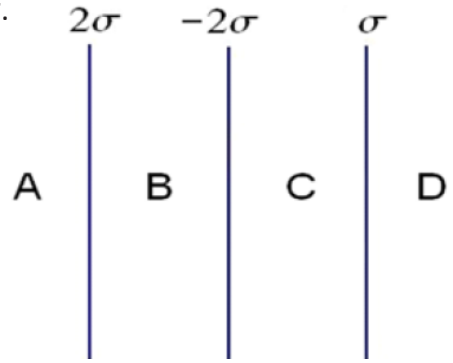
(ii) emf induced in the other coil during the change. (3)

Section E

All questions are compulsory. In case of internal choices, attempt any one.

31. a) State Gauss's law in electrostatics. Show that with the help of a suitable figure that outward flux due to a point charge Q, in vacuum within the gaussian surface, is independent of its size and shape.

b) In the figure there are three infinite long thin sheets having surface charge density +2σ, -2σ and +σ respectively. Give the magnitude and direction of the electric field at a point to the left of the sheet of charge density +2σ and to the right of the sheet of charge density +σ.



OR

a) Define an ideal electric dipole. Give an example.

b) Derive an expression for the torque experienced by an electric dipole in a uniform electric field. What is the net force acting on this dipole?

c) An electric dipole of length 2 cm is placed with its axis making an angle of 60^0 with respect to a uniform electric field of 10^5 N/C. If it experiences a torque of $8\sqrt{3}$ Nm, calculate the (i) magnitude of charge on the dipole, and its potential energy. (5)

32. (a) With the help of a labelled diagram, describe briefly the underlying principle and working of a step-up transformer and derive the transformer equation.

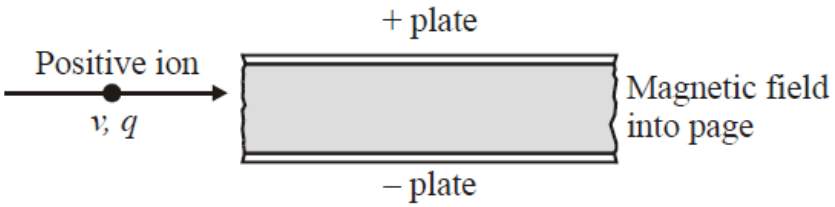
(b) Write any two sources of energy loss in a transformer.

(c) Efficiency of a transformer is 80 % and primary and secondary coil has 30 and 120 turns respectively. Current in the secondary coil is 0.25 A. Find out current in the primary.

OR

(a) Describe briefly, with the help of a labelled diagram, the basic parts of an ac generator.
(b) State the working principle of ac generator.
(c) Derive the expression for the instantaneous value of the emf induced in the rotor.
(d) An ac generator consists of a coil of 2000 turns, each of area 80 cm^2 and rotating at angular speed of 200 rpm in a uniform magnetic field of 48 mT. Calculate the peak and rms value of emf induced in the coil. (5)

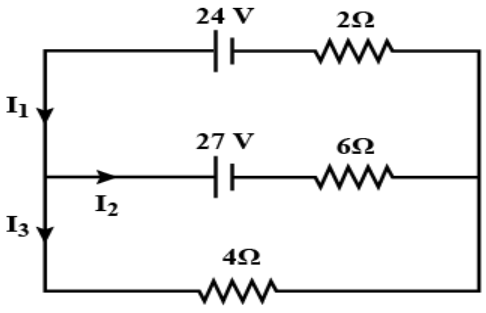
33. Particle physics often involves passing beams of particles through electric and/or magnetic fields. The diagram illustrates a beam of positive ions, each with charge q and travelling at speed v, entering a region containing both an electric field of strength E and a magnetic field of flux density B. The electric field acts between the parallel plates. The magnetic field acts into the page.



(a) The electric field causes a force on an ion when it is between the plates. State a formula for the magnitude of this force.
(b) In which direction does this force act?
(c) The magnetic field causes a force on the ion in the opposite direction to the force from the electric field. With a suitable combination of values of U, E and B, the electric and magnetic forces balance and each ion will travel straight through the region without changing direction. Calculate the value of U for an ion to travel straight through the region if $E = 1.2 \times 10^4 Vm$ and B = 0.40 T.
(d) Explain why ignoring the effect of gravity on the ion is justified.

OR

(a) State Kirchhoff's rules.
(b) Using a diagram, obtain the balance condition in a Wheatstone bridge.
(c) Using kirchhoff's rules determine the currents I_1, I_2 and I_3 for the network given.



(5)