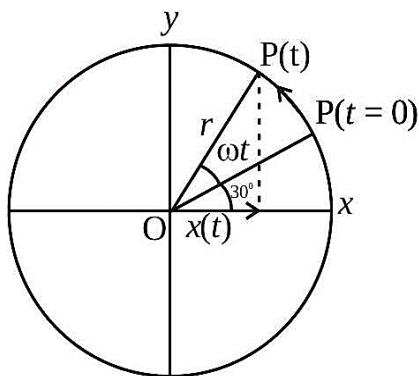


1. (c) $V_p = \frac{kQ}{r}$

$$50 = \frac{9 \times 10^9 \times 5 \times 10^{-9}}{r}$$

$$r = \frac{45}{50} = \frac{9}{10} = 0.9 \text{ m} = 90 \text{ cm}$$

2. (a)



$$x(t) = r \cos(\omega t + 30^\circ)$$

$$x(t) = r \cos(\omega t + \pi/6)$$

3. (c)

(A) Torque $\Rightarrow \vec{\tau} = \vec{r} \times \vec{F}$

$$[\tau] = [L][MLT^{-2}]$$

$$\Rightarrow ML^2 T^{-2}$$

(B) Stress $= \frac{F}{A} \Rightarrow \frac{MLT^{-2}}{L^2}$

$$[\text{stress}] = ML^{-1} T^{-2}$$

(C) Pressure gradient $= \frac{\Delta P}{\Delta x}$

$$\Rightarrow \frac{[F/A]}{[L]} \Rightarrow \frac{MLT^{-2}}{L^3}$$

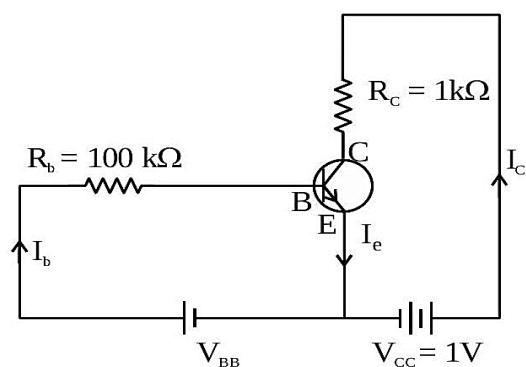
$$\Rightarrow ML^{-2} T^{-2}$$

(D) Coefficient of viscosity $\Rightarrow F = 6\pi\eta rv$

$$MLT^{-2} = [\eta]L^2 T^{-1}$$

$$[\eta] = ML^{-1} T^{-1}$$

4. (d)



Considering the transistor in saturation mode $V_{CE} = 0$

Using KVL

$$-I_C R_C + V_{CC} = 0$$

$$I_C = \frac{V_{CC}}{R_C} = \frac{1}{1 \times 10^3}$$

$$I_C = 10^{-3} \text{ A}$$

$$\beta = \frac{I_C}{I_b}$$

$$I_b = \frac{10^{-3}}{100} \Rightarrow 10^{-5} \text{ A} \Rightarrow I_b = 10 \mu\text{A}$$

5. (a) $y = x - \frac{x^2}{20}$

For maximum height,

$$\frac{dy}{dx} = 0 \Rightarrow 1 - \frac{2x}{20} = 0$$

$$x = 10$$

$$\text{So, } y_{\max} = 10 - \frac{100}{20} = 5 \text{ m}$$

6. (d) $N = N_0 \left(\frac{1}{2}\right)^n$

$$\frac{N_0}{8} = N_0 \left(\frac{1}{2}\right)^n$$

$$n = 3$$

$$3 \text{ half lives} = 3 \text{ days}$$

$$1 \text{ half life} = 1 \text{ day}$$

$$5 \text{ days} = 5 \text{ half life}$$

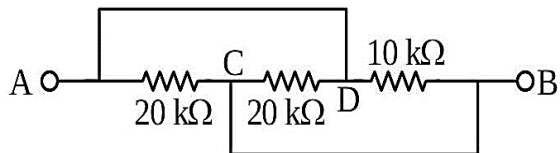
$$N = N_0 \left(\frac{1}{2}\right)^n$$

$$8 \times 10^{-3} = N_0 \left(\frac{1}{2}\right)^5$$

$$N_0 = 256 \times 10^{-3} \text{ kg}$$

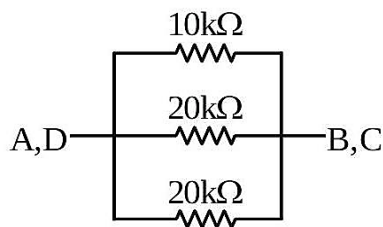
$$N_0 = 256 \text{ g}$$

7. (a)



$$V_A = V_D$$

$$V_C = V_B$$



All resistors are in parallel.

$$\frac{1}{R_{eq}} = \frac{1}{10} + \frac{1}{20} + \frac{1}{20}$$

$$R_{eq} = 5 \text{ k}\Omega.$$

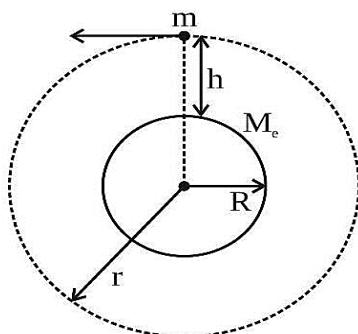
8. (c) Force = $mg = 5000 \text{ g}$

$$\text{Area of cross section} = 250 \text{ cm}^2 = 250 \times 10^{-4} \text{ m}^2$$

$$\text{max imum pressure} = \frac{\text{Force}}{\text{area of cross section}}$$

$$= \frac{5000 \text{ g}}{250 \times 10^{-4}} = \frac{20 \times \text{g}}{10^{-4}} = 2 \times 10^6 \text{ Pa}$$

9. (d)



$$L = mvr$$

$$v = \sqrt{\frac{GM_e}{r}}$$

$$L = m \sqrt{\frac{GM_e}{r}} \cdot r$$

$$L \propto r^{\frac{1}{2}}$$

Now distance from centre is increased by 8 times.

So new distance from centre = $r + 8r = 9r$

Now angular momentum $L' \propto (9r)^{1/2}$

$$\frac{L}{L'} = \frac{r^{1/2}}{(9r)^{1/2}} = \frac{1}{3}$$

$$L' = 3L$$

10. (c) Kinetic energy = $\frac{f}{2} kT$, T is absolute temperature.

If K_1 is kinetic energy at 27°C .

K_2 is kinetic energy at new temperature T .

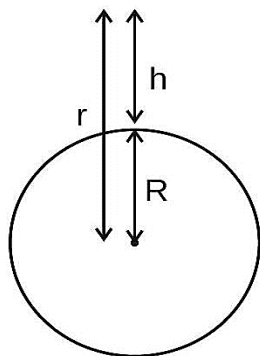
$$\frac{K_1}{K_2} = \frac{T_1}{T_2} \Rightarrow \frac{1}{2} = \frac{300}{T}$$

$$T = 600 \text{ K}$$

$$T = 327^\circ\text{C}$$

11. (a) For point outside the surface of earth

$$g = \frac{GM}{r^2}$$



r = distance from center of earth

$$\Rightarrow g(h) = \frac{GM}{(R+h)^2} \Rightarrow g(h) = \frac{GM}{R^2 \left(1 + \frac{h}{R}\right)^2}$$

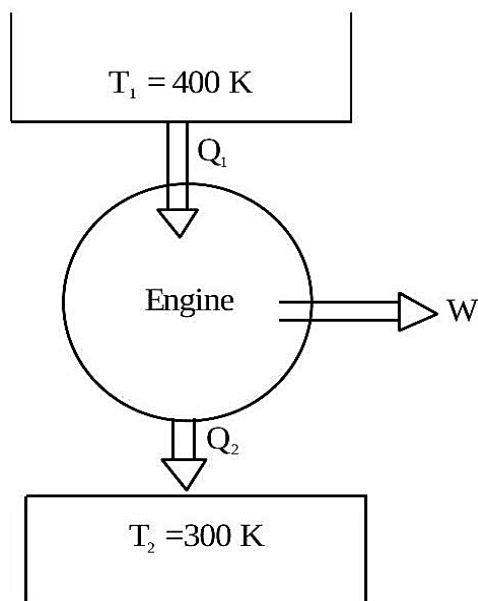
$$\Rightarrow g(h) = \frac{GM}{R^2} \left(1 + \frac{h}{R}\right)^{-2}$$

$$\text{If } h \ll R, \left(1 + \frac{h}{R}\right)^{-2} \approx 1 - \frac{2h}{R}$$

$$\Rightarrow g(h) = \frac{GM}{R^2} \left(1 - \frac{2h}{R}\right)$$

$$\Rightarrow g(h) = g_{\text{surface}} \left(1 - \frac{2h}{R}\right), \frac{GM}{R^2} = g_{\text{surface}}$$

12. (c)



$$\text{Efficiency of carnot engine } \eta = 1 - \frac{T_2}{T_1} = \frac{W}{Q_1}$$

$$\Rightarrow \frac{W}{Q_1} = 1 - \frac{300}{400} = \frac{1}{4}$$

$$\Rightarrow \frac{2 \text{ kJ}}{Q_1} = \frac{1}{4}$$

$$\Rightarrow Q_1 = 8 \text{ kJ}$$

13. (a) Area under velocity time graph gives displacement of body in given time.

Area under acceleration time graph gives change in velocity in the given time.

So Statement I false

Statement II True

14. (b) X rays are emitted when target metal is bombarded with high energy electron.

15. (c) Fringe width (β) = $\frac{D\lambda}{d}$

$$\Rightarrow \frac{\beta_2}{\beta_1} = \frac{\lambda_2}{\lambda_1}$$

$$\Rightarrow \frac{\beta_2}{2 \text{ mm}} = \frac{600 \text{ nm}}{400 \text{ nm}} = \frac{3}{2}$$

$$\Rightarrow \beta_2 = 3 \text{ mm}$$

16. (b) Electromagnets are made of soft iron because it has high permeability and low retentivity. So, both A and R are correct and R is the correct explanation of A

17. (a) Intensity of light $\propto$ number of photons $\propto$ no of photo electrons $\propto$ photo current

So, A is correct

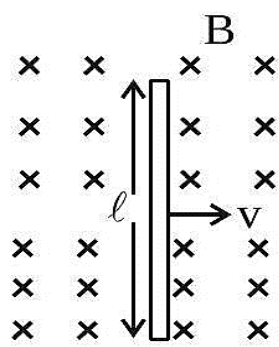
$$KE_{\max} = h\nu - \phi$$

$KE_{\max}$ depends on frequency

So, C is correct

So, A and C are correct

18. (a)

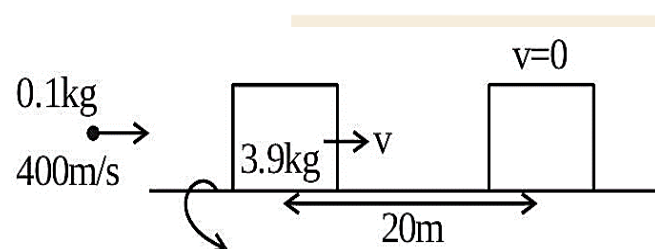


$$\text{Induced emf} = Blv$$

$$\Rightarrow 0.08 = 0.4 \left(\frac{10}{100} \right) v$$

$$\Rightarrow v = \left(\frac{0.08 \times 10}{0.4} \right) \Rightarrow v = 2 \text{ m/s}$$

19. (d)



Rough surface

$$P_i = P_f \text{ (Collision)}$$

$$\Rightarrow (0.1)(400) = (0.1 + 3.9)v$$

$$\Rightarrow v = \frac{0.1 \times 400}{4} = 10 \text{ m/s}$$

$$a = \frac{\mu mg}{m} = \mu g$$

Apply equation of motion,

$$v^2 = u^2 + 2as$$

$$\Rightarrow 0 = (10)^2 - 2\mu g \times 20$$

$$\Rightarrow 40\mu g = 100$$

$$\Rightarrow \mu = \frac{100}{2 \times 10 \times 20} = \frac{1}{4}$$

20. (d) Power radiated from a linear antenna of length $l \propto \left(\frac{1}{\lambda}\right)^2$

21. (4) Quality factor = $\frac{X_L}{R} = \frac{\omega L}{R}$

$$\omega = \frac{1}{\sqrt{LC}} = \frac{1}{\sqrt{1 \times 6.25 \times 10^{-6}}} = \frac{10^3}{2.5} = 400/\text{sec}$$

$$\text{Q-factor} = \frac{400 \times 1}{100} = 4$$

22. (60) $f = \frac{nv}{2\ell}$, for fundamental mode $n = 1$

$$f = \frac{v}{2\ell}$$

$$f \propto \frac{1}{\ell}$$

$$\frac{f_1}{f_2} = \frac{\ell_2}{\ell_1}$$

$$\frac{120}{180} = \frac{\ell_2}{90}$$

$$\ell_2 = 60 \text{ cm}$$

23. (27) $\frac{1}{\lambda} = R \left[\frac{1}{n_1^2} - \frac{1}{n_2^2} \right]$ for H-atom

For balmer series, $n_1 = 2$

$$\frac{1}{\lambda} = R \left[\frac{1}{4} - \frac{1}{n_2^2} \right]$$

For H_α , $n_2 = 3$

& H_β , $n_2 = 4$

$$\frac{1}{\lambda_{H_\alpha}} = R \left[\frac{1}{4} - \frac{1}{9} \right] = \frac{5R}{36}$$

$$\frac{1}{\lambda_{H\beta}} = R \left[\frac{1}{4} - \frac{1}{16} \right] = \frac{3R}{16}$$

$$\frac{\frac{1}{\lambda_{H\alpha}}}{\frac{1}{\lambda_{H\beta}}} = \frac{\frac{5R}{36}}{\frac{3R}{16}}$$

$$\frac{\lambda_{H\alpha}}{\lambda_{H\beta}} = \frac{27}{20} = \frac{x}{20}$$

$$x = 27$$

24. (125) $n = 8 \times 10^{28} \text{ m}^{-3}$

$$\text{Area} = 2 \times 10^{-6} \text{ m}^2$$

$$I = 3.2 \text{ A}$$

$$I = neAv_d$$

$$V_d = \frac{I}{neA} = 125 \times 10^{-6} \text{ m/s}$$

25. (4) Stress = $Y \times \text{strain}$

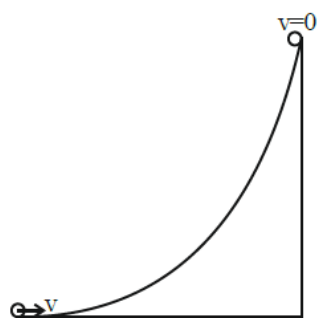
$$\text{Stress} = Y \times \frac{\Delta \ell}{\ell}$$

$$= Y \times \frac{\ell \alpha \Delta T}{\ell} = Y \alpha \Delta T$$

$$\text{Compressive Tension} = \text{Stress} \times \text{Area of cross section}$$

$$= Y \alpha \Delta T = 4 \times 10^4 \text{ N}$$

26. (75)



At highest point $KE_f = 0$

$$\text{Initial KE} = \text{Translational KE} + \text{Rotational KE}$$

$$= \frac{1}{2}mv^2 + \frac{1}{2}I\omega^2$$

In case of rolling $v = R\omega$

$$= \frac{1}{2}mv^2 + \frac{1}{2} \times \frac{2}{3}mR^2 \times \frac{v^2}{R^2}$$

$$= \frac{5}{6}mv^2$$

Apply energy conservation

$$KE_i + PE_i = KE_f + PE_f$$

$$\frac{5}{6}mv^2 = mgh$$

$$h = \frac{5}{6 \times 10} \times 9 \text{ m} = \frac{15}{20} \text{ m} = 75 \text{ cm}$$

27. (30) Given

$$M = 5 \text{ kg}$$

$$P_i = 10 \text{ kg m/s (initial momentum)}$$

$$\text{Impulse} = F\Delta t = \Delta P = P_f - P_i$$

$$2 \times 5 = P_f - 10$$

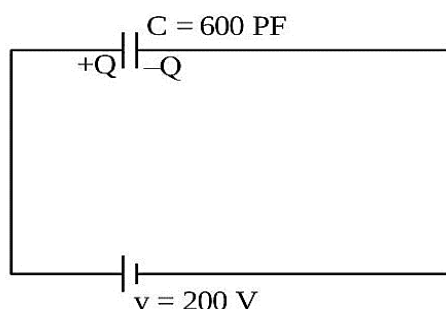
$$P_f = 20 \text{ kg m/s (final momentum)}$$

$$\text{Increase in KE} = KE_f - KE_i$$

$$= \frac{P_f^2}{2m} - \frac{P_i^2}{2m}$$

$$= \frac{400}{2 \times 5} - \frac{100}{2 \times 5} = 40 - 10 = 30 \text{ J}$$

28. (6)

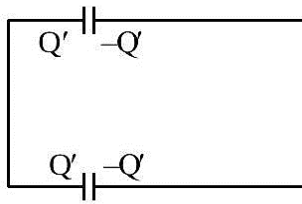


$$Q = CV = 600 \times 10^{-12} \times 200 = 12 \times 10^{-8} \text{ C}$$

$$\text{Initial energy} = \frac{1}{2}CV^2$$

$$= \frac{1}{2} \times 600 \times 10^{-12} \times (200)^2 = 12 \mu\text{J}$$

When connected to another uncharged capacitor



Charge will be equally distributed on identical capacitor $Q' = \frac{Q}{2} = 6 \times 10^{-8}$

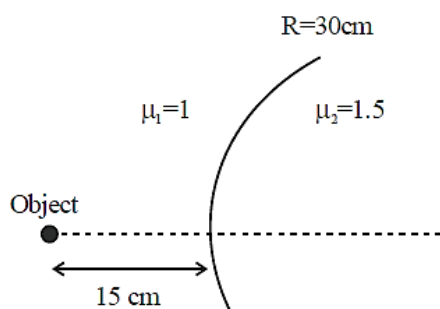
$$\text{Final energy} = 2 \times \frac{Q'^2}{2C} = \frac{Q'^2}{C}$$

$$\frac{(6 \times 10^{-8})^2}{600 \times 10^{-12}} = 6 \mu\text{J}$$

Energy lost = Initial energy - Final energy

$$= (12 - 6) \mu\text{J} = 6 \mu\text{J}$$

29. (30)



$$\frac{\mu_2}{v} - \frac{\mu_1}{u} = \frac{\mu_2 - \mu_1}{R}$$

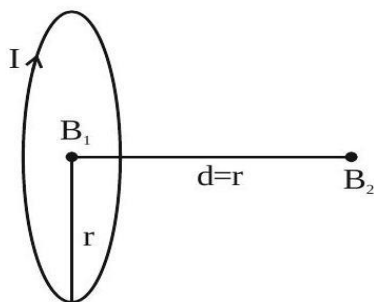
$$\frac{1.5}{v} - \frac{1}{-15} = \frac{1.5 - 1}{30} = \frac{1}{60}$$

$$\frac{1.5}{v} + \frac{1}{15} = \frac{1}{60}$$

$$\frac{1.5}{v} = \frac{1}{60} - \frac{1}{15} = \frac{-1}{20}$$

$$\frac{1.5}{v} = -\frac{1}{20} \Rightarrow v = -30 \text{ cm}$$

30. (8)



$$\text{Magnetic field at centre } (B_1) = \frac{\mu_0 I}{2r}$$

$$\text{Magnetic field on axis} = \frac{\mu_0 I r^2}{2(r^2 + d^2)^{3/2}}$$

Value of $d = r$ (given)

$$B_2 = \frac{\mu_0 I}{4\sqrt{2}r}$$

$$\frac{B_1}{B_2} = \frac{\mu_0 I}{2r} \times \frac{4\sqrt{2}r}{\mu_0 I} = \frac{2\sqrt{2}}{1} = \frac{\sqrt{8}}{1}$$

$$x = 8$$

31. (c) All non-zero digits are significant.

0.00253

Significant figures = 3(2,5,3)

1.0003

Zeros between non-zero digit are significant.

Thus, 1.0003 has 5 significant figures.

15.0

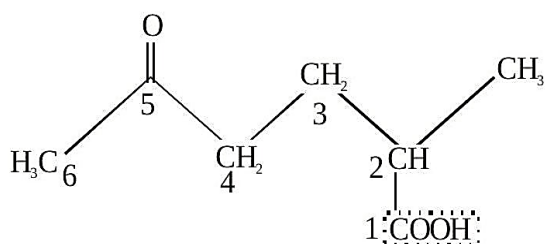
Significant number = 3

163

Significant number = 3

32. (c)

33. (b)



IUPAC NAME

2-Methyl-5-oxohexanoic acid

34. (c) Vanderwaal constant - 'a'

(i) Ar = 1.34

(ii) CH₄ = 2.25

(iii) H₂O = 5.46

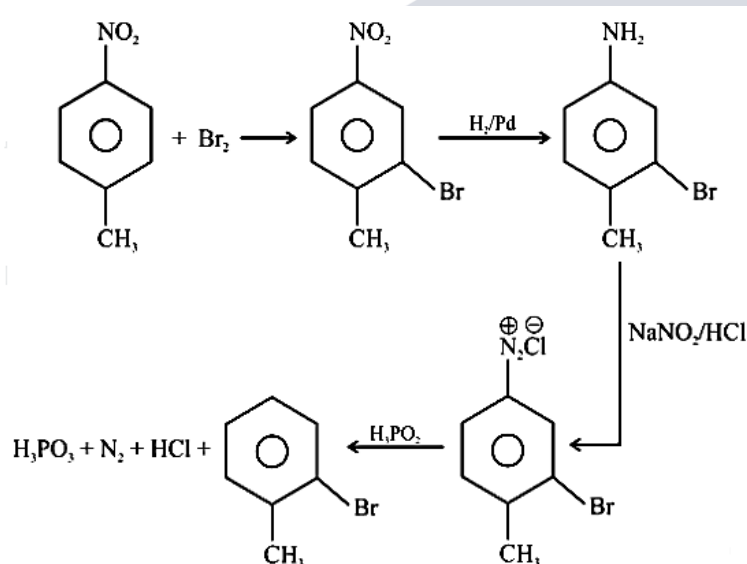
(iv) C₆H₆ = 18.57

'a' symbolises force of attraction and directly proportional to surface area

35. (c)

36. (d) In redox titration, indicators are sensitive to oxidation potential and in acid base titration, indicators are sensitive to change in pH of solution Both statement are false.

37. (d)



38. (b) By using positive catalyst:

(i) ΔH does not change

(ii) Activation energy decreases

39. (b) Urea acts as a stabilizer in the decomposition of H₂O₂

40. (d) Drugs that bind to the receptor site and inhibit its natural function are called antagonists

41. (a)

For option (A)

Cr⁺³: 3 d³

CN⁻ → SFL

⇒ No. of unpaired electrons = 3

For option (B)

$\text{Fe}^{+2}: 3 d^6$
 $\text{H}_2\text{O}: \text{WFL}$

No. of unpaired electrons = 4
 For option (C)

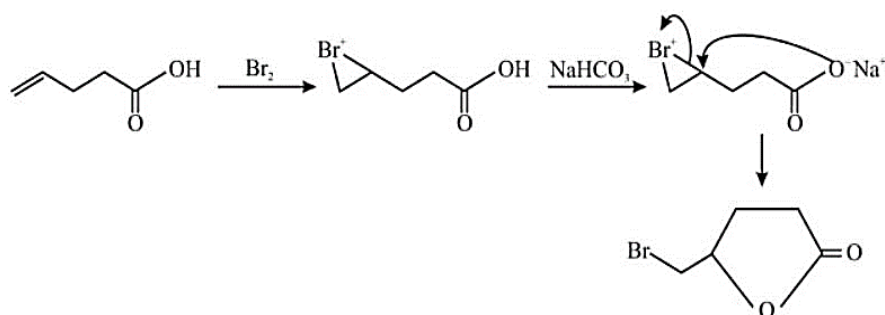
$\text{Co}^{+3}: 3 d^6$
 $\text{NH}_3: \text{SFL}$

No. of unpaired electrons = 0
 For option (D)

$\text{N}^{+2}: 3 d^8$
 $\text{NH}_3: \text{SFL}$

No. of unpaired electrons = 2

42. (b)



43. (a) In case of Hall's process, reduction of Al_2O_3 to Al can be done using graphite.

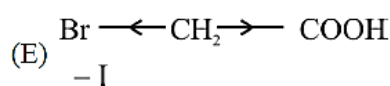
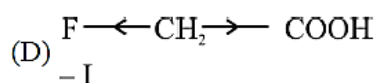
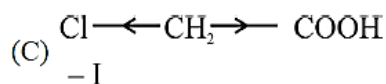
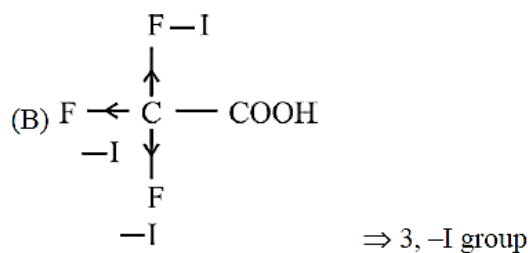
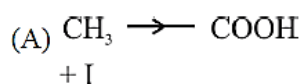
44. (a) Due to bigger size of potassium, it forms more efficient lattices as compared to sodium with silicates. The abundance of sodium in ocean is more due to the more soluble nature of salt of sodium as compared to potassium salts.

45. (c) According to List I and List II option (c) is correct.

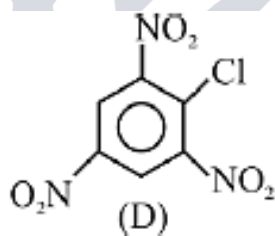
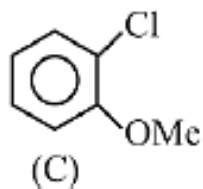
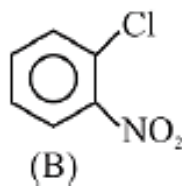
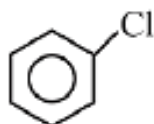
46. (b) $\sqrt{v} \propto Z$

47. (d)

Acidic Strength $\propto \frac{1}{+I \text{ effect}}$
 Acidic Strength $\propto -I \text{ effect}$
 $\text{F} > \text{Cl} > \text{Br} - I \text{ effect order}$



48. (d)

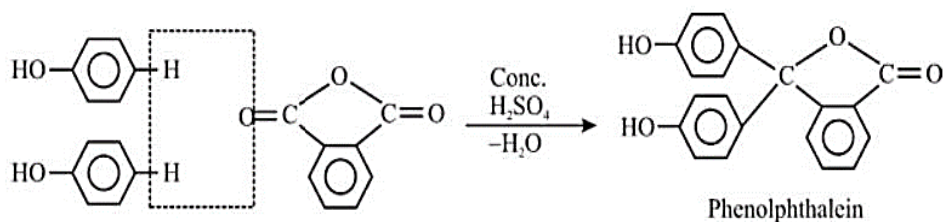


$D > B > A > C$

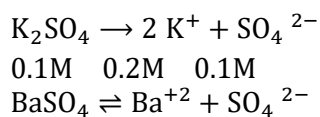
(-M) group increases reactivity whereas (+M) group decreases reactivity of Halobenzene towards Nucleophilic substitution reaction.

49. (b) $\frac{\% \text{CaO}}{\% \text{SiO}_2 + \% \text{Al}_2\text{O}_3 + \% \text{Fe}_2\text{O}_3} = 1.9 - 2.1$

50. (a)



51. (233)



$$a - S S S + 0.1 \approx 0.1$$

$$K_{\text{SP}} = S \times 10^{-1}$$

$$\Rightarrow 1 \times 10^{-10} = S \times 10^{-1}$$

$$\Rightarrow S = 10^{-9} \text{ mol L}^{-1}$$

$$\text{So, } S = 10^{-9} \times 233 \text{ g L}^{-1}$$

So, Answer: 233

52. (556) Coagulating Value $\propto \frac{1}{\frac{\text{C.C.V}}{(\text{C.P})}}$

$$\Rightarrow \frac{(\text{C.V})_{\text{AlCl}_3}}{(\text{C.V})_{\text{NaCl}}} = \frac{(\text{C.P})_{\text{NaCl}}}{(\text{C.P})_{\text{AlCl}_3}}$$

$$\Rightarrow \frac{0.09}{50.04} = \frac{(\text{C.P})_{\text{NaCl}}}{(\text{C.P})_{\text{AlCl}_3}}$$

$$\Rightarrow (\text{C.P})_{\text{AlCl}_3} = 556 (\text{C.P})_{\text{NaCl}}$$

So, Answer = 556

53. (3) Radial node = $n - \ell - 1$

$$7s \Rightarrow \text{R.N} = 7 - 0 - 1 = 6$$

$$7p \Rightarrow \text{R.N} = 7 - 1 - 1 = 5$$

$$6s \Rightarrow \text{R.N} = 6 - 0 - 1 = 5$$

$$8p \Rightarrow \text{R.N} = 8 - 1 - 1 = 6$$

$$8d \Rightarrow \text{R.N} = 8 - 2 - 1 = 5$$

So, Answer is 3

54. (1411)

$$\text{C}_2\text{H}_4(\text{g}) + 3\text{O}_2(\text{g}) \rightarrow 2\text{CO}_2(\text{g}) + 2\text{H}_2\text{O}(\ell)$$

$$\Delta U = -1406 \text{ kJ mol}^{-1}, T = 300 \text{ K}$$

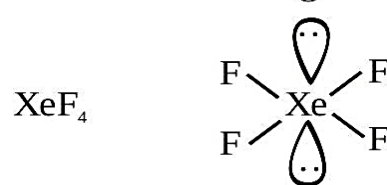
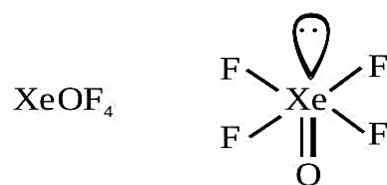
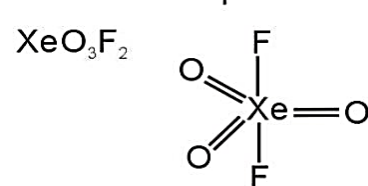
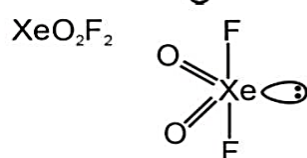
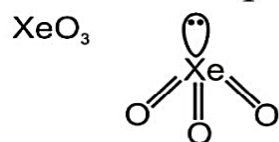
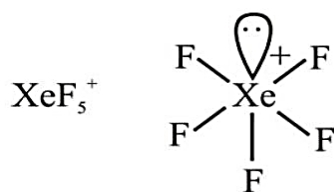
$$\Delta H = \Delta U + \Delta n_g RT$$

$$\Delta H = -1406 + (-2) \times 8.3 \times 300 = -1406 - 4.98$$

$$= -1410.98 \text{ kJ mol}^{-1} \approx -1411$$

$$\Delta H = T \Delta S = -1411 \text{ kJ mol}^{-1}$$

55. (4)



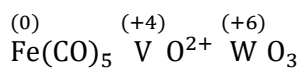
56. (8)

$$\frac{(T_B)_x}{(T_B)_y} = \frac{2}{1} \frac{(\Delta H)_x}{(\Delta H)_y} = \frac{1}{2}$$

$$\frac{(\Delta T_B)_x}{(\Delta T_B)_y} = m = \frac{(K_B)_x \times \text{molality}}{(K_B)_y \times \text{molality}}$$

$$= \frac{(T.B)_x^2}{(T.B)_y^2} \times \frac{\Delta H_y}{(\Delta H)_x} = (2)^2 \times 2 = 8$$

57. (10)



So, Sum of oxidation state = 0 + 4 + 6 = 10

58. (4) $[\text{Mn}(\text{NCS})_6]^{x-}$

Number of unpaired electron = 5

So, Mn must be in +2 oxidation state (Mn^{+2})

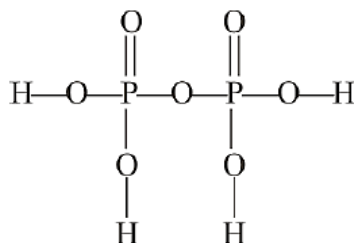
$$\Rightarrow 2 + (-6) = -x$$

$$\Rightarrow -4 = -x$$

$$\Rightarrow x = 4$$

59. (1) Option B is incorrect

60. (6)



$$\frac{\sigma}{\pi} = \frac{12}{2} = 6$$

So, Answer is 6

61. (c)

62. (c)

63. (d)

64. (c)

65. (a)

$$\begin{aligned} T_{r+1} &= {}^{11}C_r (2x^2)^{11-r} \left(\frac{1}{2x}\right)^r \\ &= {}^{11}C_r 2^{11-2r} x^{22-3r} \\ 22-3r &= 10 \text{ and } 22-3r = 7 \\ r &= 4 \text{ and } r = 5 \\ \text{Coefficient of } x^{10} &= {}^{11}C_4 \cdot 2^3 \\ \text{Coefficient of } x^7 &= {}^{11}C_5 \cdot 2^1 \\ \text{difference} &= {}^{11}C_4 \cdot 2^3 - {}^{11}C_5 \cdot 2 \\ &= \frac{11 \times 10 \times 9 \times 8}{24} \times 8 - \frac{11 \times 10 \times 9 \times 8 \times 7}{120} \times 2 \\ &= 11 \times 10 \times 3 \times 8 - 11 \times 3 \times 4 \times 7 \\ &= 11 \times 3 \times 4 \times (20 - 7) \\ &= 11 \times 12 \times 13 \\ &= 12(12-1)(12+1) \\ &= 12(12^2 - 1) \\ &= 12^3 - 12 \end{aligned}$$

66. (d) 5670

$M_2 A_2 T_2$ HEICS

= total words - when C & S are together

$$\frac{11}{2} - \frac{10}{2} \times 1$$

$$\frac{10}{2} \times 9$$

$$= \frac{9 \times 10 \times 9 \times 8 \times 7}{8} \times 6$$

$$= 5670 \times 6$$

$$k = 5670$$

67. (c)

68. (a)

$$\sum_{x=0}^{\infty} P(X=x) = 1$$

$$k(1 + 2 \cdot 3^{-1} + 3 \cdot 3^{-2} + 4 \cdot 3^{-3} + \dots \infty) = 1$$

$$\text{Let } s = 1 + \frac{2}{3} + \frac{3}{3^2} + \frac{4}{3^3} + \dots \infty$$

$$\frac{s}{3} = \frac{1}{3} + \frac{2}{3^2} + \frac{3}{3^3} + \dots \infty$$

$$\frac{2s}{3} = 1 + \frac{1}{3} + \frac{1}{3^2} + \frac{1}{3^3} + \dots \infty$$

$$\frac{2s}{3} - \frac{1}{1 - \frac{1}{3}} = \frac{3}{2}$$

$$s = \frac{9}{4}$$

$$\text{so } k = \frac{4}{9}$$

$$P(X \geq 2) = 1 - P(x=0) - P(x=1)$$

$$= 1 - \frac{4}{9} \left(1 + \frac{2}{3}\right)$$

$$= \frac{7}{27}$$

69. (d)

$$4\cos^2 \theta - 1 = 4(1 - \sin^2 \theta) - 1$$

$$= 3 - 4\sin^2 \theta = \frac{\sin 3\theta}{\sin \theta}$$

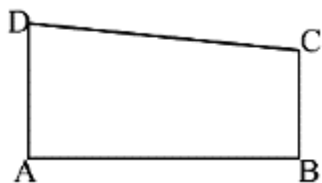
so given expression can be written as

$$36 \times \frac{\sin 27^\circ}{\sin 9^\circ} \times \frac{\sin 81^\circ}{\sin 27^\circ} \times \frac{\sin 243^\circ}{\sin 81^\circ} \times \frac{\sin 729^\circ}{\sin 243^\circ}$$

$$36 \times \frac{\sin 729^\circ}{\sin 9^\circ} = 36$$

70. (b)

71. (b)



$$\begin{aligned}
 \text{Vector Area} &= \vec{v} \\
 &= \frac{1}{2} \overrightarrow{AB} \times \overrightarrow{AC} + \frac{1}{2} \overrightarrow{AC} \times \overrightarrow{AD} \\
 &= \frac{1}{2} (\overrightarrow{AB} - \overrightarrow{AD}) \times \overrightarrow{AC} \\
 &\left(\begin{aligned} \overrightarrow{AB} &= -\hat{i} + \hat{j} + 4\hat{k} \\ \overrightarrow{AD} &= -\hat{i} - 7\hat{j} - 8\hat{k} \\ \overrightarrow{AC} &= -4\hat{i} - 4\hat{j} + 4\hat{k} \end{aligned} \right) \\
 &= \frac{1}{2} (8\hat{j} + 12\hat{k}) \times (-4)(\hat{i} + \hat{j} - \hat{k}) \\
 &= \frac{1}{2} \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 0 & 8 & 12 \\ 1 & 1 & -1 \end{vmatrix} \\
 &= (-2)(-20\hat{i} + 12\hat{j} - 8\hat{k}) \\
 &= 8(5\hat{i} - 3\hat{j} + 2\hat{k}) \\
 \therefore \text{Area} &= |\vec{v}| \\
 &= 8\sqrt{25 + 9 + 4} = 8\sqrt{38}
 \end{aligned}$$

72. (d)

$$\begin{aligned}
 \theta &= \cos^{-1} \frac{1}{3} \therefore \sin \theta = \sqrt{1 - \frac{1}{9}} = \frac{2\sqrt{2}}{3} \\
 \sin \theta &= \frac{a \cdot 1 + 1(-1) + (-1) \cdot 1}{\sqrt{a^2 + 1 + 1 \cdot \sqrt{3}}} = \frac{2\sqrt{2}}{3} \\
 \Rightarrow \{3(a - 2)\}^2 &= 24(a^2 + 2) \\
 \Rightarrow 3(a^2 - 4a + 4) &= 8a^2 + 16 \\
 \Rightarrow 5a^2 + 12a + 4 &= 0 \\
 \Rightarrow 5a^2 + 10a + 2a + 4 &= 0 \\
 \therefore a &= -2, \frac{-2}{5} \because a \in \mathbb{Z} \\
 \therefore a &= -2
 \end{aligned}$$

Distance of (6, -6, 4) from

$$-2x + y - z - b = 0 \text{ is } 3\sqrt{6}$$

$$\therefore \left| \frac{-12 - 6 - 4 - b}{\sqrt{4 + 1 + 1}} \right| = 3\sqrt{6}$$

$$\Rightarrow |b + 22| = 18$$

$$\therefore b = -40, -4$$

$$\because |a - b| \leq 10$$

$$\therefore b = -4$$

$$\therefore a^4 + b^2$$

$$= 32 \text{ Ans.}$$

73. (a)

$$25^{190} - 8^{190} \text{ is divisible by } 25 - 8 = 17$$

$$19^{190} - 2^{190} \text{ is divisible by } 19 - 2 = 17$$

$$25^{190} - 19^{190} \text{ is divisible by } 25 - 19 = 6$$

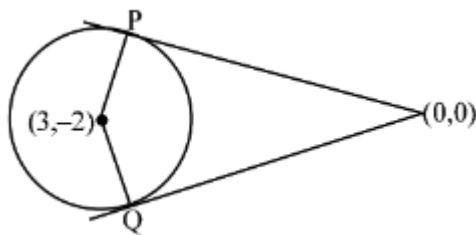
$$8^{190} - 2^{190} \text{ is divisible by } 8 - 2 = 6$$

$$\text{L.C.M. of } 1746 = 34$$

$$\therefore \text{divisible by } 34 \text{ but not by } 14$$

74. (c)

75. (b)



Circumcircle of $\triangle OPQ$

$$(x - 0)(x - 3) + (y - 0)(y + 2) = 0$$

$$x^2 + y^2 - 3x + 2y = 0$$

$$\text{passes through } \left(\alpha, \frac{1}{2} \right)$$

$$\therefore \alpha^2 + \frac{1}{4} - 3\alpha + 1 = 0$$

$$\Rightarrow \alpha^2 - 3\alpha + \frac{5}{4} = 0$$

$$\Rightarrow 4\alpha^2 - 12\alpha + 5 = 0$$

$$\Rightarrow 4\alpha^2 - 10\alpha - 2\alpha + 5 = 0$$

$$(2\alpha - 1)(2\alpha - 5) = 0$$

$$\therefore \alpha = \frac{1}{2}, \frac{5}{2}$$

76. (a)

77. (b)

78. (d)

79. (b)

80. (d)

81. (6)

82. (309)

83. (150)

$$\frac{2}{y} = \frac{1}{x} + \frac{1}{z}$$

$$2y^2 = xz$$

$$\frac{2}{y} = \frac{x+z}{xz} = \frac{x+z}{2y^2}$$

$$x+z = 4y$$

$$xy + yz + zx = \frac{3}{\sqrt{2}}xyz$$

$$y(x+z) + zx = \frac{3}{\sqrt{2}}xz \cdot y$$

$$4y^2 + 2y^2 = \frac{3}{\sqrt{2}}y \cdot 2y^2$$

$$6y^2 = 3\sqrt{2}y^3$$

$$y = \sqrt{2}$$

$$x + y + z = 5y = 5\sqrt{2}$$

$$3(x + y + z)^2 = 3 \times 50 = 150$$

84. (20)

85. (9)

$$x^2 - 12x + [x] + 31 = 0$$

$$\{x\} = x^2 - 11x + 31$$

$$0 \leq x^2 - 11x + 31 < 1$$

$$x^2 - 11x + 30 < 0$$

$$x \in (5, 6)$$

$$\text{so } [x] = 5$$

$$x^2 - 12x + 5 + 31 = 0$$

$$x^2 - 12x + 36 = 0$$

$$x = 6 \text{ but } x \in (5, 6)$$

so

$$x \in \phi$$

$$m = 0$$

Now

$$\text{Now } x^2 - 5|x+2| - 4 = 0$$

$$x \geq -2$$

$$x^2 - 5x - 14 = 0$$

$$(x-7)(x+2) = 0$$

$$x = 7, -2$$

$$x < -2$$

$$x^2 + 5x + 6 = 0$$

$$(x+3)(x+2) = 0$$

$$x = -3, -2$$

$$x = \{7, -2, -3\}$$

$$n = 3$$

$$m^2 + mn + n^2 = n^2 = 9$$

86. (16)

$$\text{Parabola is } y^2 = 12x$$

$$\text{Let } Q(3t^2, 6t)$$

$$\text{so } P(27t^2, 18t)$$

$$\begin{aligned} R(\alpha, \beta) &= (at_1t_2, a(t_1 + t_2)) \\ &= (3t \cdot 3t, 3(t + 3t)) \\ R(\alpha, \beta) &= (9t^2, 12t) \end{aligned}$$

$$\frac{\beta^2}{\alpha} = \frac{(12t)^2}{9t^2} = \frac{144}{9} = 16$$

87. (12)

88. (11)

P_2 is given by

$$\begin{vmatrix} x-5 & y-1 & z-1 \\ 3 & 2 & 1 \\ 3 & 1 & 2 \end{vmatrix} = 0$$

$$x - y - z = 3$$

DR of line intersection of P_1 & P_2

$$\begin{vmatrix} i & j & k \\ 1 & -1 & 1 \\ 3 & -1 & -7 \end{vmatrix} \\ +6\hat{i} + 4\hat{j} + 2\hat{k}$$

Let

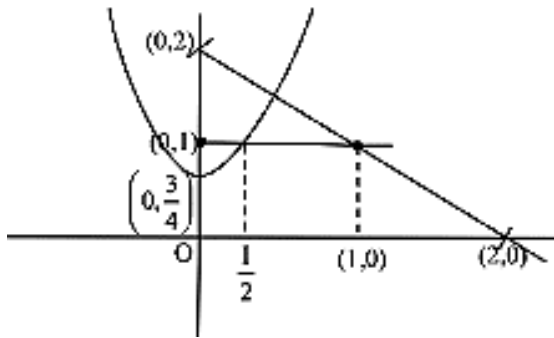
$$\begin{aligned} z = 0, \quad x - y &= 3 \\ 3x - y &= 11 \\ 2x &= 8 \\ x &= 4 \\ y &= 1 \end{aligned}$$

So Line is

$$\begin{aligned} \frac{x-4}{6} &= \frac{y-1}{4} = \frac{z-0}{2} = r \\ (\alpha, \beta, \gamma) &= (6r+4, 4r+1, 2r) \\ 6(\alpha-7) + 4(\beta-4) + 2(\gamma+1) &= 0 \\ 6\alpha - 42 + 4\beta - 16 + 2\gamma + 2 &= 0 \\ 36r + 24 + 16r + 4 + 4r - 56 &= 0 \\ 56r &= 28 \\ r &= \frac{1}{2} \\ \alpha + \beta + \gamma &= 12r + 5 \\ &= 6 + 5 = 11 \end{aligned}$$

89. (384)

90. (17)



$$\int_0^{\frac{1}{2}} \left(x^2 + \frac{3}{4} \right) dx + \frac{1}{2} \times \left(\frac{3}{2} + \frac{1}{2} \right) \times 1$$

$$= \left[\frac{x^3}{3} + \frac{3x}{4} \right]_0^{\frac{1}{2}} + 1$$

$$A = \frac{1}{24} + \frac{3}{8} + 1$$

$$12A = \frac{1}{2} + \frac{36}{8} + 12$$

$$= \frac{1}{2} + \frac{9}{2} + 12$$

$$= 5 + 12$$

$$= 17$$

