**PT-2**

# HALF YEARLY EXAMINATION 2022-23

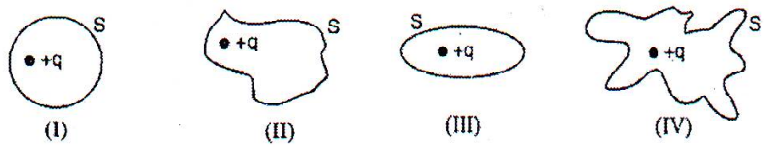
**Class XII** **PHYSICS** **Time : 3 hrs.**
**Marks : 70**

## General Instructions:

Question paper is divided in to five sections, Section A - MCQ - 18 questions, Section B (2 marks) - 7 questions and Section C (3 marks - questions 4 marks each.) 5 questions, Section D (5 marks) - 3 questions, Section E (4 marks) 2 case study.

**SECTION A** **18 × 1 = 18**

1. The electric flux through the surface

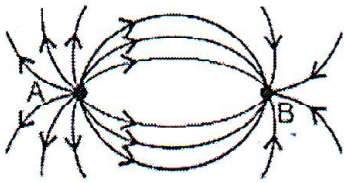



a) In the same for all the figures

b) In figure (ii) is same as in figure (iii) but is smaller than figure (iv)

c) In figure (iv) is the largest d) In figure (iii) is the least

2. The spatial distribution of the electric field due to two charges (A and B) is shown in figure. Which one of the following statements is correct?



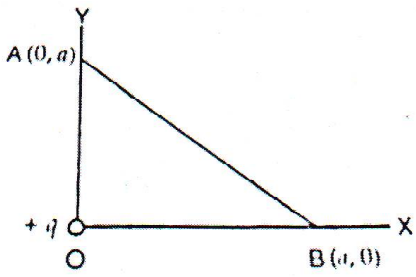

a) A is +ve and B is –ve and $|A| > |B|$

b) Both are –ve but A > B

c) A is –ve and B is +ve and $|A| = |B|$

d) Both are +ve but A > B

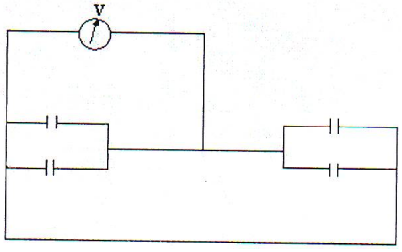
3. A point charge +q is placed at the origin O as shown in the figure. Work done in taking another point charge - Q from point A(0, a) to another point B(a, 0) along the straight path AB is :




a) Zero b) $\left(-\frac{1}{4\pi\varepsilon_0}\cdot\frac{qQ}{a^2}\right)\sqrt{2}a$

c) $\left(\frac{1}{4\pi\varepsilon_0}\cdot\frac{qQ}{\sqrt{2}}\right)\frac{a}{\sqrt{2}}$ d) $\left(\frac{1}{4\pi\varepsilon_0}\cdot\frac{qQ}{a^2}\right)\sqrt{2}a$

4. For capacitors, each of capacitance 50 $\mu F$ are connected as shown in the figure. If the voltmeter reads 100 V, the charge on each capacitor is




a) 0.5 C

b) $2 \times 10^{-3}$C

c) $5 \times 10^{-3}$C d) 0.5 C

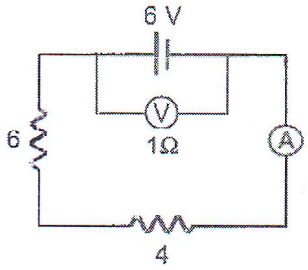
5. In the circuit shown here, the readings of the ammeter and voltmeter are :

a) 0.6A, 6V

b) $\frac{6}{11}$A, $\frac{60}{11}$V

c) 6A, 60V

d) $\frac{11}{6}$A, $\frac{11}{60}$V




6. The current flowing through a lamp marked as 50W, 250 V is

a) 5A b) 2 A c) 2.5A d) 0.2 A

7. For a cell, the terminal difference is 2.2 V, when the circuit is open and reduces to 1.8 V, when cell is connected to a resistance R = $5\Omega$. The internal resistance of cell is

a) $\frac{5}{9}\Omega$ b) $\frac{10}{9}\Omega$ c) $\frac{9}{10}\Omega$ d) $\frac{11}{9}\Omega$

8. The maximum current that can be measured by a galvanometer of resistance $40\,\Omega$. is 10 mA. It is converted into voltmeter that can read upto 50V. The resistance to be connected in the series with the galvanometer is

a) $2010\,\Omega$ b) $4050\,\Omega$ c) $5040\,\Omega$ d) $4960\,\Omega$

9. The ratio of induced emf in a coil of 50 turns and area A oscillating at frequency 50Hz to that in a coil of 100 turns and same area oscillating at frequency 100 Hz is

A) 1 : 4 b) 1 : 8 c) 2 : 3 d) 1 : 6

10. A circular coil of wire consisting of 100 turns, each of radius 8.0 cm carries a current of 0.40A. What is the magnitude of the magnetic field B at the centre of the coil?

a) $5.2 \times 10^{-3}$ T b) $7.1 \times 10^{-5}$T c) $3.5 \times 10^{-5}$T d) $3.1 \times 10^{-4}$T

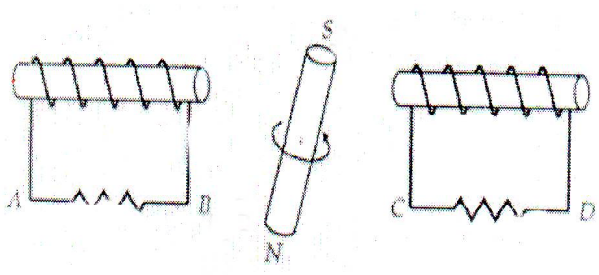
11. The magnet in figure rotates as shown on a pivot through its centre. At the instant shown, what are the directions of the induced currents?

a) A to B and D to C

b) A to B and C to D

c) B to A and D to C

d) B to A and C to D

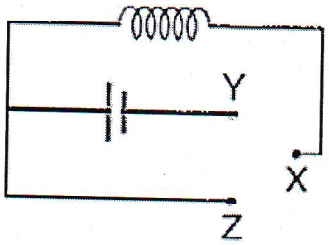



12. In transformer, core is made of soft iron to reduce

a) None of these b) Eddy current losses

c) Hysteresis losses d) Force opposing electric current

13. In the circuit shown, the coil has inductance and resistance. When X is joined to Y, the time constant is $\tau$ during the growth of the current. When the steady-state is reached, heat is produced in the coil at a rate P. X is now joined to Z.




a) the total heat produced in the coil is $P\tau$

b) the total heat produced in the coil is $2\,P\tau$

c) the total heat produced in the coil $\frac{1}{2}\,P\tau$

d) the data given is not sufficient to reach a conclusion

14. A $100\,\Omega$ resistance and a capacitor of $100\,\Omega$ resistance are connected in series across a 220 V source. When the capacitor is 50% charged, the peak value of the displacement current is

a) 4.4 A b) $11\sqrt{2}$A c) 2.2 A d) 11 A

15. A pair of adjacent coils has a mutual inductance of 1.5 H. If the current in one coil changes from 0 to 20 A in 0.5 s, what is the change of flux linkage with the other coil?

a) 20 Wb b) 30Wb c) 71 Wb d) 63 Wb

**Assertion Reason based questions**

16. Assertion (A) : Electric field is discontinuous across the surface of a spherical charged shell.

Reason (A) : Electric potential is continuous across the surface of a spherical charged shell.

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 but R is true.

17. Assertion (A) : Two protons placed at different distances, between the plates of a parallel plate capacitor experience the same force.

Reason (A) : The electric field between the plates of the capacitor is constant.

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 but R is true.

18. Assertion (A) : A paramagnetic sample display greater magnetisation (for the same magnetising field) when cooled.

Reason (A) : The magnetisation does not depend on temperature.

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 but R is true.

## SECTION B 7 × 2 = 14

19. Name the waves that are often referred to as 'heat waves'. Name the physical quantity that has (i) higher (ii) lower (iii) same value for these Waves, as compared to X-rays.

**OR**

When an ideal capacitor is charged by a dc battery, no current flows. However, when an ac source is used, the current flows continuously. How does one explain this, based on the concept of displacement current?

20. A short bar magnet of magnetic moment 0.9 $JT^{-1}$ is placed with its axis at $30^{o}$ to a uniform magnetic field. It experiences a torque of 0.063J.

    i. Calculate the magnitude of the magnetic field.

    ii. In which orientation will the bar magnet be in stable equilibrium in the magnetic field?

21. A virtual current of 4 A flows in a coil when it is connected in a circuit having alternating current of frequency 50 Hz. Power consumed in the coil is 240 W. Calculate the inductance of the coil if the virtual potential difference across it is 100 V.

22. A battery of 10 V is connected to a capacitor of capacity 0.1 F. The battery is now removed and this capacitor is connected to a second uncharged capacitor . If the charge distributes equally on these two capacitors, find the total energy stored in the two capacitors. Further, compare this energy with the initial energy stored in the first capacitor.

23. Two point charges $q_1$ and $q_2$ are located at points (a, 0, 0) and (0, b, 0) respectively. Find the electric field due to both these charges at the point (0, 0, c).

24. Explain the term 'drift velocity' of electrons in a conductor. Hence obtain the expression for the current through a conductor in terms of 'drift velocity'.

**OR**

State the two Kirchhoff's rules used in electric networks. How are these rules justified?

25. Show that the current leads the voltage in phase by $\pi/2$ in an ac circuit containing an ideal capacitor.

## SECTION C 5 × 3 = 15

i) It is necessary to use satellites for long distance TV transmissions. Why?

ii) If the earth did not have an atmosphere, would its average surface temperature be higher or lower than what it is now? **1**

iii) Some scientists have predicted that a global nuclear war on the earth would be followed by a severe' nuclear winter' with a devastating effect on life on earth. What might be the basis of this prediction?

27. Using Gauss' law, obtain the expression for the electric field due to uniformly charged spherical shell of radius R at a point outside the shell. Draw a graph showing the variation of electric field with r, for r > R and r < R.

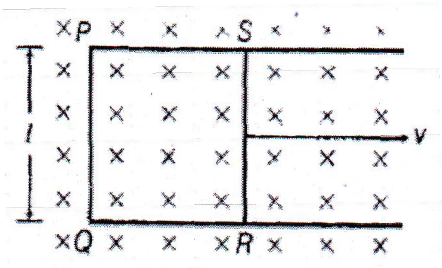
**OR**

Define the term 'electric dipole movement'. Is it a scalar or vector?

Deduce an expression for the electric field at a point on the equatorial plane of an electric dipole of length 2a.

28. The heater coil of an electric kettle is rated at 2000 W, 200 V. How much time will it take in raising the temperature of 1 litre of water from 20°C to 100° C, assuming that only 80% of the total heat energy produced by the heater coil is used in raising the temperature of water. Density of water = 1 g $cm^{-3}$ and specific heat of water = 1 cal $g^{-1}{}^{o}C^{-1}$.

29. Figure shows a rectangular conducting loop PQRS in which arm RS of length l is movable. The loop is kept in a uniform magnetic field B directed downward perpendicular to the plane of the loop. The arm RS is moved with a uniform speed v.




Deduce an expression for

i) the emf induced across the arm RS.

ii) the external force required to move the arm and

iii) the power dissipated as heat.

30. An inductor L of inductance $X_L$ is connected in series with a bulb B and an AC source. How would brightness of the bulb change when

i) number of turn in the inductor is reduced,

ii) an iron rod is inserted in the inductor and

iii) a capacitor of reactance $X_C = X_L$ is inserted in series in the circuit. Justify your answer in each case.

**OR**

A voltage V = Vm sin $\omega t$ is applied across an inductor. Determine the average power dissipated over a cycle, And, hence define watt less current.

**SECTION D** **3 × 5 = 15**

31. A circuit containing a 80 mH inductor and a 60 $\mu F$ capacitor in series is connected to a 230 V 50 Hz supply. The resistance of the circuit is negligible.

a) Obtain the current amplitude and rms values.

b) Obtain the rms values of potential drops across each element.

c) What is the average power transferred to the inductor?

d) What is the average power transferred to the capacitor?

e) What is the total average power absorbed by the circuit? [Average' implies 'averaged over one cycle'.]

**OR**

a) Draw a schematic sketch of an ac generator describing its basic elements. state briefly its working principle. Show a plot of variation of

i) Magnetic, flux and

ii) Alternating emf versus time generated by a loop of wire rotating in a magnetic field.

b) Why is choke coil needed in the use of fluorescent tubes with ac mains?

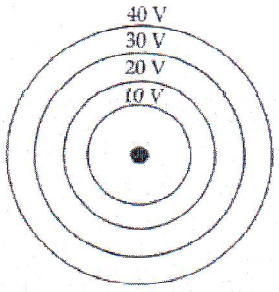
32. i) Two isolated metal spheres A and B have radii R and 2R respectively, and the same charge q. Find which of the two spheres have greater.

a) capacitance and

b) energy density just outside the surface of the spheres

ii) a) Show that the equipotential surfaces are closed together in the regions of a strong field and far apart in the regions of a weak field. Draw equipotential surfaces for an electric dipole.

b) Concentric equipotential surfaces due to a charged body placed at the centre are shown. Identify the polarity of the charge and draw the electric field lines due to it.




**OR**

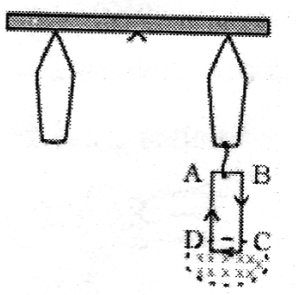
Show by graph how 'q' given to a capacitor varies with its potential difference. Using the graph or otherwise, prove that the energy of a capacitor is 1/2 $CV^2$. Calculate the energy, density of the electrostatic field in a parallel plate capacitor.

33. i) Derive the expression for the magnetic field due to a current carrying coil of radius R at a distance x from the centre along the X-axis.

ii) A straight wire carrying a current of 5A is bent into a semicircular arc of radius 2 cm as shown in the figure. Find the magnitude and direction of the magnetic field at the centre of the arc.

**OR**

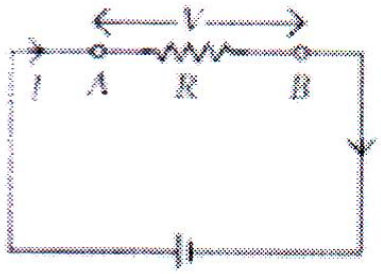
A 100 turn rectangular coil ABCD (in XY plane) is hung from one arm of a balance (figure). A mass 500 g is added to the other arm to balance the weight of the coil. A current 4.9 passes through the coil and a constant magnetic field of 0.2 T acting inward (in xz plane) is switched on such that only arm CD of length 1 cm lies in the field. How much additional mass 'm' must be added to regain the balance?




**SECTION E** **2 × 4 = 8**

34. **Read the source given below and answer the following questions.**

Whenever an electric current is passed through a conductor, it becomes hot after some time. The phenomenon of the production of heat in a resistor by the flow of an electric current through it is called heating effect of current or Joule heating. Thus, the electrical energy supplied by the source of emf is converted into heat. In purely resistive circuit, the energy expended by the source entirely appears as heat. But if the circuit has an active element like a motor then a part of the energy supplied by the source goes to do useful work and the rest appears as heat. Joule's law of heating form the basis of various electrical appliances such as electric bulb, electric furnace, electric press etc.




i) If the coil of a heater is cut to half, what would happen to heat produced? **1**

ii) Find the heat emitted by a bulb of 100 W in 1 min. **1**

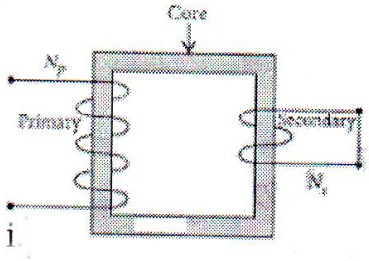
iii) A 25 W and 100W bulbs are joined in series and connected to the mains. Which bulbs will glow brighter? Give reason. **2**

**OR**

A rigid container with thermally insulated wall contains a coil of resistance 100 $\Omega$, carrying current 1A. What will be the change in its internal energy after 5 min. Why a conductor heats up when electric current is passed through it?

35. **Read the passage given below and answer the following questions.**

Step-down transformers are used to decrease or step-down voltages. These are used when voltages need to be lowered for use in homes and factories. A small town with a demand of 800 kW of electric power at 220V is situated 15 km away from an electric plant generating power at 440 V. The resistance of the two wireline carrying power is $0.5\,\Omega$ per km. The town gets power from the line through a 4000 - 220 V step-down transformer at a sub-station in the town.




i) Find the value of total resistance of the wire. **1**

ii) How much power must the plant supply, assuming there is negligible power loss due to leakage? **1**

iii) Find the line power loss in the form of heat. Write the various power losses in a transformer. **2**

**OR**

Calculate the current drawn by the primary of a transformer which steps down 200 V to 20 V to operate a device of resistance $20\,\Omega$. Assume the efficiency of the transformer to be 80%.