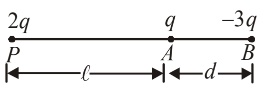
Sample Paper 2

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

55	(a)

SOLUTIONS

1. **(b)**



Let a charge $2q$ be placed at P, at a distance I from A where charge q is placed, as shown in figure.

The charge $2q$ will not experience any force, when force, when force of repulsion on it due to q is balanced by force of attraction on it due to $-3q$ at B where AB = d

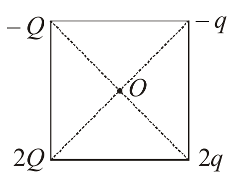
or $\dfrac{(2q)(q)}{4\pi\varepsilon_0 \ell^2} = \dfrac{(2q)(-3q)}{4\pi\varepsilon_0 (\ell + d)^2}$

$(\ell + d)^2 = 3\ell^2$ or $2\ell^2 - 2\ell d - d^2 = 0$

$\therefore \quad \ell = \dfrac{2d \pm \sqrt{4d^2 + 2d^2}}{4} = \dfrac{d}{2} \pm \dfrac{\sqrt{3}d}{2}$

$\ell = \dfrac{d + \sqrt{3}d}{2}$

2. **(a)** Let the side length of square be 'a' then potential at centre O is



$V = \dfrac{k(-Q)}{\left(\frac{a}{\sqrt{2}}\right)} + \dfrac{k(-q)}{\frac{a}{\sqrt{2}}} + \dfrac{k(2q)}{\frac{a}{\sqrt{2}}} + \dfrac{k(2Q)}{\frac{a}{\sqrt{2}}} = 0$ (Given)

$= -Q - q + 2q + 2Q = 0 = Q + q = 0 \Rightarrow Q = -q$

3. **(a)** Gaussian surface cannot pass through any discrete charge because electric field due to a system of discrete charges is not well defined at the location of the charges. But the Gaussian surface can pass through a continuous charge distribution.

4. **(c)** The component of electric field in any direction is negative of the rate of change of electric potential with distance in that direction.

$\therefore \quad E_x = -\dfrac{dV}{dx}$

5. **(d)** Electric field lines do not form closed loop. This follows from the conservative nature of electric field.

6. **(d)**

7. **(b)**

8. **(c)** $R = \dfrac{\rho\ell}{A} \Rightarrow R = \dfrac{\rho\ell}{\pi r^2}$

Given , $\ell_x = \dfrac{\ell_y}{2}$

$r_x = \dfrac{r_y}{2}$

So, ratio of resistance of x to that of Y is,

$\Rightarrow \dfrac{R_x}{R_y} = \dfrac{\ell_x}{\ell_y} \times \dfrac{r_y^2}{r_x^2} \Rightarrow \dfrac{(\ell_y/2)}{\ell_y} \times \dfrac{r_y^2}{\left(\frac{r_y^2}{2}\right)^2}$

$\Rightarrow \dfrac{\ell_y}{2\ell_y} \times \dfrac{\ell_y^2}{\ell_y^2} \times 4 \Rightarrow \dfrac{2}{1}$

9. **(a)** Kirchhoff's first law deals with conservation of electrical charge & the second law deals with conservation of electrical energy.

10. **(b)** The deflection in galvanometer will not be changed due to interchange of cells and the galvanometer.
11. **(b)** The charged particle will move along the lines of electric field (and magnetic field). Magnetic field will exert no force. The force by electric field will be along the lines of uniform electric field. Hence the particle will move in a straight line.
12. **(b)** $F \propto i_1 i_2$, so force on B due to C will be greater than that due to A. Hence net force on B acts towards C.
13. **(b)** $R_t = R_0(1+\alpha t)$ at t°C $R_t = 3R_0$

$\alpha = 4\times10^{-3}\ /°C$

$3R_0 = R_0(1+4\times10^{-3}\times t)$

$\therefore\ 3-1 = 4\times10^{-3}t$

$\therefore\ t = \dfrac{2}{4\times10^{-3}} = 500°C$

14. **(b)**
15. **(d)**
16. **(c)**
17. **(b)** $F = iBl\sin\theta$. This is maximum when $\sin\theta = 1$ or $\theta = \pi/2$.
18. **(c)** $L = 2\text{mH},\ i = t^2e^{-t}$

$$E = -L\frac{di}{dt} = -L[-t^2e^{-t} + 2te^{-t}]$$

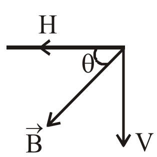
when $E = 0$,

$-e^{-t}t^2 + 2te^{-t} = 0$ or, $2t\,e^{-t} = e^{-t}t^2 \Rightarrow t = 2$ sec.

19. **(d)** $\varphi = BA\cos\theta = 2.0\times0.5\times\cos60°$

$= \dfrac{2.0\times0.5}{2} = 0.5$ weber.

20. **(b)** Induced e.m.f. in the ring opposes the motion of the magnet.
21. **(c)** Horizontal component of earth's field, $H = B\cos\theta$, since, $\theta = 60°$



$3.6\times10^{-5} = B\times\dfrac{1}{2}$

$\Rightarrow B = 7.2\times10^{-5}$ Tesla

22. **(d)**
23. **(d)** $V_{rms} = \dfrac{200\sqrt{2}}{\sqrt{2}} = 200V$

$$I_{rms} = \frac{V_{rms}}{X_C} = \frac{200}{\frac{1}{100\times10^{-6}}} = 2\times10^{-2} = 20mA$$

24. **(c)** Capacitive reactance, $X_C = \dfrac{1}{\omega C} = \dfrac{1}{2\pi fC}$

$\Rightarrow X_L \propto \dfrac{1}{f}$

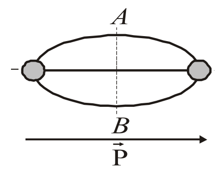
With increases in frequency, X_C decreases.
Hence, option (c) represents the hyperbolic graph which is correct.

25. **(b)** $N_p = 140, N_s = 280, I_p = 4A, I_s = ?$

For a transformer $\dfrac{I_s}{I_p} = \dfrac{N_p}{N_s}$

$\Rightarrow \dfrac{I_s}{4} = \dfrac{140}{280} \Rightarrow I_s = 2A$

26. **(b)** The direction of electric field at equatorial point A or B will be in opposite direction, as that of direction of dipole moment.



27. **(c)**
28. **(a)** Valence electrons are outermost electrons these can get transferred on rubbing.
29. **(c)** Potential energy decreases whenever there is attraction. A negative charge placed at centroid causes attraction.
30. **(a)** Potential at B, V_B is maximum

$V_B > V_C > V_A$

As in the direction of electric field potential decreases.

31. **(a)**
32. **(b)** We know that, $I_{rms} = I_0/\sqrt{2}$ and $I_m = 2I_0/\pi$

$\therefore\ \dfrac{I_m}{I_{rms}} = \dfrac{2\sqrt{2}}{\pi}$

33. **(c)** As work is done by the field, K.E. of the body increases by

$K.E. = W = q(V_A - V_B)$

$= 10^{-8}(600-0) = 6\times10^{-6}$ J

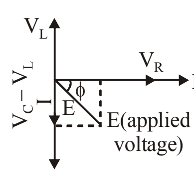
34. **(a)** $E = 8\sin\omega t + 6\sin2\omega t$

$\Rightarrow E_{peak} = \sqrt{8^2+6^2} = 10$ V

$E_{rms} = \dfrac{10}{\sqrt{2}} = 5\sqrt{2}$ V

35. **(a)**
36. **(d)** $\tan\phi = \dfrac{V_C - V_L}{V_R}$ (if $V_C > V_L$)

$= \dfrac{V_L - V_C}{R}$ (if $V_L > V_C$)



where ϕ is angle between current & applied voltage.

37. **(b)** $V_{rms} = \sqrt{\dfrac{(T/2)V_0^2 + 0}{T}} = \dfrac{V_0}{\sqrt{2}}$.
38. **(c)** Field at the center of a circular coil of radius r is

$B = \dfrac{\mu_0 I}{2r}$

39. **(b)** $\theta = \dfrac{NiAB}{C} \Rightarrow \theta \propto N$ [Number of turns]

40. **(a)**

41. **(a)**

42. **(a)** Here, $C = 30\ \mu F = 30 \times 10^{-6}$ F,

$L = 27$ mH $= 27 \times 10^{-3}$ H

$$\therefore \quad \omega = \frac{1}{\sqrt{LC}} = \frac{1}{\sqrt{27\times10^{-3}\times30\times10^{-6}}} = \frac{1}{\sqrt{81\times10^{-8}}}$$

$$= \frac{10^4}{9} = 1.1 \times 10^3 \text{ rad s}^{-1}$$

43. **(d)** The e.m.f. is induced when there is change of flux. As in this case there is no change of flux, hence no e.m.f. will be induced in the wire.

44. **(d)** $B = \mu_0 nI = 4\pi\times10^{-7}\times10\times5 = 2\pi\times10^{-5}$ T.

45. **(c)** When switch is closed , the magnetic flux through the ring will increase and so ring will move away form the solenoid so as to compensate this flux. This is according to Lenz's law.

46. **(c)** In an atom, electrons revolve around the nuclear and such the circular orbits of electrons may be considered as the small current loops. In addition to orbital motion, an electron has got spin motion also. So the total magnetic moment of electron is the vector sum of its magnetic charge moments due to orbital and spin motion. Particles at rest do not produce magnetic field.

47. **(c)** $C' = kC$, and so, $U' = \frac{1}{2}(kC)V^2 = kU$. Also $q' = C'V = kCV = kq$, and so charge density increases.

48. **(c)** Electron and proton have same amount of charge so they have same coulomb force. They have different acceleration because they have different masses.

49. **(a)**

50. **(b)** Irrespective of the charges on the inner and outer conductors, the inner conductor is always at a higher potential as long as the charge on inner conductor is not zero. Therefore charge flows from B to A. When the whole charge of B flows to A and charge on B becomes zero then A and B are at same potential.

51. **(c)**

52. **(b)** As $R \propto V^2/P$ or $R \propto 1/P$, so resistance of heater is less than that of fan.

53. **(b)** Most of the charges flowing around the circuit are valence electrons stripped off the metal atoms in the wires and light bulbs. A battery doesn't "supply" all of the charges. It merely pushes around charges already present in the circuit.

Statements (c) and (d) are both true. All charges flowing into the light bulb also flow back out; no current gets " used up" But inside the bulb, those charges lose energy. This lost electrical energy converts into light and heat. So, the current has lower "potential" after flowing through the bulb.

54. **(b)** The rate of generation of heat, for a given potential difference is, $P = V^2/R$

55. **(a)** A heating wire should be such that it produces more heat when current is passed through it and also does not melt. It will be so if it has high specific resistance and high melting point.