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$$\frac{1}{2}mv^2 = \frac{kq_1q_2}{r}, \qquad r \propto \frac{1}{v^2}$$

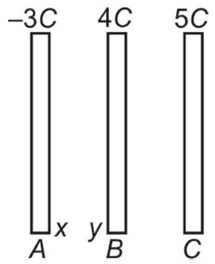
$$\frac{r}{r_1} = \frac{\left(\frac{v}{2}\right)^2}{v^2}, \qquad r_1 = 4r$$

6. $dV = -\vec{E} \cdot \overrightarrow{dx}$

$$\int_{V_0}^{V_A} dV = -\int_0^2 40x^3 dx, \qquad V_A - V_O = -160V$$

7. $$\frac{KQq}{r} + \frac{KQq}{r\sqrt{2}} + \frac{Kq^2}{r} = 0$$

$$\frac{Q\left(\sqrt{2}+1\right)}{\sqrt{2}} = -q \Rightarrow Q = -\frac{q\sqrt{2}}{\sqrt{2}+1}$$

8. 

Change on outer surface of A and C

$$= \frac{-3C + 4C + 5C}{2} = 3C$$

x + 3 = –3C , x = –6C ; y = –x, = 6C

9. $V = KQ\left(\frac{1}{b} - \frac{1}{a}\right) = 9 \times 10^9 \times 10^{-9}(2-1)$, = 9 volt.

10. $W_{P-Q}^{external} = -q\left(V_P - V_Q\right)$

$\Rightarrow 160 \times 10^{-6} = 2 \times 10^{-6}\left(V_Q - V_P\right)$

$\Rightarrow V_Q - V_P = 80\,V, \quad \Rightarrow V_P - V_Q = -80\,V$

11. $\phi_E = \frac{q_{net}}{\varepsilon_0} = \varepsilon_0^{-1}$

12. $V' = \frac{KQ}{R} = \frac{KnCV}{n^{\frac{1}{3}}r} = n^{\frac{2}{3}}V$

13. Equipotential surfaces are denser in strong field while they are rarer in weak electric field.
They never intersect
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14. Potential for conducting solid sphere on surface is same as that at any point inside.

15. $V = \frac{Q}{4\pi\varepsilon_0 R} + \frac{q}{4\pi\varepsilon_0 r}, = \frac{\sigma 4\pi R^2}{4\pi\varepsilon_0 R} + \frac{\sigma 4\pi r^2}{4\pi\varepsilon_0 r}$

$= \frac{\sigma}{\varepsilon_0}(R + r)$

16. Number of electrons, to be removed from silver doller, $n = \frac{q}{e} = \frac{2.4C}{1.6 \times 10^{-19}C} = 1.5 \times 10^{19}$

17. Fact

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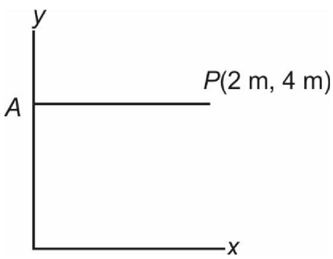
19. 

Work done in moving from 0 to A

$W_1 = \int_0^4 qE_y dy = \int_0^4 4y dy = 32J$

Work done in moving from A to P

$W_2 = \int_0^2 qE_x dx = \int_0^2 2x dx = 4J$

$\therefore$ net work done = 32 + 4 = 36 J

20. $F = \frac{kq^2}{r^2} \ldots$

Final changes, $q_A = \frac{q}{2}; q_B = \frac{3q}{4}, q_C = \frac{3q}{4}$

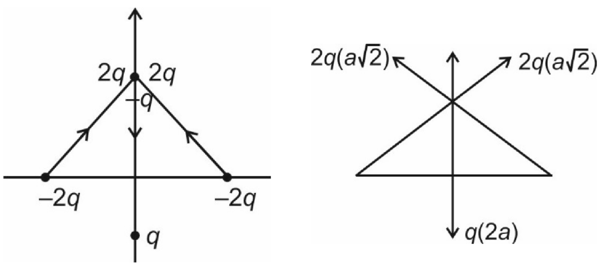
Net force on C,

$$F_c = \frac{k\left(\frac{3q}{4}\right)^2}{(r/2)^2} - \frac{k\left(\frac{q}{2}\right)\left(\frac{3q}{4}\right)}{(r/2)^2}$$

$$= \frac{36kq^2}{16r^2} - \frac{3kq^2}{2r^2}, \qquad = \frac{3}{4}\frac{kq^2}{r^2} = \frac{3}{4}F$$

21. $E \geq \frac{\Delta V}{\Delta r} \therefore E \geq 10V/m$

22. Time varying electric field produces a magnetic field.

23. 

$\overline{P_{net}}, (4qa - 2qa)\hat{j} = 2qa\hat{j}$

24. Let C_s is the effective capacitance.

$$\frac{1}{C_s} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3} = \frac{1}{3} + \frac{1}{6} + \frac{1}{12}; \quad \therefore C_s = \frac{12}{7}\mu F$$

Charge on C_2 = Charge on C_s

$C_2 V_2 = C_s V$

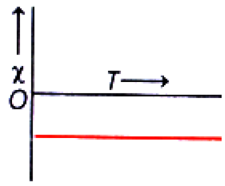
$$V_2 = \frac{C_s V}{C_2} = \frac{\frac{12}{7} \times 14}{6} = 4V$$

25. Radius of circular path, $r = \frac{L}{2}$

Magnetic moment

$$\vec{M} = IL^2\left(-\hat{j}\right) + \frac{I\pi}{2}\frac{L^2}{4}\left(-\hat{i}\right) = -IL^2\hat{j} - \frac{I\pi L^2}{8}\hat{i}$$

26. For diamagnetic sub stances, the magnetic susceptibility is negative and it is independent of temperature.



27. $\frac{q^2}{2(2C)} = 40 \times 10^{-6} J$

$\frac{q^2}{C} = 160 \times 10^{-6}$

$\Rightarrow q^2 = 10 \times 10^{-6} \times 160 \times 10^{-6}$

$\Rightarrow q = 40\mu C \Rightarrow q_{C_1} = \frac{q}{2}$

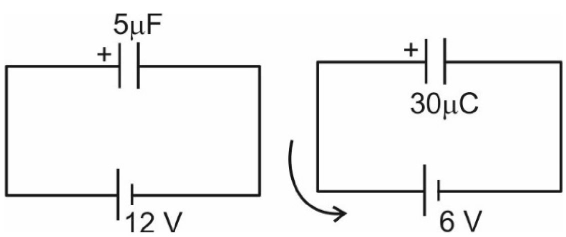
28. $C_1 = \frac{A\varepsilon_0 k}{\frac{d}{3}} \Rightarrow C_1 = \frac{3A\varepsilon_0 k}{d}$

$C_2 = \frac{2A\varepsilon_0 k}{\frac{2d}{3}} \Rightarrow C_2 = \frac{3A\varepsilon_0 k}{d}$

$C_{eff} = \frac{C_1 C_2}{C_1 + C_2} \Rightarrow C_{eff} = \frac{3A\varepsilon_0 k}{2d}$

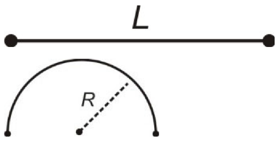
29. Effective area of capacitor is A_1; $C = \frac{\varepsilon_0 A_1}{d}$

30. $C = \frac{\varepsilon_0 A k_2}{2d_1} \Rightarrow q = CE \Rightarrow q = \frac{\varepsilon_0 A k_2 E}{2d_1}$

31. 

$U_i + W_b = U_f +$ Heat

$$\frac{1}{2}(5)(12)^2 - 6 \times 30 = \frac{1}{2}(5)(6)^2 + \text{Heat}$$

32. 

$M = mL$

$M = m2R$

$= m2\left(\frac{L}{\pi}\right)$

$= \frac{2}{\pi}mL = \frac{2M}{\pi}$

33. $\frac{10 - V_A}{C} + \frac{20 - V_A}{C} + \frac{30 - V_A}{C} + \frac{40 - V_A}{C} = 0$

$4V_A = 100 \Rightarrow V_A = 25V$

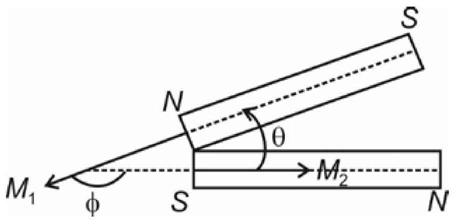
35. Unit is amp-m^2

36. $C = \frac{A\varepsilon_0 k}{d}$

$U = \frac{1}{2}\frac{q^2}{C}$

$q \rightarrow$ remains same
$C \rightarrow$ decrease
$U \rightarrow$ increase

37. Fact

38. 

$M_1 = M_2 = M$
Resultant magnetic moment =M
$M^2 = M^2 + M^2 + 2MM\cos\phi$

$\cos\phi = -\frac{1}{2} = \phi = 120°$

$\theta = 180° - 120° = 60°$

39. The magnetic field lines in the hole will be from North pole to South pole where as the magnetic field lines in the magnet will be form South pole to North pole. Therefore the net magnetic field lines inside the magnet get increase. Which results in the decrease of the net pole strength which result in the decrease in magnitude of magnetic momentum.

40. $\frac{M}{L}$

$= \frac{q}{2m}M$

$= \frac{q}{2m} \times mvR = \frac{qvR}{2}$

41. Beyond Curie temperature, ferromagnetic substance becomes paramagnetic.

42. According to Wein, ferromagnetism arises due to interaction of spin of electrons of one atom with that of neighbouring atoms.

43. $V_0 = 1000V$

Now $C = \frac{K\varepsilon_0 A}{d'} = \frac{4 \times \varepsilon_0 A}{2d} = 2C_0$

$C_0V_0 = 2C_0 \times V' \therefore V' = \frac{V_0}{2} = 500V$

44. $\oint \vec{B} \cdot d\vec{S} = \mu_0 m_{net}$

45. $E_{dielectric} = \frac{E_o}{k}$

Answer-Key

1.	4	**2.**	1	**3.**	4	**4.**	4	**5.**	4	**6.**	1	**7.**	4	**8.**	2	**9.**	4	**10.**	4
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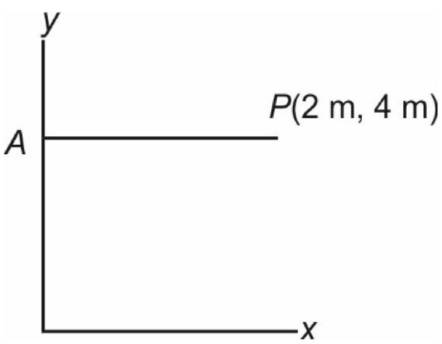

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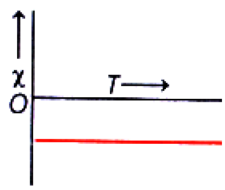

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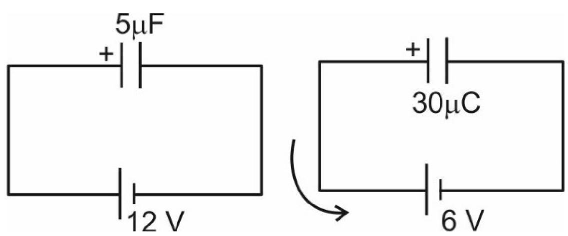

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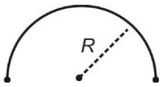

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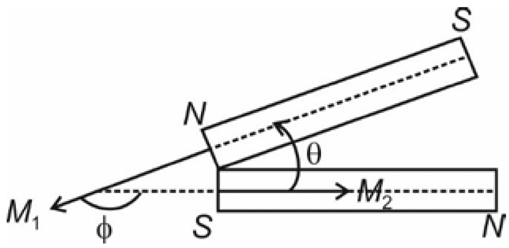
16. 

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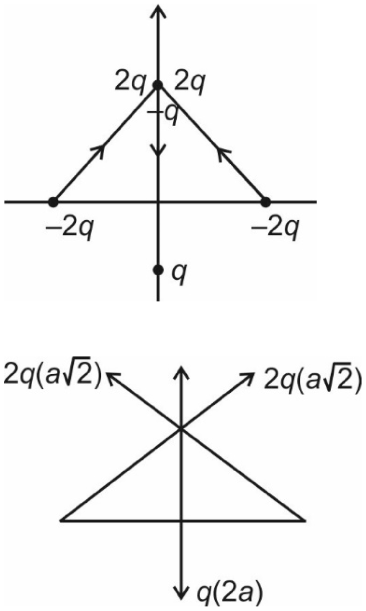
32. 

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$V_A - V_O = -160V$

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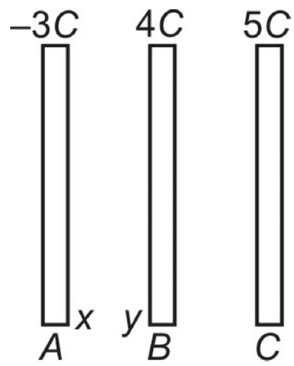
$\frac{Q\left(\sqrt{2}+1\right)}{\sqrt{2}} = -q \Rightarrow Q = -\frac{q\sqrt{2}}{\sqrt{2}+1}$

42. 

Change on outer surface of A and C

$= \frac{-3C + 4C + 5C}{2} = 3C$

x + 3 = –3C $\Rightarrow$ x = –6C

y = –x = 6C

43. $V = KQ\left(\frac{1}{b} - \frac{1}{a}\right) = 9 \times 10^9 \times 10^{-9}(2-1) = 9$ volt.

44. Electrostatic lines of force do not form closed loops, as electrostatic field is a conservative field.

Answer-Key

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101.	1	**102.**	1	**103.**	2	**104.**	3	**105.**	3	**106.**	2	**107.**	1	**108.**	3	**109.**	2	**110.**	2
111.	2	**112.**	3	**113.**	3	**114.**	2	**115.**	1	**116.**	3	**117.**	3	**118.**	2	**119.**	3	**120.**	3
121.	3	**122.**	4	**123.**	2	**124.**	2	**125.**	4	**126.**	4	**127.**	2	**128.**	3	**129.**	4	**130.**	3
131.	3	**132.**	3	**133.**	2	**134.**	4	**135.**	3	**136.**	4	**137.**	3	**138.**	1	**139.**	3	**140.**	1
141.	2	**142.**	3	**143.**	1	**144.**	1	**145.**	3	**146.**	1	**147.**	2	**148.**	2	**149.**	3	**150.**	1
151.	1	**152.**	1	**153.**	2	**154.**	2	**155.**	2	**156.**	1	**157.**	2	**158.**	3	**159.**	3	**160.**	2
161.	2	**162.**	2	**163.**	3	**164.**	1	**165.**	2	**166.**	2	**167.**	4	**168.**	4	**169.**	2	**170.**	1
171.	1	**172.**	3	**173.**	4	**174.**	2	**175.**	1	**176.**	3	**177.**	1	**178.**	4	**179.**	2	**180.**	4