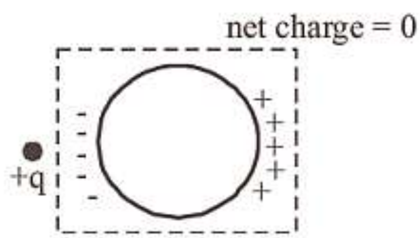
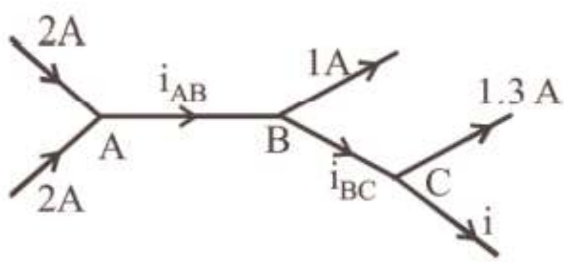
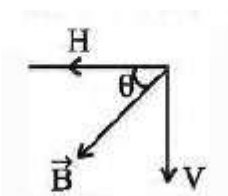
	# Sample Question Paper (TERM - I)
	## Solutions
	<u>Section – A</u>
1.	**Solution:** (d) They form closed loop **Explanation:** Electric field lines do not form closed loop. This follows from the conservative nature of electric field.
2.	**Solution:** (d) -12 V **Explanation:** (d) When negative terminal is grounded, positive terminal of battery is at $+12$ V. When positive terminal is grounded, the negative terminal will be at -12 V.
3.	**Solution:** (c) 2.24×10^{-16} J **Explanation:** $\frac{W_{PQ}}{q} = (V_Q - V_P)$ $\Rightarrow W_{PQ} = q(V_Q - V_P)$ $= (-100 \times 1.6 \times 10^{-19})(-4 - 10)$ $= +2.24 \times 10^{-16}$ J
4.	**Solution:** (a) $\mu_0 \mu_r$ **Explanation:** Relative magnetic permeability $\mu_r = \frac{\mu}{\mu_o} \Rightarrow \mu = \mu_o \times \mu_r$
5.	**Solution:** (a) 4.00 **Explanation:** $H = I^2 Rt$. Here $R_1 = \rho \frac{\ell}{\pi r^2}$ and $R_2 = \rho \frac{\ell}{\pi (2r)^2}$ That is, $R_1 = 4R_2$. Hence, $\frac{H_1}{H_2} = 4$.
6.	**Solution:** (b) 2 **Explanation:** The charge through the coil = area of current-time $(i - t)$ graph $q = \frac{1}{2} \times 0.1 \times 4 = 0.2C$ $q = \frac{\Delta\phi}{R}$ [$\because$ Change in flux $(\Delta\phi) = q \times R$] $q = 0.2 = \frac{\Delta\phi}{10}$ $\Delta\phi = 2$ weber

7.	**Solution:** (b) $10^{-3}\Omega$ in parallel **Explanation:** Here, $R_g = 100\Omega; I_g = 10^{-5}$ A; I = 1 A; S =? $S = \frac{I_g R_g}{I - I_g} = \frac{10^{-5} \times 100}{1 - 10^{-5}} = 10^{-3}\Omega$ in parallel
8.	**Solution:** (d) The electron will continue to move with uniform velocity along the axis of the solenoid **Explanation:** Let the electron (e) is projected with a uniform velocity (v) in a uniform magnetic field B. The magnitude of force on it is $\lvert\vec{F}\rvert = -e\lvert\vec{v} \times \vec{B}\rvert = -evB\sin\theta$ As $\theta = 0^0$, $\lvert\vec{F}\rvert = -evB\sin 0^0$ Hence the electron will continue to move with uniform velocity along the axis of the solenoid.
9.	**Solution:** (b) $E_a = 2E_e$ **Explanation:** We have $E_a = \frac{2kp}{r^3}$ and $E_e = \frac{kp}{r^3}$; $\therefore E_a = 2E_e$
10.	**Solution:** (b) T, T, F, F **Explanation:** (i) Lorentz force depends on q, **v** and **B** (charge of the particle, the velocity and the magnetic field). Force on a negative charge is opposite to that on a positive charge. (ii) The magnetic force $q[\mathbf{v} \times \mathbf{B}]$ includes a vector product of velocity and magnetic field. The vector product makes the force due to magnetic field vanish (become zero) if velocity and magnetic field are parallel or anti-parallel. The force acts in a (sideways) direction perpendicular to both the velocity and the magnetic field. Its direction is given by the screw rule.
11.	**Solution:** (a) it measures potential in open circuit **Explanation:** Potentiometer measures voltage when galvanometer shows zero current rating, mean it takes zero current (open circuit) while measuring voltage across any component, that is why it is more accurate as all the current passing through that component only.
12.	**Solution:** (c) 4.0 V **Explanation:** Since $W_{A \to B} = q(V_B - V_A)$ $\Rightarrow V_B - V_A = \frac{16}{4} = 4$ V
13.	**Solution:** (c) intensity of magnetization **Explanation:** For each half pole strength m becomes half

	$M = m \times 2l$ becomes half and volume $V = a \times 2l$ also becomes half therefore, magnetic intensity remains constant.
14.	**Solution:** (d) increasing the current through it The self-inductance of a long solenoid is given by $L = \mu_r \mu_0 n^2 Al$ Self-inductance of a long solenoid is independent of the current flowing through it.
15.	**Solution:** (b) decreased, proportional to $\frac{1}{2}$ **Explanation:** In oil, C becomes twice, V becomes half. Therefore, $E = V/d$ becomes half.
16.	**Solution:** (d) zero **Explanation:** When a positive point charge is placed outside a conducting sphere, a rearrangement of charge takes place on the surface. But the total charge on the sphere is zero as no charge has left or entered the sphere. 
17.	**Solution:** (d) a clockwise current and then an anti-clock wise current. **Explanation:** According to Lenz's law, when switch is closed, the flux in the loop increases out of plane of paper, so induced current will be clockwise and when switch is opened current is decreasing so the direction of induced current is such that it will support. Hence anti-clock wise current is setup in close loop.
18.	**Solution:** (d) Depends upon the relative values of internal and external resistances.
19.	**Solution:** (d) mv/Bq **Explanation:** Force, $F = qVB = \frac{mv^2}{R}$ $\therefore R = \frac{mv}{Bq}$
20.	**Solution:** (d) F, T, T **Explanation:** Relative motion between the magnet and the coil that is responsible for induction in the coil.

21.	**Solution:** (b) along a line of force, if its initial velocity is zero **Explanation:** If charge particle is put at rest in electric field, then it will move along line of force.
22.	**Solution:** (d) a decrease in the energy of the system unless $Q_1R_2 = Q_2R_1$ **Explanation:** When $\frac{Q_1}{R_1} \neq \frac{Q_2}{R_2}$; current will flow in connecting wire so that energy decreases in the form of heat through the connecting wire.
23.	**Solution:** (a) average value of complete cycle is zero
24.	**Solution:** (d) Zero **Explanation:** Given: Magnetic field B Rod separated by L According to question, Loop is not close So EMF will induce in the rod but current will not flow. $\therefore$ Force $F = BIL = 0$
25.	**Solution**: (a) According to Kirchhoff's first law At junction A, $i_{AB} = 2 + 2 = 4$ A At junction B, $i_{AB} = i_{BC} + 1$ $\Rightarrow i_{BC} = 4 - 1 \Rightarrow 3$ A 
	Section – B
26.	**Solution:** (c) 6×10^{-6} J **Explanation:** As work is done by the field, K.E. of the body increases by K.E. $= W = q(V_A - V_B)$ $= 10^{-8}(600 - 0) = 6 \times 10^{-6}$ J
27.	**Solution:** (d) $20 Nm^2C^{-1}$

	Explanation: Here, $\vec{E} = 2\hat{i} + 3\hat{j} + \hat{k}NC^{-1}, \vec{S} = 10\hat{i}m^2$ Electric flux, $\phi = \vec{E}.\vec{S}$ $= (2\hat{i} + 3\hat{j} + \hat{k}NC^{-1}) \cdot (10\hat{i}\, m^2)$ $= 20Nm^2C^{-1}$
28.	**Solution:** (a) $\varepsilon, \frac{r}{n}$ **Explanation:** In the parallel combination, $\frac{\varepsilon_{eq}}{r_{eq}} = \frac{\varepsilon_1}{r_1} + \frac{\varepsilon_2}{r_2} + \cdots + \frac{\varepsilon_n}{r_n}$ $\frac{1}{r_{eq}} = \frac{1}{r_1} + \frac{1}{r_2} + \cdots + \frac{1}{r_n}$ $(\because \varepsilon_1 = \varepsilon_2 = \varepsilon_3 = \cdots.. = \varepsilon_n = \varepsilon \text{ and } r_1 = r_2 = r_3 = \cdots r)$ $\therefore \frac{\varepsilon_{eq}}{r_{eq}} = \frac{\varepsilon}{r} + \frac{\varepsilon}{r} + \cdots + \frac{\varepsilon}{r} = n\frac{\varepsilon}{r}$ $\frac{\varepsilon}{r_{eq}} = \frac{1}{r} + \frac{1}{r} + \cdots. + \frac{1}{r} = \frac{n}{r}\ r_{eq} = r/n$ From (i) and (ii) $\varepsilon_{eq} = n\frac{\varepsilon}{r_{eq}} \times r_{eq} = n \times \frac{\varepsilon}{r} \times \frac{\varepsilon}{r} = \varepsilon$
29.	**Solution:** (b) 7.2×10^{-5} tesla **Explanation:** Horizontal component of earth's field, $H = B\cos\theta$, since, $\theta = 60°$  $3.6 \times 10^{-5} = B \times \frac{1}{2}$ $\Rightarrow B = 7.2 \times 10^{-5}$ Tesla
30.	**Solution:** (a) 0.013/ °C **Explanation:** $R_t = R_0(1 + \alpha t)$ $5\Omega = R_0(1 + \alpha \times 50)$ and $7\Omega = R_0(1 + \alpha \times 100)$ or $\frac{5}{7} = \frac{1+50\alpha}{1+100\alpha}$ or $\alpha = \frac{2}{150} = 0.0133/\ °C$
31.	**Solution:** (c) 40 m/s **Explanation:** The electron moves with constant velocity without deflection. Hence, force due to magnetic field is equal and opposite to force due to electric field.

	$qvB = qE \Rightarrow v = \frac{E}{B} = \frac{20}{0.5} = 40\ m/s$
32.	**Solution:** (c) $q_A = q_B = 5.5\mu C$ **Explanation:** The charge on disc A is $10^{-6}\mu C$. The charge on disc B is $10 \times 10^{-6}\mu C$. The total charge on both = $11\mu C$. When touched, this charge will be distributed equally i.e., $5.5\mu C$ on each disc.
33.	**Solution:** (d) M/2 **Explanation:** As magnetic moment = pole strength × length and length is halved without affecting pole strength, therefore, magnetic moment becomes half.
34.	**Solution:** (b) $\frac{C}{3}$, 3 V **Explanation:** In series combination of capacitors $V_{eff} = V + V + V = 3\ V$ $\frac{1}{C_{eff}} = \frac{1}{C} + \frac{1}{C} + \frac{1}{C} \Rightarrow C_{eff} = \frac{C}{3}$ Thus, the capacitance and breakdown voltage of the combination will be $\frac{C}{3}$ and 3 V.
35.	**Solution:** (d) Q/ε_0 **Explanation:** According to Gauss's theorem, $E \oint ds = \frac{q}{\epsilon_0}\left[\text{Here} \oint ds = 4\pi R^2\right]$ $\therefore E = \frac{q/4\pi R^2}{\epsilon_0} [\because q/4\pi R^2 = \sigma]$ or $E = \sigma/\varepsilon_0$
36.	**Solution:** (c) $\frac{2\pi m}{qB}$ **Explanation:** Equating magnetic force to centripetal force, $\frac{mv^2}{r} = qvB\sin 90°$ Time to complete one revolution, $T = \frac{2\pi r}{v} = \frac{2\pi m}{qB}$
37.	**Solution:** (b) If both Assertion and Reason are correct but Reason is not the correct explanation of the Assertion. **Explanation:** Force on any charge due to a number of other charges is the vector sum of all the forces on that charge due to the other charges, taken one at a time. The individual

	force is unaffected due to the presence of other charges. This is the principle of superposition of charges.
38.	**Solution:** (b) If both Assertion and Reason are correct but Reason is not the correct explanation of the Assertion. **Explanation:** If a proton & electron are placed in the same uniform electric field they experience different acceleration. Electric force on test charge is independent of its mass. Hence both statements are true. But reason is not explanation of assertion.
39.	**Solution:** (a) If both Assertion and Reason are correct and the Reason is the correct explanation of the Assertion. **Explanation:** Power loss $= i^2R = \left(\frac{P}{V}\right)^2 R$ [P = Transmitted power]
40.	**Solution:** (b) If both Assertion and Reason are correct but Reason is not the correct explanation of the Assertion. **Explanation:** In case of inductive circuit emf leads current by $\pi/2$ rad
41.	**Solution:** (a) If both Assertion and Reason are correct and the Reason is the correct explanation of the Assertion. **Explanation:** $\frac{dq}{dt} = -\frac{1}{R}\frac{d\phi}{dt} \Rightarrow dq = -\frac{d\phi}{R} \Rightarrow q = \frac{(\phi_1 - \phi_2)}{R}$ which is independent of time.
42.	**Solution:** (b) If both Assertion and Reason are correct but Reason is not the correct explanation of the Assertion. **Explanation:** When a magnet is cut into pieces, each piece becomes new magnet. $M' = \frac{ml}{2} = \frac{M}{2}$.
43.	**Solution:** (A) If both Assertion and Reason are correct and the Reason is the correct explanation of the Assertion.
44.	**Solution:** (c) If the Assertion is correct but Reason is incorrect. **Explanation:** The e.m.f. of a dry cell is dependent upon the electrode potential of cathode and anode which in turn is dependent upon the reaction involved as well as concentration of the electrolyte. It has nothing to do with size of the cell.
45.	**Solution:** (a) If both Assertion and Reason are correct and the Reason is the correct explanation of the Assertion. $As(V_B - V_A) = \frac{W_{AB}}{q} = -\int_A^B \vec{E} \cdot \vec{d\ell}$ $= kq\left[\frac{1}{r_A} - \frac{1}{r_B}\right]$

	Which depends on the initial and final position.
46.	**Solution:** (d) perpendicular to the magnetic field
47.	**Solution:** (b) $2\sqrt{2} : \pi$ **Explanation:** We know that, $I_{rms} = I_0/\sqrt{2}$ and $I_m = 2I_0/\pi$ $\therefore \frac{I_m}{I_{rms}} = \frac{2\sqrt{2}}{\pi}$
48.	**Solution:** (a) give more intense light **Explanation:** When a bulb and a capacitor are connected in series to an ac source, then on increasing the frequency the current in the circuit is increased, because the impedance of the circuit is decreased. So, the bulb will give more intense light.
49.	**Solution:** (a) 240 V, 5 A **Explanation:** $\frac{E_S}{E_p} = \frac{n_s}{n_p}$ or $E_s = E_p \times \left(\frac{n_s}{n_p}\right)$ $\therefore\ E_s = 120 \times \left(\frac{200}{100}\right) = 240\ V$ $\frac{I_p}{I_s} = \frac{n_s}{n_p}$ or $I_s = I_p\left(\frac{n_p}{n_s}\right) \therefore I_s = 10\left(\frac{100}{200}\right) = 5amp$
	<u>Section –C</u>
50.	**Solution:** (a) be 4 times **Explanation:** inductive reactance = $2\pi fL$ therefore, when f is made 4 times, inductive reactance also becomes 4 times
51.	**Solution:** (c) one charge is positive and other is negative **Explanation:** The potential energy is negative whenever there is attraction. Since a positive and negative charge attract each other therefore their energy is negative. When both the charges are separated by infinite distance, they do not attract each other and their energy is zero.
52.	**Solution:** (b) 12×10^{-6} J **Explanation:** When the charge is released to move freely, the work done by electric field is equal

	to change in kinetic energy $\therefore W_{EF} = \Delta KE \Rightarrow -q\Delta V = \Delta KE$ $KE = -3 \times 10^{-6}(1 - 5) = 12 \times 10^{-6}$ J
53.	**Solution:** (a) zero **Explanation:** Here, $V_A = V_B = \frac{1}{4\pi\varepsilon_0} \cdot \frac{Q}{a/\sqrt{2}}$ Hence, $V_A - V_B = 0$ Work done, $W = q\ (V_A - V_B) = 0$
54.	**Solution:** (a) increase **Explanation:** Because work is to be done by an external agent in moving a positive charge from lower potential to higher potential and this work gets stored in the form of potential energy of the system. Hence, it increases.
55.	**Solution:** (d) no work is done **Explanation:** Equipotential surface has same potential at all points on the surface. Thus potential difference between two points is zero i.e. $\Delta V=0$ Work done in moving a charge over an equipotential surface $W=q\Delta V$ $\Longrightarrow W=0$