Sample Paper 9

ANSWER KEYS																			
1	(b)	**7**	(c)	**13**	(b)	**19**	(b)	**25**	(a)	**31**	(b)	**37**	(b)	**43**	(b)	**49**	(c)	**55**	(a)
2	(d)	**8**	(d)	**14**	(a)	**20**	(c)	**26**	(b)	**32**	(d)	**38**	(b)	**44**	(a)	**50**	(c)		
3	(b)	**9**	(c)	**15**	(a)	**21**	(a)	**27**	(d)	**33**	(c)	**39**	(d)	**45**	(a)	**51**	(a)		
4	(b)	**10**	(a)	**16**	(d)	**22**	(a)	**28**	(a)	**34**	(d)	**40**	(b)	**46**	(c)	**52**	(b)		
5	(a)	**11**	(d)	**17**	(b)	**23**	(a)	**29**	(c)	**35**	(d)	**41**	(c)	**47**	(a)	**53**	(c)		
6	(c)	**12**	(c)	**18**	(c)	**24**	(c)	**30**	(c)	**36**	(a)	**42**	(a)	**48**	(d)	**54**	(c)		

SOLUTIONS

1. **(b)** $W_{el.} = q(V_i - V_f)$

or $6.4 \times 10^{-19} = -1.6 \times 10^{-19}(V_A - V_B)$

or $V_A - V_B = -4V$

or $V_A - V_C = -4V \qquad (\because V_B = V_C)$

or $V_C - V_A = 4V$

2. **(d)** For distances far away from centre of dipole

$$E_{axis} = E_a = \frac{1}{4\pi\varepsilon_0}\frac{2p}{r^3}$$

$$E_{equa} = E_e = \frac{1}{4\pi\varepsilon_0} - \frac{p}{r^3}$$

$$\frac{d}{dr}(E_a) = \frac{1}{4\pi\varepsilon_0} 2p \frac{d}{dr}(r^{-3}) = -6 \cdot \frac{1}{4\pi\varepsilon_0}\frac{p}{r^4} \quad \text{...(i)}$$

$$\frac{d}{dr}(E_e) = \frac{1}{4\pi\varepsilon_0} p \frac{d}{dr}(r^{-3}) = -3\frac{1}{4\pi\varepsilon_0}\frac{p}{r^4} \quad \text{...(ii)}$$

From equations (i) and (ii) the magnitude of change in electric field w.r.t. distance is more in case of axis of dipole as compared to equatorial plane.

3. **(b)** Current density J = I/A

$= 50 \times 16^{-6}/50 \times 10^{-6} = 1\ Am^{-2}$

4. **(b)** Electric field is always zero inside a conductor.

If there is any excess of charge on a hollow conductor it always resides on the outer surface of conductor. Therefore inside a hollow conductor there is no charge and hence charge density is zero.

5. **(a)** Energy required to charge the capacitor is $W = U = QV$

$$\Rightarrow U = CV^2 = \frac{\varepsilon_0 A}{d}\cdot V^2 = \frac{\varepsilon_0 Ad}{d^2}\cdot V^2 = \varepsilon_0 E^2 Ad$$

$$\left[\because E = \frac{V}{d}\right]$$

6. **(c)**

7. **(c)** $R = \frac{\rho \ell_1}{A_1}$, now $\ell_2 = 2\ell_1$

$A_2 = \pi(r_2)^2 = \pi(2r_1)^2 = 4\pi r_1^2 = 4A_1$

$\therefore\ R_2 = \frac{\rho(2\ell_1)}{4A_1} = \frac{\rho\ell}{2A} = \frac{R}{2}$

$\therefore$ Resistance is halved, but specific resistance remains the same.

8. **(d)**

9. **(c)** Volume of 8 small drops = Volume of big drop

$$8 \times \frac{4}{3}\pi R^3 = \frac{4}{3}\pi R^3 \Rightarrow R = 2r$$

As capacity is proportional to *r*, hence capacity becomes 2 times.

10. **(a)** $H = I^2 Rt$. Here $R_1 = \rho\frac{1}{\pi r^2}$ and

$R_2 = \rho\frac{1}{\pi(2r)^2}$ That is, $R_1 = 4R_2$. Hence, $\frac{H_1}{H_2} = 4$

11. **(d)** Given : Number of cells, $n = 5$, emf of each cell $= E$

Internal resistance of each cell $= r$

In series, current through resistance R

$$I = \frac{nE}{nr + R} = \frac{5E}{5r + R}$$

In parallel, current through resistance R

$$I' = \frac{E}{\frac{r}{n} + R} = \frac{nE}{r + nR} = \frac{5E}{r + 5R}$$

According to question, $I = I'$

$$\therefore \frac{5E}{5r + 5R} = \frac{5E}{r + 5R} \Rightarrow 5r + R = r + 5R$$

or $R = r \quad \therefore \frac{R}{r} = 1$

12. **(c)** Kirchhoff's junction rule states that the algebraic sum of all currents into and out of any branch point is zero : $\Sigma I = 0$. By convention, the sign of current entering a junction is positive and current leaving a junction is negative. $4A + 5A - 6A + I_{AB} = 0$, therefore $I_{AB} = -3A$. The wire between points A and B carries a current of 3A away from the junction.

13. **(b)** Magnetic field is given by $B = \frac{\mu_0 i}{2\pi r}$ *i.e.*, $B \propto \frac{1}{r}$ which implies that field has cylindrical symmetry.

14. **(a)** $B = \frac{\mu_0 I}{2r} \times \frac{\theta}{2\pi} = \frac{\mu_0 I\theta}{4\pi r}$

15. **(a)** Potential gradient $= \frac{V_A - V_B}{\ell} = \frac{i \times \rho}{A} = \frac{0.1 \times 10^{-7}}{10^{-6}}$
$= 10^{-2}$ V/m

16. **(d)**

17. **(b)** $i = \frac{C\theta}{NAB} \Rightarrow i \propto \theta$

18. **(c)** 19. **(b)**

20. **(c)** The field lines remain continuous, emerging from one face of the solenoid and entering into the other face.

21. **(a)**

22. **(a)** $e = \frac{-d\phi}{dt} = \frac{-d}{dt}\left(6t^2 - 5t + 1\right) = -12t + 5$
$e = -12(0.25) + 5 = 2$ volt
$i = \frac{e}{R} = \frac{2}{10} = 0.2A.$

23. **(a)** Peak value, $I_0 = \frac{e_o}{R}$

24. **(c)** 25. **(a)**

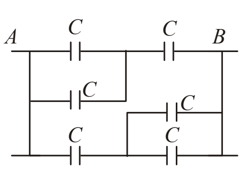
26. **(b)** Here, $q_1 = 1 \times 10^{-7}C$, q_2 and 2×10^{-7} C, $r = 20$ cm $= 20 \times 10^{-2}$ *m*
$$F = \frac{q_1 q_2}{4\pi\varepsilon_0 r^2} = \frac{9\times10^9 \times 1\times10^{-7} \times 2\times10^{-7}}{(20\times10^{-2})^2}$$
$= 4.5 \times 10^{-3}$ *N*

27. **(d)**

28. **(a)** Gauss's law is valid for any closed surface, no matter what its shape or size.

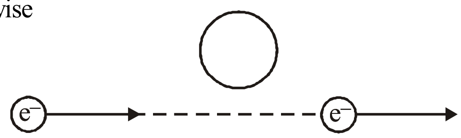
29. **(c)** $q = 1\mu C = 1 \times 10^{-6}C$, $r = 4$ cm $= 4 \times 10^{-2}$ m
Potential $V = \frac{kq}{r} = \frac{9\times10^9 \times 10^{-6}}{4\times10^{-2}} = 2.25 \times 10^5$ V.
Induced electric field $E = -\frac{kq}{r^2}$
$= \frac{9\times10^9 \times 1\times10^{-6}}{16\times10^{-4}} = -5.625 \times 10^6$ V/m

30. **(c)** The network is equivalent to therefore equivalent capacitance $= [2C \text{ series } C] \,//\, [C \text{ series } 2C]$



$= 2\left(\frac{2C \times C}{2C + C}\right) = \frac{4C}{3}$

31. **(b)** Current will be induced,
when e^- comes closer the induced current will be anticlockwise when e^- comes farther induced current will be clockwise



32. **(d)** Here, number of turns n = 1000; current through the solenoid i = 4A; flux linked with each turn = 4×10^{-3} Wb
∴ Total flux linked = $1000[4 \times 10^{-3}] = 4$ wb
$\phi_{total} = 4 \Rightarrow Li = 4 \Rightarrow L = 1$ H

33. **(c)** B and C are at the same potential, therefore potential difference between A and B and that between A and C is same in both the cases. Hence work done is same in both the cases.

34. **(d)** Impedence of a capacitor is $X_C = 1/\omega C$
$$X_C = \frac{1}{2\pi f C} = \frac{1}{2\pi \times 50 \times 2 \times 10^{-6}} = \frac{5000}{\pi}.$$

35. **(d)**

36. **(a)** We know that impedance of the LCR circuit
$(Z) = \sqrt{\{(X_L - X_C)^2 + R^2\}} = \sqrt{\{(50-50)^2 + (10)^2\}} = 10\Omega$

37. **(b)** If q is the required charge, then
$\frac{q^2}{2C} = \frac{1}{2}\frac{Q^2}{2C}$
$\therefore q = \frac{Q}{\sqrt{2}}.$

38. **(b)**

39. **(d)** Magnetic field at the centre of solenoid,
$B_{solenoid} = \mu_0 nI$
Given : No. of turns / length,
$n = \frac{N}{L} = \frac{100}{50\times10^{-2}} = 200$ turns/ m
Current, $I = 2.5$ A
$\therefore B_{solenoid} = \mu_0 nI = 4\pi\times10^{-7} \times 200 \times 2.5$
$= 6.28\times10^{-4}$ T

40. **(b)**

41. **(c)** $\phi = LI \Rightarrow L = \frac{\phi}{I} = \frac{y}{x}$ henry

42. **(a)** $N_P = 400$, $N_S = 2000$ and $V_S = 1000$ V.
$\frac{V_P}{V_S} = \frac{N_P}{N_S}$ of,
$V_P = \frac{V_S \times N_P}{N_S} = \frac{1000 \times 400}{2000} = 200$V.

43. **(b)** Magnetic moment, $M = m\ell$
$\frac{M}{\ell} = m$, where m is the polestrength.

Therefore distance between poles = $\sqrt{(\ell/2)^2+(\ell/2)^2}$

$=\frac{\ell}{\sqrt{2}}$ So, $M'=\frac{m\ell}{\sqrt{2}}=\frac{M}{\sqrt{2}}$

44. **(a)** Induced emf, $e=-\frac{d\phi}{dt}$

45. **(a)** The restoring torque brings it back to its stable equillibrium.

46. **(c)**

47. **(a)** $\frac{dq}{dt}=-\frac{1}{R}\frac{d\phi}{dt} \Rightarrow dq=-\frac{d\phi}{R} \Rightarrow q=\frac{(\phi_1-\phi_2)}{R}$
which is indipendent of time.

48. **(d)** **49.** **(c)**

50. **(c)** $r=\frac{\sqrt{2mK}}{qB}$ *i.e.* $r \propto \frac{\sqrt{m}}{q}$

Here kinetic energy K and B are same.

$\therefore \quad \frac{r_p}{r_\alpha}=\frac{\sqrt{m_p}}{\sqrt{m_a}}.\frac{q_\alpha}{q_p}=\frac{\sqrt{m_p}}{\sqrt{4m_p}}.\frac{2q_p}{q_p}=1$

51. **(a)** The galvanometer cannot as such be used as an ammeter to measure the value of the current in a given circuit. This is for two reasons (i) Galvanometer is a very sensitive device, it gives a full-scale deflection for a current of the order of μA. (ii) For measuring currents, the galvanometer has to be connected in series and as it has a large resistance, this will change the value of the current in the circuit.

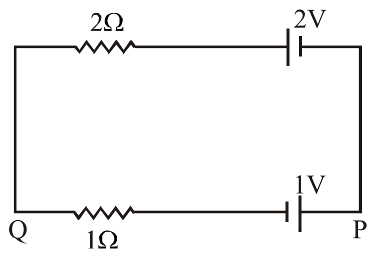
52. **(b)** In the given case cell is in open circuit (i = 0) so voltage across the cell is equal to its e.m.f.

53. **(c)** $r=E/I=1.5/3=0.5$ ohm.

54. **(c)** $\frac{100}{R+r}=\frac{90}{R} \Rightarrow \frac{R+r}{R}=\frac{10}{9}$

$\Rightarrow 1+\frac{0.5}{R}=\frac{10}{9} \Rightarrow \frac{0.5}{R}=\frac{1}{9} \Rightarrow R=4.5\,\Omega$

55. **(a)**



$E_{net}=\frac{E_1r_2-E_2r_1}{r_1+r_2}$ or $E_{net}=\frac{2-2}{2+1}=0$