(SESSION 2024-25)

BASAVA INTERNATIONAL SCHOOL

TERM1 EXAMINATION

PHYSICS (042)

CLASS: XII **M.M. 70**

DATE: 9.9.24 **TIME: 3 HRS**

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 Dand Section E.

(3) Section A contains 16 very short answer questions and four assertion reasoning MCQs of 1 mark each, Section B contains 5 short answer questions of 2 marks each, Section C contains seven short answer questions of 3 marks each, Section D contains two questions of 4 marks each and Section E contains 3 long answer questions.

(4) There is no overall choice. However internal choice is provided. You must attempt only one of the choices in such questions.

Section – A

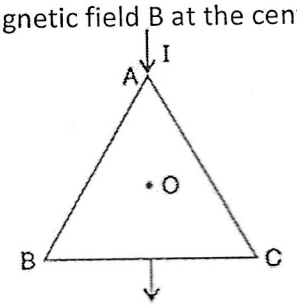
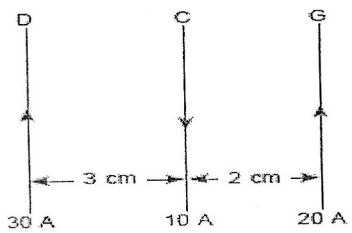
Q1 Two equal and opposite charges of 2×10^{-10} C are placed at a distance of 1 cm forming a dipole and placed in an electric field of 2×10^{5} N/C. The maximum torque on the dipole is 1

(a) 4×10^{-7} Nm (b) 8×10^{8} Nm (c) $2\sqrt{2} \times 10$ Nm (d) 4×10^{7} Nm

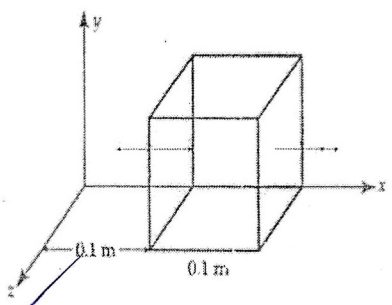
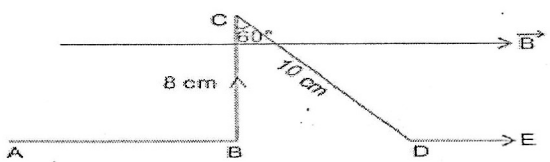
Q2 When two charged conductors are connected by a wire 1

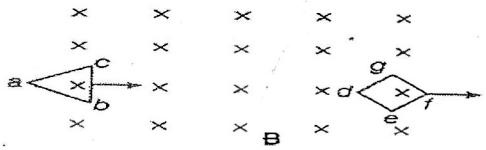
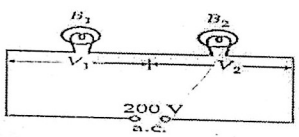
(a) there is always gain of energy (b) there is loss or gain of energy depending on the potentials (c) there will not be any change in energy (d) there is always loss of energy

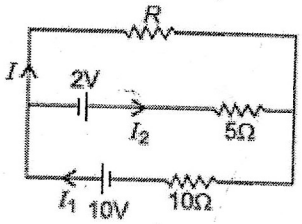
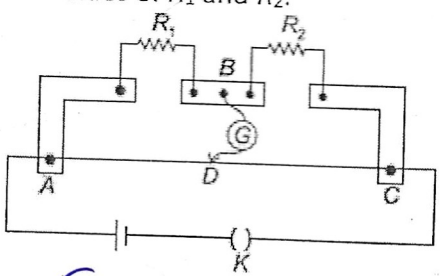
Q3 Work done in moving a unit positive charge through a distance of x metre on an equipotential surface is: (a) 1/x joule (b) zero (c) $1/x^2$ joule (d) x^2 joule 1

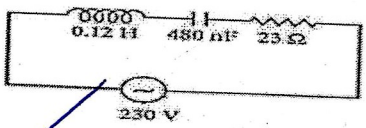
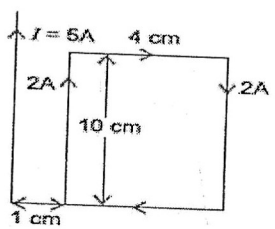
Q4	Two unequal resistors are connected in series across a battery. Then the (a) potential difference across the bigger resistor is greater (b) power dissipated in both resistors is the same (c) potential difference across each resistor is same. (d) current in the smaller resistor is large.	1
Q5	An equilateral triangle is made by uniform wires AB, BC, CA. A current I enters at A and leaves from the mid-point of BC. If the lengths of each side of the triangle is L, the magnetic field B at the centroid O of the triangle is:  (a) $(\mu_0/4\pi)\ 4I/L$ (B) $(\mu_0/4\pi)\ 2I/L$ (C) ZERO (D) $(\mu_0/2\pi)\ 4I/L$	1
Q6	At a point on the right bisector of a magnetic dipole, the magnetic: (a) field varies as r^3 (b) potential is zero at all points (c) field is perpendicular to the axis of dipole (d) potential varies as $1/r^2$	1
Q7	Three long, straight parallel wires, carrying current are arranged as shown in the figure. The force experienced by a 25 cm length of wire C is  (a) 10^{-3} N (b) 2.5×10^{-3} N (c) zero (d) 1.5×10^{3} N	1
Q8	Whenever the flux linked with a circuit changes, there is an induced emf in the circuit. This emf in the circuit lasts (a) forever (b) as long as the magnetic flux in the circuit changes (c) for a long duration (d)) for a very short duration	1

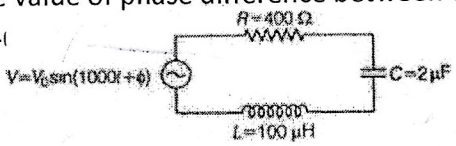
Q9	A series circuit consists of an ac source of variable frequency, a 115.0 Ω resistor, a 1.25 μF capacitor, and a 4.50 mH inductor. The impedance of this circuit when the angular frequency of the ac source is adjusted to half the resonant angular frequency is: (a) 156.0 Ω (b) 166.0 Ω (c) 176.0 Ω (d) 146.0 Ω	1
Q10	In a series LR circuit, $X_L = 3R$. If a capacitor with $X_C = R$ is added in series, the ratio of new to old power factor is : (a) 1/√2 (b) 2 (c) 1 (d) √2	1
Q11	An e m wave is propagating in a medium with a velocity $\vec{V} = V\hat{i}$. The instantaneous oscillating electric field of this e m wave is along +y axis. Then the direction of the oscillating magnetic field of the e m wave will be along: (a) -y direction (b) -x direction (c) +z direction (d) -z direction	1
Q12	Which of the following electromagnetic radiations have the longest wavelength? (a) Microwaves (b) γ-rays (c) X-rays (d) Radio waves	1
Q13	**Assertion (A):** The conductivity of an electrolyte is very low as compared to metal at room temperature **Reason (R):** The number density of free ions in electrolytes is much smaller compared to the number density offree electrons in metals. Further, ions drift much more slowly, being heavier (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.	1
Q14	**Assertion (A):** When two identical loops of copper and Aluminium are rotated with the same speed in the samemagnetic field, the induced e.m.f. will be the same. **Reason (R):** Resistance of the two loops are equal. (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.	1
Q15	**Assertion (A):** If the frequency of the alternating current in an ac circuit consisting of an inductance coil is increased then the current gets decreased. **Reason (R):** The current is inversely proportional to the frequency of the alternating current	1

	(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.	1
Q16	**Assertion (A):** The eye is most sensitive for the light of frequency 5.36×10^{14} Hz. **Reason (R):** The frequency of light is directly proportional to wavelength of light. (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.	1
	Section B	
Q17	a. Using Gauss's law, prove that the electric field at a point due to a uniformly charged infinite plane sheet is independent of the distance from it. b. How is the field directed if (i) the sheet is positively charged (ii) negatively charged? OR The electric field components due to a charge inside the cube of side 0.1 m are as shown. $E_X = ax$, where a = 100 N/C-m, $E_Y = 0$, $E_Z = 0$  Calculate: (i) the flux through the cube, and (ii) the charge inside the cube.	2
Q18	Find the magnitude of the force on each segment of the wire as shown in figure, if a magnetic field of 0.30 T, is applied parallel to AB and DE. Take the value of the current, flowing in the wire as 1 ampere. 	2

Q19	Two loops of different shapes are moved into a region of uniform magnetic field in the directions marked by arrows as shown in the figure. What is the direction of the induced current in each loop?  OR Derive an expression for self inductance of a long solenoid.	2
Q20	When 200 volts d.c. are applied across a coil, a current of 2 ampere flows through it. When 200 volts a.c. of 50 cps are applied to the same coil, only 1.0 ampere flows. Calculate the resistance, impedance and inductance of the coil.	2
Q21	Identify the following electromagnetic radiations as per the wavelengths given below. Write one application of each. a. 1 mm b. 10^{-3} nm c. 10^{-8} m	2
	Section C	
Q22	Using Gauss's law deduce the expression for the electric field due to a uniformly charged spherical conducting shell of radius *R* at a point (i) outside and (ii) inside the shell. Plot a graph showing variation of electric field as a function of $r > R$ and $r < R$. (*r* being the distance from the centre of the shell)	3
Q23	What is parallel plate capacitor? Derive an expression for its capacity.	3
Q24	Two bulbs B_1 and B_2 are connected in series with an a.c. source of emf 200 V, as shown in Figure. The labels on the bulbs read 200 V, 60 W and 200 V, 100 W respectively  Calculate the ratio of: (i) The resistances $R_1/_2$, (ii) p.d. across the bulbs, V_1/V_2, (iii) The power being consumed when connected in series, P_1/P_2.	3

Q25	Two cells of E.M.F. 10 V and 2 V and internal resistances 10 Ω and 5 Ω respectively, are connected in parallel as shown. Find the effective voltage across *R*. 	3
Q26	An aeroplane is flying horizontally from west to east with a velocity of 900 km/h. Calculate the potential difference developed between the ends of its wings having a span of 20 m. The horizontal component of Earth's magnetic field is 5×10^{-4} T and angle of dip is 30^0.	3
Q27	In the meter bridge experiment set up, shown in the figure, the null point *D* is obtained at a distance of 40 cm from end *A* of the meter bridge wire. If a resistance of 10 Ω is connected in series with R_1, null point is obtained at *AD* = 60 cm. Calculate the values of R_1 and R_2. 	3
Q28	(a) Which of the following, if any, can act as a source of electromagnetic waves? (i) A charge moving with a constant velocity. (ii) A charge moving in a circular orbit. (iii). A charge at rest. (b) Identify the part of the electromagnetic spectrum, to which waves of frequency (i) 10^{20} Hz, (ii) 10^9 Hz belong.	3
	SECTION D	
Q29	Read the text carefully and answer the questions: Static charges do not experience any force. The charge when moving in a magnetic field experience a force. This force depends upon the magnetic field, charge and the velocity component perpendicular to the direction of magnetic field. Fleming's left hand rule can be used to determine the direction of force on a charge particle. (i) Work done by a magnetic field on a charged particle is (a) $(\frac{1}{2})mv^2$ (b) $(3/4)\ mv^2$ (c) zero (d) $(4/3)\ mv^2$ (ii) S.I. unit of magnetic field is . (a) Newton (b) Pascal (c) Tesla (d) Coulomb	4

	(iii) A charged particle moving antiparallel to the magnetic field (a) experiences force (b) Do not experiences force (c) will stop moving (d) none (iv) What is the force on a proton entering in a magnetic field of density 2.5 T with velocity 10^7 m/s at an angle of 60^0 with the field (a) 2.4×10^{-12} N (b) 4.2×10^{-12} N (c) 3.4×10^{-12} N (d) 4.3×10^{-12} N	
Q30	*Read the para given below and answer the questions that follow:* Resonant Series LCR Circuit. When the frequency of ac supply is such that the inductive reactance and capacitive reactance become equal, the impedance of the series LCR circuit is equal to the ohmic resistance in the circuit. Such a series LCR circuit is known as resonant series LCR circuit and the frequency of the ac supply is known as resonant frequency. Resonance phenomenon is exhibited by a circuit only if both L and C are present in the circuit. We cannot have resonance in a RL or RC circuit. A series LCR circuit with L = 0.12 H, C = 480 nF, R = 23 Ω is Connect to a 230 V variable frequency supply.  (a) Find the value of source frequency for which current amplitude is maximum. (b) What will be the value of maximum current? (c) Find the value of maximum power. (d) What is the Q-factor of the given circuit?	4
	Section E	
Q31	(i) A rectangular loop of wire of size 4 cm × 10 cm carries a steady current of 2 A. A straight long wire carrying 5 A current is kept near the loop as shown. If the loop and the wire are coplanar, find (i) the torque acting on the loop and (ii) the magnitude and direction of the force on the loop due to the current carrying wire.  (ii) Deduce the expression for the magnetic dipole moment of an electron orbiting around the central nucleus	5
Q32	(i) State Ampere's circuital law, expressing it in integral form. (ii) A long straight wire of a circular cross- section of radius 'a' carries a steady current	5

	i. The current is uniformly distributed across the cross-section. Apply Ampere's circuital law to calculate the magnetic field at a point at distance (r) in the region for (i) r< a (ii) r> a	
Q33	(i). Determine the value of phase difference between the current and the voltage in the given series L-C  (ii). Calculate the value of additional capacitor which may be joined suitably to the capacitor C that would make the power factor of the circuit unity. OR (i). With the help of a labelled diagram, describe the principle and working of an ac generator. Hence, obtain an expression for the instantaneous value of the emf generated. (ii). The coil of an ac generator consists of 100 turns of wire, each of area 0.5 m^2. The resistance of the wire is 100 Ω.The coil is rotating in a magnetic field of 0.8 T perpendicular to its axis of rotation, at a constant angular speed of 60 radian/ sec. Calculate the maximum emf generated and power dissipated in the coil.	5

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