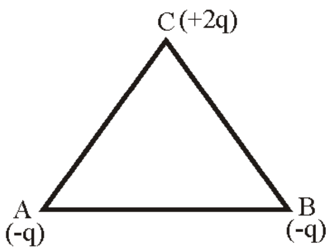
1. (4)



$$V_A = -\frac{kq}{r},\ V_B = -\frac{kq}{r},\ V_C = \frac{k\times 2q}{r}$$

$$V = V_A + V_B + V_C = 0$$

From charge configuration at the centre electric field is non-zero.

2. (3)

$$\tau = PE\sin\theta$$

$$PE = \frac{\tau}{\sin\theta}$$

$$U = PE\cos\theta = \frac{\tau}{\sin\theta}.\ \cos\theta = \frac{10\sqrt{2}}{\tan 30^0}$$

$$= \frac{10\sqrt{2}}{\frac{1}{\sqrt{3}}} = 10\sqrt{6} = 24.5\text{ J}$$

3. (2)

$$P = \frac{V^2}{R},\quad R = \frac{V^2}{P} = \frac{(60)^2}{160} = 22.5\Omega$$

$$V = IR,\quad I = \frac{60}{22.5} = 2.6\text{ A}$$

$$I = \frac{ne}{t},\quad n = \frac{It}{e} = \frac{2.6\times 60}{1.6\times 10^{-9}} = 10^{21}$$

4. (3)

$$mg = BI\ell,\quad I = \frac{mg}{B\ell} = \frac{1\times 10}{2\times 1} = 5A$$

5. (3)

$$\chi = \frac{I}{H},\quad I = \chi H = 3\times 10^{-4}\times 4\times 10^{-4}$$

$$= 12\times 10^{-8}\text{ Am}^{-1}$$

6. (2)

$$R = \frac{\sqrt{2mqV}}{qB};\quad R \propto \sqrt{m},$$

$$\frac{R_1^2}{R_2^2} = \frac{M_1}{M_2},\ \frac{M_1}{M_2} = \left(\frac{R_1}{R_2}\right)^2$$

7. (3)

$$I_P = \frac{5000}{200} = 25A$$

$$\text{Output power } = 5000\times\frac{80}{100} = 4000\text{W}$$

$$I_S = \frac{4000}{250} = 16A$$

8. (1)

Cs^+ and Br^- ions touch each other along the body diagonal of the cube. The shortest distance between them is given by $\frac{\sqrt{3}a}{2} = \frac{1.732 \text{ x } 4.3}{2} = 3.723$ Å

9. (2)

$$\Delta S = \left[50 - \frac{3}{2}\text{x } 40 - \frac{1}{2}\text{x } 60\right]\text{JK}^{-1} = -40\text{ JK}^{-1}$$

$$\Delta H = -20\text{KJ}$$

At equilibrium $T\Delta S = \Delta H$

$$T = \frac{\Delta H}{\Delta S} = \frac{-20\text{ x }10^3\text{ J}}{-40\text{JK}^{-1}} = 500\text{ K}$$

10. (4)

$Cu^+ + e \rightarrow Cu \qquad E^0 = x_1$ ....(1)

$Cu^{2+} + 2e \rightarrow Cu \qquad E^0 = x_2$ ....(2)

$Cu^{2+} + e \rightarrow Cu^+$ ....(3)

We can observe that

(3) = (2) - (1)

$$\Delta G_3 = \Delta G_2 - \Delta G_1$$

$$-n_3F E_3^0 = -n_2 F E_2^0 + n_1 F E_1^0$$

$$E_3^0 = \frac{n_2E_2^0 - n_1E_1^2}{n_3} = \frac{2x_2 - x_1}{1}$$

11. (3)

$$t_{1/2}\ \alpha\ \frac{1}{[A]_0^{n-1}}$$

Hence as $t_{1/2}$ doubles, $[A]_0$ gets halved So,

$$t_{1/2}\ \alpha\ \frac{1}{[A]_0}$$ so, it is 2nd order

12. (4)

13. (2)

14. (2)

15. (2)

16. (2)

17. (1)

18. (1)

$$\lim_{x \to 0+} = f(o) = \lim_{x \to 0} \frac{2\sin^2 x/2}{x} = k$$

19. (1)

20. (3)

$$\left(\tan^{-1} x + \cot^{-1} x\right) + \cot^{-1} x = \frac{2\pi}{3},\ \cot^{-1} x = \frac{\pi}{6}$$

21. (2)

Remember that $\int \sqrt{x^2+1}\, dx$

$$= \frac{x}{2}\sqrt{x^2+1} + \frac{1}{2}\log\left(x + \sqrt{x^2+1}\right)$$

$$\therefore \frac{d}{dx}\left(\frac{x}{2}\sqrt{x^2+1} + \frac{1}{2}\log\left(x + \sqrt{x^2+1}\right)\right)$$

$$= \sqrt{x^2+1}$$

22. (2) $x^2 + y^2 = 25$ ....(1)

$$2x + 2y\frac{dy}{dx} = 0 \Rightarrow \frac{dy}{dx} = \frac{-x}{y}$$

Slope of the line 3x - 4y = 7 is m = 3/4

Since tangent is parallel to the given line

$$\frac{dy}{dx} = \frac{3}{4} \Rightarrow -\frac{x}{y} = \frac{3}{4} \Rightarrow y = -\frac{4x}{3} \text{ ...(2)}$$

From eq.(1) $x^2 + \frac{16}{9}x^2 = 25 \Rightarrow x = \pm 3$

If x = 3, from eq.(ii) $y = -\frac{4}{3}(3) = -4$

If x = -3 from eq. (2) $y = -\frac{4}{3}(-3) = 4$

$\therefore$ The points are (3,-4) and (-3,4)

23. (4) $y^2 = 2ax$ ...(1)

Put $x = a/2$, $y^2 = 2a\ a/2$, $y = \pm a$,

$\therefore$ The points are $\left(a/2, a\right)$ and $\left(a/2, -a\right)$

on differentiation of (1) w.r.t x we get

$$2y\frac{dy}{dx} = 2a \Rightarrow \frac{dy}{dx} = \frac{a}{y}$$

At $\left(a/2, a\right) \frac{dy}{dx} = \frac{a}{y} = \frac{a}{a} = 1 = m_1$

At $\left(a/2, -a\right) \frac{dy}{dx} = \frac{a}{y} = \frac{a}{-a} = -1 = m_2$

Since m_1 x m_2 = -1, the two tangents are at right angles.

24. (1)

$f'(x) = 2/3\,(x-1)^{-1/3}$ which does not exist for

x = 1. $\therefore$ f(x) is not derivable in any interval containing 1. $\therefore$ f '(x) exists is (1,2)

$\therefore$ Mean value theorem is applicable in (1,2)

25. (2)

'*' is commutative as b * a = |b - a| - 1

= |a - b| - 1 = a * b

$(\because |-x| = |x|\ \forall x \in R)$