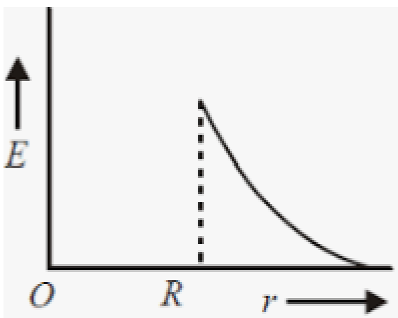
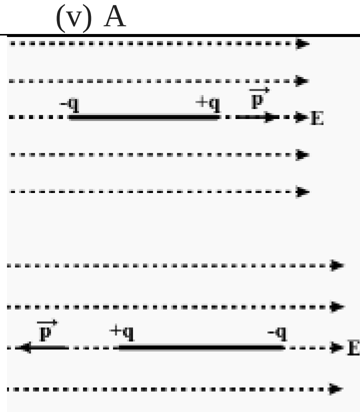
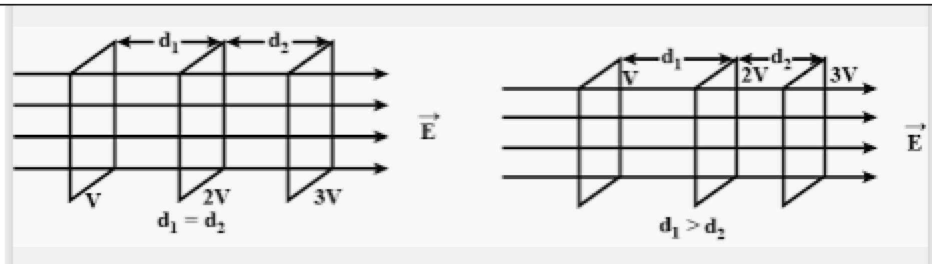
SET	A

INDIAN SCHOOL MUSCAT
HALF YEARLY EXAMINATION 2022
PHYSICS (042)

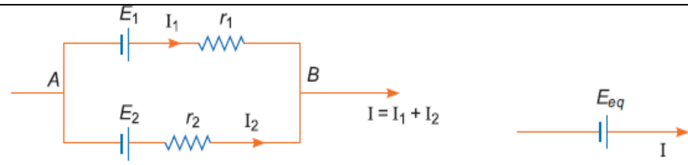
CLASS:XII Max.Marks: 70

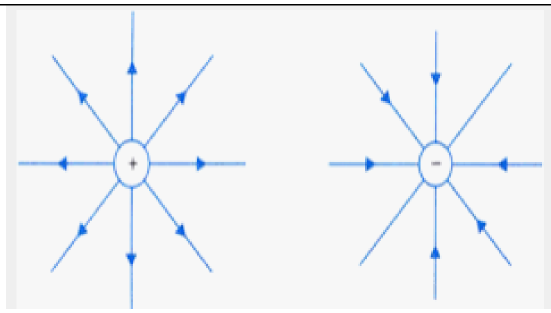
MARKING SCHEME			
SET	QN.NO	VALUE POINTS	MARKS SPLIT UP
A	1	C. 	1
	2	D 1.8 x 10^5 Nm^2 C^{-1}	1
	3	C. σ/ε_0	1
	4	B. 90^0	1
	5	B. 10V	1
	6	A. 0.1 V	1
	7	A. conservation of electric charge and energy respectively	1
	8	A. 1 Ω	1
	9	A. $T_1 > T_2$	1
	10	A. -r, ε	1
	11	B. Anticlockwise	1
	12	B. B/4	1
	13	B.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

	14	(i) Both Assertion(A)and Reason(R) are true and Reason(R) is the correct explanation of A	1
	15	(i) Both Assertion(A)and Reason(R) are true and Reason(R) is the correct explanation of A.	1
	16	(iii) Assertion(A) is true but Reason(R) is false.	1
	17	(i) Both Assertion(A)and Reason(R) are true and Reason(R) is the correct explanation of A	1
	18	(ii) Both Assertion(A)and Reason(R) are true but Reason(R) is not the correct explanation of A.	1
	19	Torsional constant	1
	20	repel	1
	21	opposite	1
	22	force	1
	23	(i) C They always form closed loops. (ii) A radially outwards (iii)B (iv)D 4 (v) D V/m	4
	24	(i) D a force and a torque (ii) B zero (iii) C 90^0 to the direction of the field (iv)D 4 τ (v) A	4
	25	 OR The electric dipole moment is defined as the product of either charge and the distance between the two charges. Electric dipole moment is a vector quantity. Its SI unit is coulomb-metre.	1+1 1 ½ ½

	26		1+1
	27	(a) capacitance will increase K times(If decrease by K not written reduce ½ mark) (b) potential difference between the plates decreases by K(If decrease by K not written reduce ½ mark)	1each
	28	(a) Drift velocity halved (b) No change	1+1
	29	$F = \frac{\mu_0}{4\pi}\frac{2I_1I_2}{r} = mg$ Here, m is mass per unit length $10^{-7} \times \frac{2 \times 12 \times 5}{1 \times 10^{-3}} = m \times 10$ $m = 10^{-7} \times \frac{2 \times 12 \times 5}{1 \times 10^{-3}} \times \frac{1}{10}$ $= 1.2 \times 10^{-3} kgm^{-1}$ Current in both wires should be opposite, so both conductors repel each other. OR Force on side AB F_{AB} $= 10^{-7} \times \frac{2 \times 2 \times 1}{2 \times 10^{-2}} \times 15 \times 10^{-2}$ $= 3 \times 10^{-6} N$ Force on side CD $F_{AB} = 10^{-7} \times \frac{2 \times 2 \times 1}{12 \times 10^{-2}} \times 15 \times 10^{-2}$ $= 0.5 \times 10^{-6} N$ Hence net force on loop $= F_{AB} - F_{CD} = 25 \times 10^{-7} N$ (towards the wire).	½ 1 ½ 1 ½ ½ ½ ½ ½ ½ ½

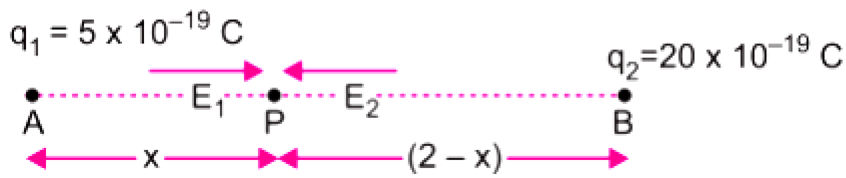
	30	Gauss's law -statement. Derivation for the electric field intensity due to an infinitely long, straight wire of linear charge density λ C/m.(diagram+ derivation)	1 ½ +1 ½
	31	Capacitor-definition Deriving expression for the capacitance of the capacitor.	1 2
	32	(i) $W_1 = W_2$. (ii) Electric field 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. (iii)The dielectric constant of a medium may be defined as the ratio of capacitance of capacitor completely filled with that dielectric medium to the capacitance of the same capacitor with vacuum between its plates. OR (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. (iii)The maximum electric field that a dielectric medium can withstand without breakdown (of its insulating property) is called its dielectric strength.	1 1 1 1 1 1
	33	The acceleration, $\vec{a} = -\frac{e}{m}\vec{E}$ 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 $I = neA\|v_d\|$ $= \frac{e^2A}{m}\tau n\|E\|$ But $I = \|j\|A$ (where j= current density) Therefore, we get $\|j\| = \frac{ne^2}{m}\tau\|E\|$. The term $\frac{ne^2}{m}\tau$ is conductivity. $\therefore \sigma = \frac{ne^2\tau}{m}$ $\Rightarrow \quad J = \sigma E$ OR	½ ½ ½ ½ 1

		(a) (b) Let I_1 and I_2 be the currents leaving the positive, terminals of the cells, and at the point B $I = I_1 + I_2$ ...(i) Let V be the potential difference between points A and B of the combination of the cells, so $V = E_1 - I_1 r_1$ ...(ii) (across the cells) and $V = E_2 - I_2 r_2$ ...(iii) From equation (i), (ii) and (iii), we get $I = \frac{(E_1 - V)}{r_1} + \frac{(E_2 - V)}{r_2}$ $= \left(\frac{E_1}{r_1} + \frac{E_2}{r_2}\right) - V\left(\frac{1}{r_1} + \frac{1}{r_2}\right)$ ...(iv) Fig. (b) shows the equivalent cell, so for the same potential difference $V = E_{eq} - I r_{eq}$ or $I = \frac{E_{eq}}{r_{eq}} - \frac{V}{r_{eq}}$ ...(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 $\frac{1}{r_{eq}} = \frac{1}{r_1} + \frac{1}{r_2} \Rightarrow r_{eq} = \frac{r_1 r_2}{r_1 + r_2}$ On further solving, we have $E_{eq}\left(\frac{1}{r_1} + \frac{1}{r_2}\right) = \frac{E_1}{r_1} + \frac{E_2}{r_2}$ $\Rightarrow E_{eq} = \frac{E_1 r_2 + E_2 r_1}{r_1 + r_2}$	1 1 ½ ½
	34		½+ ½ 1+1
	35	(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)	2 ½ + ½



(c)

$$\frac{1}{4\pi\varepsilon_0}\ \frac{q_1}{x^2} = \frac{1}{4\pi\varepsilon_0}\ \frac{q_2}{(2-x)^2}$$ ½



½

Given, $q_1 = 5\times10^{-19}$ C, $q_2 = 20\times10^{-19}$ C

Therefore, $\frac{5\times10^{19}}{x^2} = \frac{20\times10^{19}}{(2-x)^2}$

or $\frac{1}{2} = \frac{x}{2-x}$ ½ + ½

or $x = \frac{2}{3}m$

OR

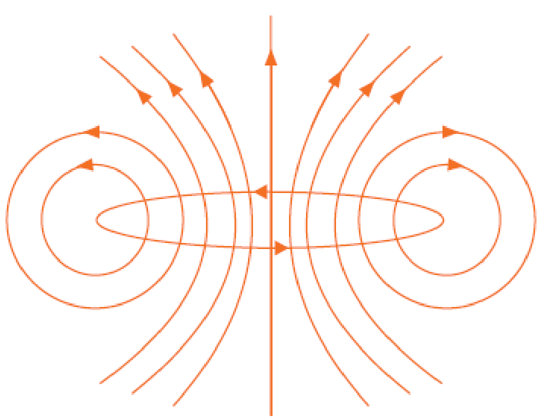
(a) (i) An electric dipole is held in a uniform electric field.- suitable diagram 1

showing that it does not undergo any translatory motion ½

deriving an expression for torque acting on it 1

specifying direction of torque ½

(b) ½

		$q_1 + q_2 = 7 \times 10^{-6}$ 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 $\Rightarrow$ $q_1 = \mathbf{5\ \mu C}$, $q_2 = \mathbf{2\ \mu C}$	1 ½
	36	(a) Definition- relaxation time 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 (c) obtaining the balance condition in terms of the resistances of four arms of Wheatstone Bridge.	1 2 1 1+1 1 2
	37	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)  OR (a) labelled diagram of a moving coil galvanometer. Its principle and working.	1 1+2 1 1

		(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.)	½+1 ½ 1 1