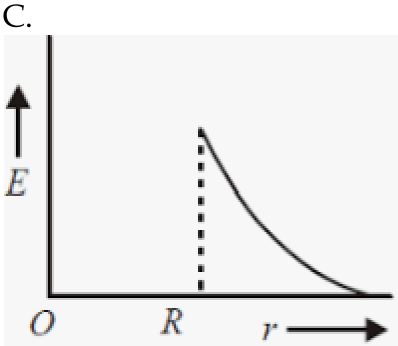
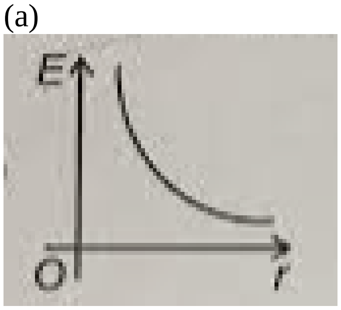
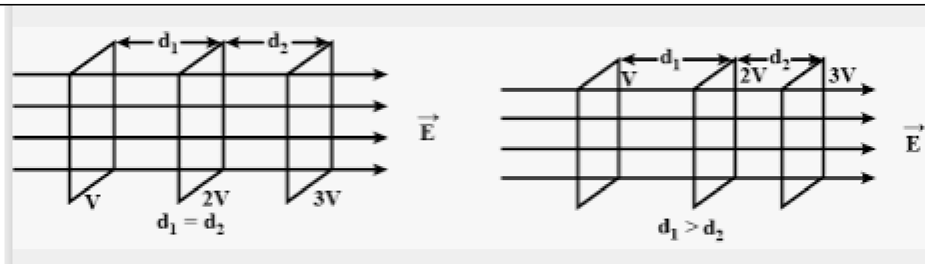
SET	B

INDIAN SCHOOL MUSCAT
HALF YEARLY EXAMINATION 2022
PHYSICS(042)

CLASS:XII Max.Marks: 70

MARKING SCHEME			
SET	QN.NO	VALUE POINTS	MARKS SPLIT UP
B	1	A. $T_1 > T_2$	1
	2	A. -r, ε	1
	3	B. Anticlockwise	1
	4	A. B/4	1
	5	B π/2	1
	6	C. 	1
	7	D $1.8 \times 10^5\ Nm^2\ C^{-1}$	1
	8	C. σ/ε_0	1
	9	A. 90^0	1
	10	B. 10V	1
	11	A 0.1 V	1
	12	A conservation of electric charge and energy respectively	1
	13	A. 1 Ω	1

	14	(i) Both Assertion(A)and Reason(R) are true and Reason(R) is the correct explanation of A	1
	15	(ii) Both Assertion(A)and Reason(R) are true but Reason(R) is not the correct explanation of A.	1
	16	(i) Both Assertion(A)and Reason(R) are true and Reason(R) is the correct explanation of A	1
	17	(i) Both Assertion(A)and Reason(R) are true and Reason(R) is the correct explanation of A.	1
	18	(iii) Assertion(A) is true but Reason(R) is false.	1
	19	series	1
	20	radial	1
	21	Along (in)	1
	22	charges	1
	23	(i) B zero (ii) C (iii) D a force and a torque (iv) A (v) D 4 τ	4
	24	(i) D V/m (ii) B (iii) A 4 (iv) C They always form closed loops. (v) A radially outwards	4
	25	(a)  (b) Electric lines of force never intersect because, at the point of intersection, two tangents can be drawn to the two lines of force. This means two directions of the electric field at the point of intersection, which is not possible OR (a) Charge on each sphere $= \frac{q_1+q_2}{2} = \frac{q_A - 3q_A}{2} = -q_A$ (b) It is a scalar quantity SI unit is Volt	2 1 1 1 ½ + ½

	26		1+1
	27	(a) capacitance will increase K times (If K times not written reduce ½ mark) (b) charge on the plates increases by K (If K times not written reduce ½ mark)	1each
	28	Magnitude of Drift velocity/unit electric field No change	1 1
	29	**Given :** $l = 20\text{ cm} = (20 \times 10^{-2})\text{ m}$ $I_1 = 1\text{ A}, \quad r_1 = 10\text{ cm} = 10 \times 10^{-2}\text{ m}$ $I_2 = 2\text{ A}, \quad r_2 = 30\text{ cm} = 30 \times 10^{-2}\text{ m}$ $F = \mu_0 I_1 I_2 l \left(\frac{1}{r_1} - \frac{1}{r_2}\right)$ $= (2 \times 10^{-7}) \times (1) \times (2) \times (20 \times 10^{-2}) \left[\frac{1}{10 \times 10^{-2}} - \frac{1}{30 \times 10^{-2}}\right]$ $= 5.3 \times 10^{-7}\text{ N}$ The direction of force is towards the infinitely long straight wire. OR $F_{\text{repulsion}} = mg$ $\frac{\mu_0 I_1 I_2 l}{2\pi r} = mg$ $\therefore \quad \left(\frac{m}{l}\right) = \frac{\mu_0 I_1 I_2}{2\pi r g}$ $= \frac{2 \times 10^{-7} \times 10 \times 6}{2 \times 10^{-3} \times 10}$ $= 6 \times 10^{-4}\text{ kg/m}$ Current in both wires should be opposite, so both conductors repel each other.	½ + ½ 1 ½ ½
	30	Gauss's law -statement. Derivation for the electric field intensity due to an infinitely large, plane sheet of charge of charge density σ C/m^2 (diagram+ derivation)	1 ½ +1 ½
	31	Capacitor-definition Deriving expression for the capacitance of the capacitor.	1 2

	32	(i) $W_1 = W_2$.	1
		(ii) Electric field intensity is zero inside the hollow spherical charged conductor. So, no work is done in moving a test charge inside the conductor and on its surface. Therefore, there is no potential difference between any two points inside or on the surface of the conductor.	1
		(iii) Yes. Electric field on the equatorial line of dipole is not zero but potential is zero.	½+1/2
		OR	1
		(i) The work done by the field is negative. This is because the charge is moved against the force exerted by the field.	
		(ii) The work done in moving a charge from one point to another on an equipotential surface is zero. If electric field is not normal to the equipotential surface, it would have non-zero component along the surface. In that case work would be done in moving a charge on an equipotential surface.	1
		(iii) Charge remains the same, potential gets lowered	½+ ½
	33	The acceleration, $\vec{a} = -\frac{e}{m}\vec{E}$	½
		The average drift velocity is given by, $v_d = -\frac{eE}{m}\tau$	
		(τ = average time between collisions or relaxation time)	
		If n is the number of free electrons per unit volume, the current I is given by $I = neA\|v_d\|$ $= \frac{e^2A}{m}\tau n\|E\|$	½
		But $I = \|j\|A$ (where j= current density) Therefore, we get $\|j\| = \frac{ne^2}{m}\tau\|E\|$.	½
		The term $\frac{ne^2}{m}\tau$ is conductivity.	½
		$\therefore \sigma = \frac{ne^2\tau}{m}$ $\Rightarrow J = \sigma E$	1
		OR	
			1
			1

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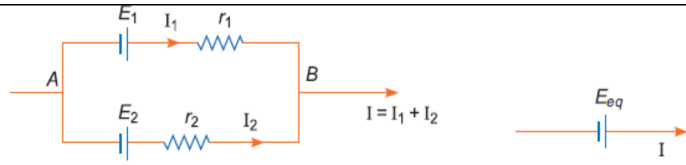

(a) (b)

Let I_1 and I_2 be the currents leaving the positive, terminals of the cells, and at the point B

$$I = I_1 + I_2 \qquad \ldots(i)$$

Let V be the potential difference between points A and B of the combination of the cells, so

$$V = E_1 - I_1 r_1 \qquad \ldots(ii) \text{ (across the cells)}$$

and $$V = E_2 - I_2 r_2 \qquad \ldots(iii)$$

From equation (i), (ii) and (iii), we get

$$I = \frac{(E_1 - V)}{r_1} + \frac{(E_2 - V)}{r_2}$$

$$= \left(\frac{E_1}{r_1} + \frac{E_2}{r_2}\right) - V\left(\frac{1}{r_1} + \frac{1}{r_2}\right) \qquad \ldots(iv)$$

Fig. (b) shows the equivalent cell, so for the same potential difference

$$V = E_{eq} - I r_{eq}$$

or $$I = \frac{E_{eq}}{r_{eq}} - \frac{V}{r_{eq}} \qquad \ldots(v)$$

On comparing Eq. (iv) and (v), we get

$$\frac{E_{eq}}{r_{eq}} = \frac{E_1}{r_1} + \frac{E_2}{r_2}$$

and $$\frac{1}{r_{eq}} = \frac{1}{r_1} + \frac{1}{r_2} \quad \Rightarrow \quad r_{eq} = \frac{r_1 r_2}{r_1 + r_2}$$

On further solving, we have

$$E_{eq}\left(\frac{1}{r_1} + \frac{1}{r_2}\right) = \frac{E_1}{r_1} + \frac{E_2}{r_2}$$

$$\Rightarrow \qquad E_{eq} = \frac{E_1 r_2 + E_2 r_1}{r_1 + r_2}$$
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<td>½

½</td>
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Similarities:
Both electrostatic field and magnetic field:
(*i*) follows the principle of superposition.
(*ii*) depends inversely on the square of distance from source to the point of interest.
Differences:
(*i*) Electrostatic field is produced by a scalar source (q) and the magnetic field is produced by a vector source (Idl)
(*ii*) Electrostatic field is along the displacement vector between source and point of interest; while magnetic field is perpendicular to the plane, containing the displacement vector and vector source.
(*iii*) Electrostatic field is angle independent, while magnetic field is angle dependent between source vector and displacement vector.(any two)
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<td>½+ ½

1+1</td>
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<td>Statement of Biot-Savart's law
Derivation for the magnetic field at the centre of a circular coil of radius R, number of turns N, carrying current I(diagram+derivation)</td>
<td>1

1+2</td>
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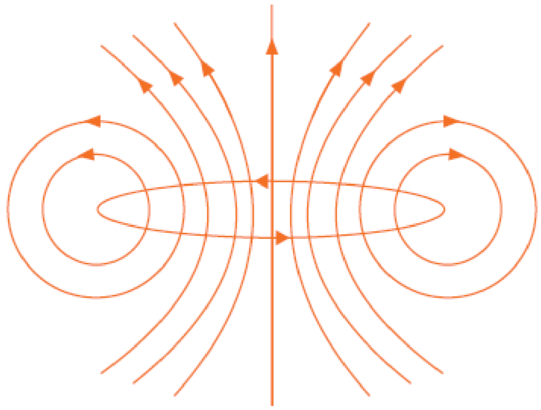
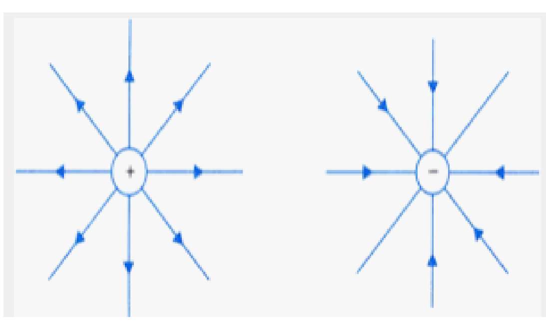
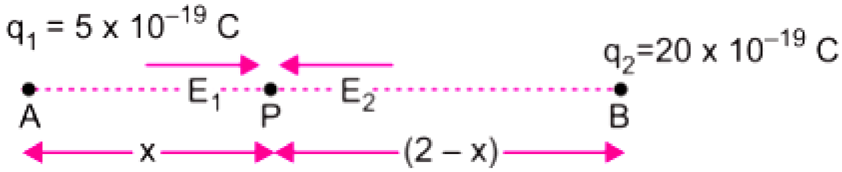
		 OR (a) labelled diagram of a moving coil galvanometer. Its principle and working. (b) (i) The cylindrical, soft iron core makes the field radial and increases the strength of the magnetic field, *i.e.*, the magnitude of the torque. (ii) Explanation for (increasing the current sensitivity of a galvanometer may not necessarily increase its voltage sensitivity.)	1 1 ½+1 ½ 1 1
	36	(a) Expression for the electric field intensity at any point outside a uniformly charged thin spherical shell of radius R and charge density σ C/m^2. (b)  (c) $$\frac{1}{4\pi\varepsilon_0}\frac{q_1}{x^2} = \frac{1}{4\pi\varepsilon_0}\frac{q_2}{(2-x)^2}$$	2 ½ + ½ ½ ½

			
		Given, $q_1 = 5\times10^{-19}$ C, $q_2 = 20\times10^{-19}$ C	½ + ½
		Therefore, $\frac{5\times10^{19}}{x^2} = \frac{20\times10^{19}}{(2-x)^2}$	
		or $\frac{1}{2} = \frac{x}{2-x}$	
		or $x = \frac{2}{3}m$	1
		OR	
		(a) (i) An electric dipole is held in a uniform electric field.- suitable diagram	½
		showing that it does not undergo any translatory motion	1
		deriving an expression for torque acting on it	½
		specifying direction of torque	½
		(b) $q_1 + q_2 = 7 \times 10^{-6}$ C $\frac{1}{4\pi\varepsilon_0}\frac{q_1 q_2}{(0.30)^2} = 1 \Rightarrow q_1 q_2 = (4\pi\varepsilon_0)(0.30)^2$ or $q_1 q_2 = \frac{1}{9\times10^9}\times9\times10^{-2} = 10^{-11}$ $(q_1 - q_2)^2 = (q_1 + q_2)^2 - 4q_1q_2$ $= (7\times10^{-6})^2 - 4\times10^{-11}$ $= 49 \times 10^{-12} - 40 \times 10^{-12} = 9 \times 10^{-12}$ $q_1 - q_2 = 3\times10^{-6}$ C Solving (*i*) and (*iii*), we get $q_1 = 5\times10^{-6}$ C, $q_2 = 2\times10^{-6}$ C $\Rightarrow q_1 = 5\ \mu$C, $q_2 = 2\ \mu$C	1 ½
	37	(a) (a) Definition- relaxation time	1 2

		Deriving an expression for drift velocity of free electrons in a conductor in terms of relaxation time (b) Resistivity of the material of a conductor depends upon the relaxation time, *i.e.*, temperature and the number density of electrons. (c)This is because constantan and manganin show very weak dependence of resistivity on temperature. OR (a) Kirchhoff 's first and second rule. (b) circuit diagram showing balancing of Wheatstone bridge obtaining the balance condition in terms of the resistances of four arms of Wheatstone Bridge.	1 1 1+1 1 2