

1. In parallel, emf across both inductors are same

$$\therefore \frac{d\phi_1}{dt} = \frac{d\phi_2}{dt} \text{ or } \phi_1 = \phi_2$$

2. $U_E = U_B$

3. Value of average current depends on interval chosen.

$$e = -\frac{\Delta\phi}{\Delta t} = -\frac{n(\phi_2 - \phi_1)}{t}$$

$$i \times 5R = -\frac{n(\phi_2 - \phi_1)}{t} \therefore i = -\frac{n(\phi_2 - \phi_1)}{5Rt}$$

5. S. I. unit of poynting vector is $\frac{J}{m^2s}$

$$6. V = V_L - V_C \Rightarrow V = 50 - 50 = 0$$

Because voltage across inductor and capacitor in opposite phase when connected in series.

7. Dynamo is based on principle of electromagnetic induction.

$$8. X_C = \frac{50}{10} = 5\Omega \quad X_L = \frac{80}{10} = 8\Omega$$

$$\text{Power factor} = \frac{R}{Z} = \frac{4}{\sqrt{4^2 + (8-5)^2}} = \frac{4}{5} = 0.8$$

$$9. Z = 30\Omega; i = \frac{V}{Z} = \frac{240}{30}, i = 8A \Rightarrow V = V_L - V_C = 0$$

$$10. B = 4 \times \frac{\mu_0 i}{4\pi d} [\sin\alpha + \sin\beta] = 4 \times \frac{\mu_0 i}{4\pi} \left(\frac{2}{L}\right) 2\sin 45^\circ$$

$$= \frac{\mu_0 i 8\sqrt{2}}{4\pi L}$$

Flux with smaller loop

$$\phi = \frac{\mu_0 i 8\sqrt{2}}{4\pi L} l^2; \quad M = \frac{\phi}{i} \Rightarrow M \propto \frac{l^2}{L}$$

11. $t = 0$, inductor behaves like an infinite resistance,

So at $t = 0, i = \frac{V}{R_2}$ and at $t = \infty$, inductor behaves

$$\text{like a conducting wire } i = \frac{V}{R_{eq}} = \frac{V(R_1 + R_2)}{R_1 R_2}$$

12. Since \vec{v} and \vec{B} are either parallel or antiparallel.

Hence emf. Induced in the rod will be zero hence $V_P \sim V_Q = 0$.

$$13. |V_p| = \frac{d\phi}{dt} = \frac{d}{dt}(40t + 5) = 40V$$

$$\text{Now } \frac{V_s}{V_p} = \frac{N_s}{N_p} \Rightarrow V_s = 40 \times \frac{500}{100} = 200V$$

$$14. v = \frac{C}{\sqrt{\mu_r \epsilon_r}} = \frac{3 \times 10^8}{\sqrt{8 \times 2}} = \frac{3}{4} \times 10^8 = 7.5 \times 10^7 \text{ m/s}$$

$$15. V = \sqrt{(IR)^2 + (X_L I - X_C I)^2}$$

$$V = \sqrt{(30)^2 + (80 - 40)^2} = 50V$$

$$16. M = \sqrt{L_1 L_2} = \sqrt{4 \times 9} = 6mH = \sqrt{4 \times 9} = 6mH$$

$$17. V_{rms} = \sqrt{\frac{\int_0^T \frac{1}{2} V^2 dT}{\frac{T}{2}}}$$

18. All inductors are parallel.

$$20. d\epsilon = \int_R^{2R} B \omega x dx = \frac{B\omega}{2} [x^2]_R^{2R} = \frac{3B\omega R^2}{2}$$

21. As electron comes close, current induced will be anticlockwise and then change direction.

22. Induced emf in the coil initially is equal to emf of cell, so initial current is zero.

$$23. \eta = \frac{P_{out}}{P_{in}} = \frac{100}{0.6 \times 220} = 0.76$$

24. If $v > v_T \Rightarrow v$ decreases and will tend to attain a value equal to v_T .

$$25. Q_4 + 10 + 5 - 8 = 0 \Rightarrow Q_4 = 7 \text{ m}^3/\text{s}$$

$$\therefore 0.5v = 7 \quad v = \frac{7}{0.5} = \frac{70}{5} = 14 \text{ m/s}$$

26. The decrease in potential energy is $Mg\ell$

$$\text{Elastic potential energy stored} = Mg\frac{\ell}{2}$$

$$\text{Heat produced} = Mg\ell - Mg\frac{\ell}{2} = Mg\frac{\ell}{2}$$

27. When r lies between PQ , force, $F = -\frac{dU}{dr}$ is positive.

$$28. u = \frac{1}{2} \text{stress} \times \text{strain} = \frac{1}{2} S \times \frac{S}{Y} = \frac{S^2}{2Y}$$

$$29. t \propto \sqrt{h_1 - h_2} \Rightarrow \frac{t_1}{t_2} = \frac{\sqrt{h} - \sqrt{\frac{h}{2}}}{\sqrt{\frac{h}{2}} - 0} = \frac{\sqrt{2} - 1}{1}$$

$$30. A(P_L - P_U) = mg$$

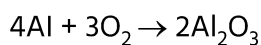
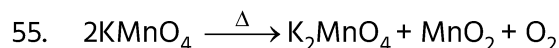
$$P_L - P_U = \frac{3 \times 10^4 \times 10}{120} = 2.5 \times 10^3 \text{ Pascal}$$

31. $\Delta l = \frac{FL}{AY} \Rightarrow \frac{\Delta l_1}{\Delta l_2} = \frac{A_2}{A_1} = \left(\frac{3}{1}\right)^2 = \frac{9}{1}$
32. From continuity equation and Bernoulli's Principle.
 $P + \frac{1}{2}\rho v^2$ constant and $A_1 V_1 = A_2 V_2$
 Where area is less, pressure be less.
33. $\frac{1}{r} = \frac{1}{r_1} - \frac{1}{r_2} \Rightarrow \frac{1}{r} = \frac{1}{6} - \frac{1}{8} \Rightarrow r = \frac{8 \times 6}{2} = 24 \text{ cm}$
34. $\frac{dV_1}{dt} = \alpha \Rightarrow \frac{dV_2}{dt} = \alpha v$; when $\frac{dv_1}{dt} = \frac{dv_2}{dt}$
35. $F = K\Delta x = \frac{YA}{L}\Delta x \Rightarrow F = YA$ (strain)
 $\Rightarrow \frac{\text{Restoring force}}{\text{Strain} \times \text{Area}} = Y$; so, $Y_1 > Y_2$
36. Pressure head = $\frac{\rho}{\rho g}$
37. $V \propto R^2 \Rightarrow V' \propto \left(\frac{1}{2^3}R\right)^2 \therefore V' = \frac{1}{2^3} \cdot 2 = \frac{1}{2^3} \text{ m/s}$
38. Pascal's law.
39. Coefficient of linear expansion $\alpha = \frac{\Delta L}{L\Delta t}$
 Longitudinal strain, $\frac{\Delta L}{L} = \alpha\Delta t$
 Stress, $\frac{F}{A} = Y \times \text{strain}$; $F = YA\alpha\Delta t$
40. Conservation of mass
41. $mg = 2\pi r \times T$
42. $B = \frac{\Delta P}{\Delta V/V'}$, $\Delta P = \text{constant}$
43. As $Y = \frac{FL}{A\Delta L} \therefore \Delta L = \frac{FL}{\pi r^2 Y}$
 $\therefore \frac{\Delta L_A}{\Delta L_B} = \frac{F_A}{F_B} \cdot \frac{Y_B}{Y_A} \cdot \left(\frac{r_B}{r_A}\right) \frac{L_A}{L_B} = \frac{3Mg}{2Mg} \cdot \left(\frac{1}{z}\right) \left(\frac{1}{y}\right)^2 (x) = \frac{3x}{2y^2z}$
44. For perfectly rigid under external force
 $\Delta l = 0$ (no strain); $Y = \frac{F/A}{\frac{\Delta l}{l}} = \frac{F}{0 \times A} = \infty$
45. Poiseuille's equation, $Q = \frac{dV}{dt} = \frac{\pi pr^4}{8\eta l}$
46. 1 mole $\text{Al}_2(\text{SO}_4)_3$ contains 12 mol oxygen atom
 \therefore .1 mole $\text{Al}_2(\text{SO}_4)_3$ contains 1.2 mol oxygen atom

47. $m = \frac{X_A}{X_B} \times \frac{1000}{M_B} = \frac{0.2}{0.8} \times \frac{1000}{18} = 13.88$
48. 2 g butane \rightarrow moles = $\frac{2}{58}$
 Number of atoms = $\frac{2}{58} \times N_A \times 14 = 0.48N_A$
 2 g nitrogen \rightarrow moles = $\frac{2}{28}$
 Number of atoms = $\frac{2}{28} \times N_A \times 2 = 0.14N_A$
 2 g silver \rightarrow moles = $\frac{2}{108}$
 Number of atoms = $\frac{2}{108} \times N_A = 0.0185N_A$
 2 g water \rightarrow moles = $\frac{2}{18}$
 Number of atoms = $\frac{2}{18} \times N_A \times 3 = 0.33N_A$
49. 1 M i.e. 1 mol of NaNO_3 in 1000 mL of solution
 Mass of solution = Volume \times Density
 = $1000 \times 1.2 = 1200 \text{ g}$
 Mass of solvent = Mass of solution - Mass of solute
 = $1200 - 85 = 1115 \text{ g}$
 $m = \frac{1 \times 1000}{1115} = 0.89 \text{ m}$
50. $\text{CaCO}_3 + 2\text{HCl} \rightarrow \text{CaCl}_2 + 2\text{H}_2\text{O} + \text{CO}_2$
 Moles of $\text{CaCO}_3 =$ Moles of CO_2
 Moles of $\text{CaCO}_3 = \frac{448}{22400} = 0.02$
 Mass of $\text{CaCO}_3 = 0.02 \times 100 \text{ g} = 2 \text{ g}$
 \therefore Percentage of $\text{CaCO}_3 = \frac{2}{5} \times 100 = 40\%$
51. At STP 11.2 L $\text{NH}_3 = 0.5$ mole $\text{NH}_3 = 8.5 \text{ g NH}_3$
52. Rate of diffusion $\propto \frac{1}{\sqrt{M}}$
 $\frac{r_{\text{H}_2}}{r_{\text{O}_2}} = \sqrt{\frac{M_{\text{O}_2}}{M_{\text{H}_2}}} = \sqrt{\frac{32}{2}} \Rightarrow \frac{r_{\text{H}_2}}{r_{\text{O}_2}} = 4 : 1$
53. $\text{N}_2 + 3\text{H}_2 \rightarrow 2\text{NH}_3$
 Mole of $\text{N}_2 = \frac{28}{28} = 1$; Mole of $\text{H}_2 = \frac{10}{2} = 5$
 H_2 is present in excess amount therefore N_2 is limiting reagent.
 Mole of ammonia produced = 2.

54. $E_{\text{metal}} = \frac{3.4 \times 8}{1.6} = 17$; Valency of metal = $\frac{51}{17}$

Formula of metal oxide M_2O_3



From equation (i) and (ii)

3 mole of $\text{O}_2 \equiv 6$ mole of $\text{KMnO}_4 \equiv 4$ mole of Al

0.1 mole of Al \equiv 0.15 mole of KMnO_4

$= 0.15 \times 158 = 23.7$ g

56. For minimum molecular mass, atleast one atom of Fe should be present in the molecule.

$x \times \frac{4.6}{100} = 56 \Rightarrow x = \frac{56 \times 100}{4.6} = 1217.39 \approx 1200$ u

57. $n = \frac{w}{M^\circ} = \frac{80 \times 10^3 \text{ g}}{6.644 \times 10^{-23} \times 6.022 \times 10^{23}}$; $n = 2000$

58. In isothermal process $dT = 0$ so $\Delta T = 0$

$dU = nC_v dT = 0 \rightarrow U = 0$; $dH = nC_p dT = 0 \rightarrow H = 0$

59. $\Delta H - T\Delta S < 0 \Rightarrow T > \frac{\Delta H}{\Delta S} = \frac{55 \times 1000}{110} = 500$ K

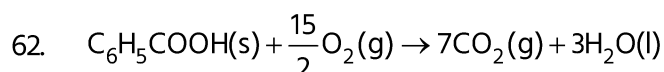
60. Increase in gaseous moles makes ΔS positive.

61. $\Delta U = q + w \Rightarrow q = +50 \text{ J}, W = -P_{\text{ext}} \Delta V$

$W = -2 \times 0.8 = -1.6 \text{ Litre atm} = -162.11 \text{ J}$

$\therefore 1 \text{ litre atm} = 101.32 \text{ J}$

$\Delta U = (+50) + (-162.11) = -112.11 \text{ J}$



$\Delta n_g = 7 - \frac{15}{2} = -\frac{1}{2}$; $\Delta H = \Delta E + \Delta n_g RT$

$-x = \Delta E - \frac{RT}{2}$; $\Delta E = -x + \frac{RT}{2} = -x + \frac{2 \times 300 \times 10^{-3}}{2}$

63. Molar entropy is intensive property, while entropy is extensive property.

64. Heat of formation is defined as the heat associated with formation of 1 mole compound from its elements in their natural/most stable state.

65. $W_{\text{rev.}} = -2.303nRT \log \frac{V_f}{V_i}$

$= -2.303 \times 2 \times 8.314 \times 400 \log \frac{20}{2} = -15.3 \text{ kJ}$

66. $W = -P_{\text{ext}}(V_2 - V_1)$

$= -0.2 \text{ atm}(20 - 10) \text{ L} = -0.2 \times 10 \text{ L} - \text{atm} = -2 \text{ Latm}$

67. Heat released when 1 mole of acid neutralizes 1 mole of base is 57.1 kJ.

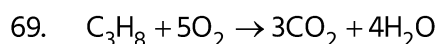
Heat released when 0.1 mole of acid neutralizes 0.1 mole of base is 5.71 kJ

68. $\Delta H_{\text{reaction}} = \Sigma(\text{BE})_{\text{reactants}} - \Sigma(\text{BE})_{\text{products}}$

$= [4 \times (\text{BE})_{\text{C-H}} + (\text{BE})_{\text{Cl-Cl}}]$

$[3 \times (\text{BE})_{\text{C-H}} + (\text{BE})_{\text{C-Cl}} + (\text{BE})_{\text{H-Cl}}]$

$= [4 \times 414 + 243] - [3 \times 414 + 331 + 431] = 105 \text{ kJ}$



$\Delta H = \Delta H_{\text{f}}(\text{product}) - \Delta H_{\text{f}}(\text{reactants})$

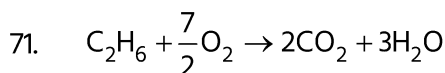
$-2220 = [3 \times (-390) + 4 \times (-240)] - \Delta H_{\text{f}}(\text{C}_3\text{H}_8)$

or $\Delta H_{\text{f}}(\text{C}_3\text{H}_8) = +2220 - 2130 = 90 \text{ kJmol}^{-1}$

70. $\Delta H = \text{B.E. (reactants)} - \text{B.E. (products)}$

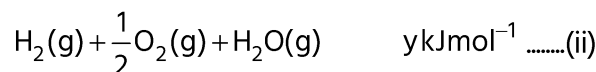
$\Delta H = [4 \times 715 + 4 \times 431] - [8 \times 410 + 1 \times 606 + 2 \times 336]$

$= 26 \text{ kJ}$

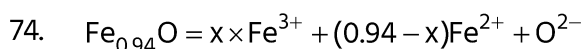
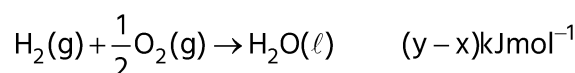


$\Delta H_{\text{comb}} = [2 \times -94.1 + 3 \times -68.3] - [1 \times -21.1]$

72. If $\Delta H < 0$ and $\Delta S > 0$ then reaction is always spontaneous because ΔG is always negative



Subtracting (1) from (2)

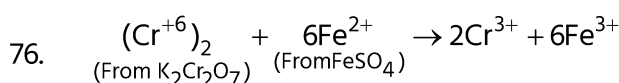


$x(+3) + (0.94 - x)(+2) + (-2) \times 1 = 0$; $x = 0.12 \text{ Fe}^{3+}$

75. $V_2 = \frac{P_1 V_1 \times T_2}{T_1 \times P_2} = \frac{700 \times 50 \times 273}{300 \times 760}$

$V_2 = 41.9 \text{ ml}$

$\% \text{ of nitrogen} = \frac{28}{22400} \times \frac{41.9}{0.3} \times 100 = 17.46\%$



77. In HN_3 , oxidation number of N is $-1/3$

In HCN it is -3 .

78. Maximum and minimum oxidation state of N is $+5$ and -3 respectively.

79. Balance equation is
 $2\text{MnO}_4^- + 5\text{H}_2\text{O}_2 + 6\text{H}^+ \rightarrow 2\text{Mn}^{2+} + 5\text{O}_2 + 8\text{H}_2\text{O}$
 $a = 2, b = 5, c = 6$ and $e = 5$.
80. $\overset{-3+1}{\text{N}}\text{H}_3 + \overset{+1-2}{\text{H}_2}\text{O} \rightarrow \overset{-3+1}{\text{N}}\text{H}_4\overset{-2+1}{\text{O}}\text{H}$
 There is no change in the oxidation state.
81. $\overset{0}{\text{P}_4}(\text{s}) + 3\text{OH}^-(\text{aq}) + 3\text{H}_2\text{O}(\ell)$
 \downarrow
 $\overset{-3}{\text{P}}\text{H}_3(\text{g}) + 3\overset{+1}{\text{H}_2}\text{PO}_2^-(\text{aq})$
 In disproportionation reaction, an element in one oxidation state is simultaneously oxidized and reduced.
82. 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
83. 16g $\text{CH}_4 = 1$ mole CH_4 contains $10 \times 6.02 \times 10^{23}$ electrons = 60.2×10^{23}
 1g $\text{H}_2 = 0.5$ mole H_2 gas occupy 11.35 litre volume at STP
 1 mole of $\text{N}_2 = 28\text{g}$ 0.5 mole of $\text{SO}_2 = 32\text{g}$
84. $\text{C}_6\text{H}_{12}\text{O}_6(\text{s}) + 6\text{O}_2(\text{g}) \rightarrow 6\text{CO}_2(\text{g}) + 6\text{H}_2\text{O}(\ell)$
 $\frac{900}{180}$
 $= 5$ mol 30 mol
 Mass of O_2 required = $30 \times 32 = 960$ gm
85. Statement I is correct but statement II is incorrect
 $\text{S}_1: \text{S}_8 + 12\text{OH}^- \rightarrow 4\text{S}^{2-} + 2\text{S}_2\text{O}_3^{2-} + 6\text{H}_2\text{O}$
 $\text{S}_2: \text{ClO}_4^-$ cannot undergo disproportionation reaction as chlorine is present in its highest oxidation state.
86. Bromine is a stronger oxidant than iodine
88. $\text{C}_2\text{H}_4(\text{g}) + 3\text{O}_2(\text{g}) \rightarrow 2\text{CO}_2(\text{g}) + 2\text{H}_2\text{O}(\ell)$
 $\Delta U = -1406 \text{ KJ mol}^{-1}, T = 300 \text{ K}$
 $\Delta H = \Delta U + \Delta n_g RT$
 $\Delta H = -1406 + (-2) \times 8.3 \times 300$
 $= -1406 - 4.98$
 $= -1410.98 \text{ KJ mol}^{-1} \approx -1411$
 $\Delta H = T\Delta S = -1411 \text{ KJ mol}^{-1}$
89. $2\text{Fe}(\text{s}) + \frac{3}{2}\text{O}_2(\text{g}) \rightarrow \text{Fe}_2\text{O}_3(\text{s}), \Delta H^\circ = -822 \text{ kJ/mol} \dots(\text{i})$
 $\text{C}(\text{s}) + \frac{1}{2}\text{O}_2(\text{s}) \rightarrow \text{CO}(\text{g}), \Delta H^\circ = -110 \text{ kJ/mol} \dots(\text{ii})$
 $3\text{C}(\text{s}) + \text{Fe}_2\text{O}_3(\text{s}) \rightarrow 2\text{Fe}(\text{s}) + 3\text{CO}(\text{g}), \Delta H_3 = z$
 $(3) = 3 \times (2) - (1) \Rightarrow \Delta H_3 = 3 \times \Delta H_2 - \Delta H_1$
 $= 3(-110) + 822 = 492 \text{ kJ/mol}$
90. $6\text{C}(\text{graphite}) + 3\text{H}_2(\text{g}) \rightarrow \text{C}_6\text{H}_6(\ell); \Delta H = 48.5 \text{ kJ/mol}$
 $\text{C}(\text{graphite}) + \text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g}); \Delta H = -393.5 \text{ kJ/mol}$
 $\text{H}_2(\text{g}) + \frac{1}{2}\text{O}_2(\text{g}) \rightarrow \text{H}_2\text{O}(\ell); \Delta H = -286 \text{ kJ/mol}$
 equation $-(1) \times 1 + (2) \times 6 + (3) \times 3$
 $- 48.5 - 6 \times 393.5 - 3 \times 286$
 $= - 3267.5 \text{ kJ for 1 mol}$
 $= - 6535 \text{ kJ for 2 mol Ans. 6535 kJ}$

Answer-Key

1.	1	2.	4	3.	1	4.	2	5.	2	6.	4	7.	1	8.	4	9.	2	10.	4
11.	2	12.	1	13.	3	14.	4	15.	1	16.	4	17.	1	18.	4	19.	4	20.	2
21.	4	22.	3	23.	2	24.	4	25.	2	26.	4	27.	4	28.	2	29.	1	30.	1
31.	3	32.	3	33.	3	34.	2	35.	1	36.	3	37.	4	38.	2	39.	2	40.	4
41.	2	42.	2	43.	1	44.	2	45.	3	46.	2	47.	4	48.	1	49.	3	50.	4
51.	4	52.	3	53.	4	54.	2	55.	2	56.	2	57.	2	58.	4	59.	2	60.	2
61.	2	62.	2	63.	3	64.	3	65.	2	66.	1	67.	1	68.	2	69.	2	70.	2
71.	1	72.	1	73.	1	74.	1	75.	2	76.	3	77.	2	78.	2	79.	2	80.	1
81.	2	82.	2	83.	1	84.	1	85.	1	86.	2	87.	3	88.	4	89.	2	90.	2
91.	3	92.	3	93.	3	94.	4	95.	2	96.	4	97.	3	98.	2	99.	3	100.	4
101.	2	102.	3	103.	4	104.	2	105.	4	106.	2	107.	1	108.	4	109.	1	110.	2
111.	4	112.	1	113.	2	114.	1	115.	3	116.	2	117.	2	118.	2	119.	4	120.	3
121.	3	122.	4	123.	2	124.	1	125.	3	126.	1	127.	2	128.	2	129.	4	130.	2
131.	4	132.	2	133.	2	134.	2	135.	3	136.	2	137.	4	138.	2	139.	4	140.	2
141.	3	142.	2	143.	3	144.	3	145.	2	146.	4	147.	2	148.	4	149.	3	150.	2
151.	2	152.	1	153.	2	154.	4	155.	4	156.	4	157.	2	158.	2	159.	1	160.	2
161.	1	162.	1	163.	3	164.	3	165.	1	166.	4	167.	1	168.	2	169.	3	170.	3
171.	2	172.	1	173.	4	174.	1	175.	1	176.	4	177.	3	178.	1	179.	3	180.	4

$$1. \quad B = 4 \times \frac{\mu_0 i}{4\pi d} [\sin\alpha + \sin\beta] = 4 \times \frac{\mu_0 i}{4\pi} \left(\frac{2}{L}\right) 2\sin 45^\circ$$

$$= \frac{\mu_0 i 8\sqrt{2}}{4\pi L}$$

Flux with smaller loop

$$\phi = \frac{\mu_0 i 8\sqrt{2}}{4\pi L} l^2; \quad M = \frac{\phi}{i} \Rightarrow M \propto \frac{l^2}{L}$$

2. $t = 0$, inductor behaves like an infinite resistance,
So at $t = 0, i = \frac{V}{R_2}$ and at $t = \infty$, inductor behaves

like a conducting wire $i = \frac{V}{R_{eq}} = \frac{V(R_1 + R_2)}{R_1 R_2}$

3. Since \vec{v} and \vec{B} are either parallel or antiparallel.
Hence emf. Induced in the rod will be zero hence $V_p \sim V_Q = 0$.

$$4. \quad V_{rms} = \sqrt{\frac{\int_0^T \frac{1}{2} V^2 dT}{\frac{T}{2}}}$$

5. All inductors are parallel.

6.

7. Value of average current depends on interval chosen.

$$8. \quad e = -\frac{\Delta\phi}{\Delta t} = -\frac{n(\phi_2 - \phi_1)}{t}$$

$$i \times 5R = -\frac{n(\phi_2 - \phi_1)}{t} \therefore i = -\frac{n(\phi_2 - \phi_1)}{5Rt}$$

9. S. I. unit of poynting vector is $\frac{J}{m^2s}$

10. If $v > v_T \Rightarrow v$ decreases and will tend to attain a value equal to v_T .

$$11. \quad Q_4 + 10 + 5 - 8 = 0 \Rightarrow Q_4 = 7 \text{ m}^3/\text{s}$$

$$\therefore 0.5v = 7 \quad v = \frac{7}{0.5} = \frac{70}{5} = 14 \text{ m/s}$$

12. The decrease in potential energy is $Mg\ell$

$$\text{Elastic potential energy stored} = Mg\frac{\ell}{2}$$

$$\text{Heat produced} = Mg\ell - Mg\frac{\ell}{2} = Mg\frac{\ell}{2}$$

$$13. \quad \Delta l = \frac{FL}{AY} \Rightarrow \frac{\Delta l_1}{\Delta l_2} = \frac{A_2}{A_1} = \left(\frac{3}{1}\right)^2 = \frac{9}{1}$$

14. From continuity equation and Bernoulli's Principle.

$$P + \frac{1}{2}\rho v^2 \text{ constant and } A_1 v_1 = A_2 v_2$$

Where area is less, pressure be less.

$$15. \quad \frac{1}{r} = \frac{1}{r_1} - \frac{1}{r_2} \Rightarrow \frac{1}{r} = \frac{1}{6} - \frac{1}{8} \Rightarrow r = \frac{8 \times 6}{2} = 24 \text{ cm}$$

16. Pascal's law.

$$17. \quad \text{Coefficient of linear expansion } \alpha = \frac{\Delta L}{L\Delta t}$$

$$\text{Longitudinal strain, } \frac{\Delta L}{L} = \alpha\Delta t$$

$$\text{Stress, } \frac{F}{A} = Y \times \text{strain}; \quad F = YA\alpha\Delta t$$

18. Conservation of mass

$$19. \quad F = K\Delta x = \frac{YA}{L}\Delta x \Rightarrow F = YA (\text{strain})$$

$$\Rightarrow \frac{\text{Restoring force}}{\text{Strain} \times \text{Area}} = Y; \text{ so, } Y_1 > Y_2$$

$$20. \quad \text{Pressure head} = \frac{p}{\rho g}$$

$$21. \quad v \propto R^2 \Rightarrow v' \propto \left(2^{\frac{1}{3}}R\right)^2 \therefore v' = 2^{\frac{2}{3}} \cdot 2 = 2^{\frac{5}{3}} \text{ m/s}$$

$$22. \quad mg = 2\pi r \times T$$

$$23. \quad B = \frac{\Delta P}{\Delta V/V'}, \Delta P = \text{constant}$$

$$24. \quad \text{As } Y = \frac{FL}{A\Delta L} \therefore \Delta L = \frac{FL}{\pi r^2 Y}$$

$$\therefore \frac{\Delta L_A}{\Delta L_B} = \frac{F_A}{F_B} \cdot \frac{Y_B}{Y_A} \cdot \left(\frac{r_B}{r_A}\right) \frac{L_A}{L_B} = \frac{3Mg}{2Mg} \cdot \left(\frac{1}{z}\right) \left(\frac{1}{y}\right)^2 (x) = \frac{3x}{2y^2z}$$

25. When r lies between PQ , force, $F = -\frac{dU}{dr}$ is positive.

$$26. \quad u = \frac{1}{2} \text{ stress} \times \text{strain} = \frac{1}{2} S \times \frac{S}{Y} = \frac{S^2}{2Y}$$

$$27. \quad t \propto \sqrt{h_1 - h_2} \Rightarrow \frac{t_1}{t_2} = \frac{\sqrt{h} - \sqrt{\frac{h}{2}}}{\sqrt{\frac{h}{2}} - 0} = \frac{\sqrt{2} - 1}{1}$$

$$28. \quad A(P_L - P_U) = mg$$

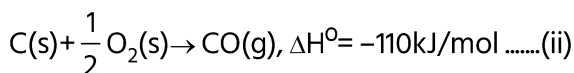
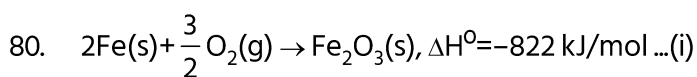
$$P_L - P_U = \frac{3 \times 10^4 \times 10}{120} = 2.5 \times 10^3 \text{ Pascal}$$

29. $d\varepsilon = \int_R^{2R} B\omega x dx = \frac{B\omega}{2} [x^2]_{-R}^{2R} = \frac{3B\omega R^2}{2}$
30. As electron comes close, current induced will be anticlockwise and then change direction.
31. Induced emf in the coil initially is equal to emf of cell, so initial current is zero.
32. $\eta = \frac{P_{out}}{P_{in}} = \frac{100}{0.6 \times 220} = 0.76$
33. $\frac{dV_1}{dt} = \alpha \Rightarrow \frac{dV_2}{dt} = \alpha v$; when $\frac{dv_1}{dt} = \frac{dv_2}{dt}$
34. For perfectly rigid under external force
 $\Delta l = 0$ (no strain) ; $Y = \frac{F/A}{\frac{\Delta l}{l}} = \frac{F}{0 \times A} = \infty$
35. Poiseuille's equation, $Q = \frac{dV}{dt} = \frac{\pi r^4}{8\eta l}$
36. $|V_p| = \frac{d\phi}{dt} = \frac{d}{dt}(40t + 5) = 40V$
 Now $\frac{V_s}{V_p} = \frac{N_s}{N_p} \Rightarrow V_s = 40 \times \frac{500}{100} = 200V$
37. $v = \frac{C}{\sqrt{\mu_r \varepsilon_r}} = \frac{3 \times 10^8}{\sqrt{8 \times 2}} = \frac{3}{4} \times 10^8 = 7.5 \times 10^7 \text{ m/s}$
38. $V = \sqrt{(IR)^2 + (X_L I - X_C I)^2}$
 $V = \sqrt{(30)^2 + (80 - 40)^2} = 50V$
39. $M = \sqrt{L_1 L_2} = \sqrt{4 \times 9} = 6mH = \sqrt{4 \times 9} = 6mH$
40. $V = V_L - V_C \Rightarrow V = 50 - 50 = 0$
 Because voltage across inductor and capacitor in opposite phase when connected in series.
41. Dynamo is based on principle of electromagnetic induction.
42. $X_C = \frac{50}{10} = 5\Omega$ $X_L = \frac{80}{10} = 8\Omega$
 Power factor $= \frac{R}{Z} = \frac{4}{\sqrt{4^2 + (8-5)^2}} = \frac{4}{5} = 0.8$
43. $Z = 30\Omega$; $i = \frac{V}{Z} = \frac{240}{30}$, $i = 8A \Rightarrow V = V_L - V_C = 0$
44. In parallel, emf across both inductors are same
 $\therefore \frac{d\phi_1}{dt} = \frac{d\phi_2}{dt}$ or $\phi_1 = \phi_2$
45. $U_E = U_B$

46. $N_2 + 3H_2 \rightarrow 2NH_3$
 Mole of $N_2 = \frac{28}{28} = 1$; Mole of $H_2 = \frac{10}{2} = 5$
 H_2 is present in excess amount therefore N_2 is limiting reagent.
 Mole of ammonia produced = 2.
47. $E_{metal} = \frac{3.4 \times 8}{1.6} = 17$; Valency of metal = $\frac{51}{17}$
 Formula of metal oxide M_2O_3
48. $2KMnO_4 \xrightarrow{\Delta} K_2MnO_4 + MnO_2 + O_2$
 $4Al + 3O_2 \rightarrow 2Al_2O_3$
 From equation (i) and (ii)
 3 mole of $O_2 \equiv 6$ mole of $KMnO_4 \equiv 4$ mole of Al
 0.1 mole of Al $\equiv 0.15$ mole of $KMnO_4$
 $= 0.15 \times 158 = 23.7 \text{ g}$
49. Molar entropy is intensive property, while entropy is extensive property.
50. Heat of formation is defined as the heat associated with formation of 1 mole compound from its elements in their natural/most stable state.
51. $W_{rev.} = -2.303nRT \log \frac{V_f}{V_i}$
 $= -2.303 \times 2 \times 8.314 \times 400 \log \frac{20}{5} = -15.3 \text{ kJ}$
52. $\Delta H = \text{B.E. (reactants)} - \text{B.E. (products)}$
 $\Delta H = [4 \times 715 + 4 \times 431] - [8 \times 410 + 1 \times 606 + 2 \times 336]$
 $= 26 \text{ kJ}$
53. $C_2H_6 + \frac{7}{2}O_2 \rightarrow 2CO_2 + 3H_2O$
 $\Delta H_{comb} = [2 \times -94.1 + 3 \times -68.3] - [1 \times -21.1]$
54. If $\Delta H < 0$ and $\Delta S > 0$ then reaction is always spontaneous because ΔG is always negative
55. $H_2O(\ell) \rightarrow H_2O(g)$ $x \text{ kJ mol}^{-1}$ (i)
 $H_2(g) + \frac{1}{2}O_2(g) \rightarrow H_2O(g)$ $y \text{ kJ mol}^{-1}$ (ii)
 Subtracting (1) from (2)
 $H_2(g) + \frac{1}{2}O_2(g) \rightarrow H_2O(\ell)$ $(y-x) \text{ kJ mol}^{-1}$
56. $\overset{-3+1}{NH_3} + \overset{+1-2}{H_2O} \rightarrow \overset{-3+1}{NH_4} \overset{+1-1}{OH}$
 There is no change in the oxidation state.

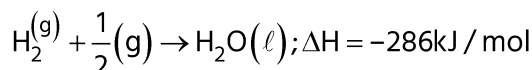
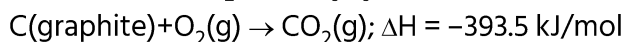
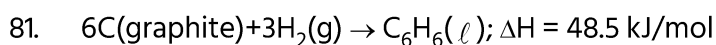
57. $\overset{0}{\text{P}}_4(\text{s}) + 3\text{OH}^-(\text{aq}) + 3\text{H}_2\text{O}(\ell)$
 $\downarrow \qquad \qquad \qquad \downarrow$
 $\overset{-3}{\text{P}}\text{H}_3(\text{g}) + 3\overset{+1}{\text{H}}_2\text{PO}_2^-(\text{aq})$
- In disproportionation reaction, an element in one oxidation state is simultaneously oxidized and reduced.
58. 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
59. Bromine is a stronger oxidant than iodine
61. $\text{C}_2\text{H}_4(\text{g}) + 3\text{O}_2(\text{g}) \rightarrow 2\text{CO}_2(\text{g}) + 2\text{H}_2\text{O}(\ell)$
 $\Delta U = -1406 \text{ KJ mol}^{-1}$, $T = 300 \text{ K}$
 $\Delta H = \Delta U + \Delta n_g RT$
 $\Delta H = -1406 + (-2) \times 8.3 \times 300$
 $= -1406 - 4.98$
 $= -1410.98 \text{ KJ mol}^{-1} \approx -1411$
 $\Delta H = T\Delta S = -1411 \text{ KJ mol}^{-1}$
62. 16g $\text{CH}_4 = 1$ mole CH_4 contains $10 \times 6.02 \times 10^{23}$ electrons = 60.2×10^{23}
 1g $\text{H}_2 = 0.5$ mole H_2 gas occupy 11.35 litre volume at STP
 1 mole of $\text{N}_2 = 28\text{g}$ 0.5 mole of $\text{SO}_2 = 32\text{g}$
63. $\text{C}_6\text{H}_{12}\text{O}_6(\text{s}) + 6\text{O}_2(\text{g}) \rightarrow 6\text{CO}_2(\text{g}) + 6\text{H}_2\text{O}(\ell)$
 $\frac{900}{180}$ 30 mol
 $= 5 \text{ mol}$ 30 mol
 Mass of O_2 required = $30 \times 32 = 960 \text{ gm}$
64. Statement I is correct but statement II is incorrect
 $\text{S}_8 + 12 \text{OH}^- \rightarrow 4\text{S}^{2-} + 2\text{S}_2\text{O}_3^{2-} + 6\text{H}_2\text{O}$
 $\text{S}_2 : \text{ClO}_4^-$ cannot undergo disproportionation reaction as chlorine is present in its highest oxidation state.
65. In HN_3 , oxidation number of N is $-1/3$
 In HCN it is -3 .
66. Maximum and minimum oxidation state of N is $+5$ and -3 respectively.
67. Balance equation is
 $2\text{MnO}_4^- + 5\text{H}_2\text{O}_2 + 6\text{H}^+ \rightarrow 2\text{Mn}^{2+} + 5\text{O}_2 + 8\text{H}_2\text{O}$
 $a = 2, b = 5, c = 6$ and $e = 5$.

68. $W = -P_{\text{ext}}(V_2 - V_1)$
 $= -0.2 \text{ atm}(20 - 10)\text{L} = -0.2 \times 10\text{L} - \text{atm} = -2\text{Latm}$
69. Heat released when 1 mole of acid neutralizes 1 mole of base is 57.1 kJ.
 Heat released when 0.1 mole of acid neutralizes 0.1 mole of base is 5.71 kJ
70. $\Delta H_{\text{reaction}} = \Sigma(\text{BE})_{\text{reactants}} - \Sigma(\text{BE})_{\text{products}}$
 $= [4 \times (\text{BE})_{\text{C-H}} + (\text{BE})_{\text{Cl-Cl}}]$
 $[3 \times (\text{BE})_{\text{C-H}} + (\text{BE})_{\text{C-Cl}} + (\text{BE})_{\text{H-Cl}}]$
 $= [4 \times 414 + 243] - [3 \times 414 + 331 + 431] = 105 \text{ kJ}$
71. $n = \frac{w}{M} = \frac{80 \times 10^3 \text{ g}}{6.644 \times 10^{-23} \times 6.022 \times 10^{23}}$; $n = 2000$
72. In isothermal process $dT = 0$ so $\Delta T = 0$
 $dU = nC_v dT = 0 \rightarrow U = 0$; $dH = nC_p dT = 0 \rightarrow H = 0$
73. $\Delta H - T\Delta S < 0 \Rightarrow T > \frac{\Delta H}{\Delta S} = \frac{55 \times 1000}{110} = 500 \text{ K}$
74. $\text{CaCO}_3 + 2\text{HCl} \rightarrow \text{CaCl}_2 + 2\text{H}_2\text{O} + \text{CO}_2$
 Moles of $\text{CaCO}_3 = \text{Moles of CO}_2$
 Moles of $\text{CaCO}_3 = \frac{448}{22400} = 0.02$
 Mass of $\text{CaCO}_3 = 0.02 \times 100 \text{ g} = 2\text{g}$
 \therefore Percentage of $\text{CaCO}_3 = \frac{2}{5} \times 100 = 40\%$
75. At STP 11.2 L $\text{NH}_3 = 0.5$ mole $\text{NH}_3 = 8.5 \text{ g NH}_3$
76. Rate of diffusion $\propto \frac{1}{\sqrt{M}}$
 $\frac{r_{\text{H}_2}}{r_{\text{O}_2}} = \sqrt{\frac{M_{\text{O}_2}}{M_{\text{H}_2}}} = \sqrt{\frac{32}{2}} \Rightarrow \frac{r_{\text{H}_2}}{r_{\text{O}_2}} = 4 : 1$
77. Increase in gaseous moles makes ΔS positive.
78. $\Delta U = q + w \Rightarrow q = +50 \text{ J}, w = -P_{\text{ext}} \Delta V$
 $W = -2 \times 0.8 = -1.6 \text{ Litreatm} = -162.11 \text{ J}$
 $\therefore 1 \text{ litreatm} = 101.32 \text{ J}$
 $\Delta U = (+50) + (-162.11) = -112.11 \text{ J}$
79. $\text{C}_6\text{H}_5\text{COOH}(\text{s}) + \frac{15}{2}\text{O}_2(\text{g}) \rightarrow 7\text{CO}_2(\text{g}) + 3\text{H}_2\text{O}(\ell)$
 $\Delta n_g = 7 - \frac{15}{2} = -\frac{1}{2}$; $\Delta H = \Delta E + \Delta n_g RT$
 $-x = \Delta E - \frac{RT}{2}$; $\Delta E = -x + \frac{RT}{2} = -x + \frac{2 \times 300 \times 10^{-3}}{2}$



$(3) = 3 \times (2) - (1) \Rightarrow \Delta H_3 = 3 \times \Delta H_2 - \Delta H_1$

$= 3(-110) + 822 = 492 \text{ kJ/mol}$

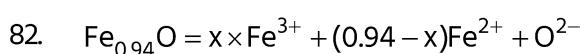


equation $-(1) \times 1 + (2) \times 6 + (3) \times 3$

$- 48.5 - 6 \times 393.5 - 3 \times 286$

$= - 3267.5 \text{ kJ for 1 mol}$

$= - 6535 \text{ kJ for 2 mol Ans. 6535 kJ}$

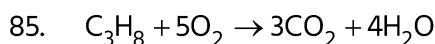
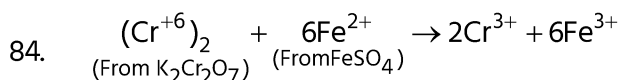


$x(+3) + (0.94 - x) \times (+2) + (-2) \times 1 = 0; x = 0.12\text{Fe}^{3+}$

83. $V_2 = \frac{P_1 V_1 \times T_2}{T_1 \times P_2} = \frac{700 \times 50 \times 273}{300 \times 760}$

$V_2 = 41.9 \text{ ml}$

% of nitrogen $= \frac{28}{22400} \times \frac{41.9}{0.3} \times 100 = 17.46\%$



$\Delta H = \Delta H_{f(\text{product})} - \Delta H_{f(\text{reactants})}$

$-2220 = [3 \times (-390) + 4 \times (-240)] - \Delta H_{f(\text{C}_3\text{H}_8)}$

or $\Delta H_{f(\text{C}_3\text{H}_8)} = +2220 - 2130 = 90 \text{ kJ mol}^{-1}$

86. For minimum molecular mass, atleast one atom of Fe should be present in the molecule.

$x \times \frac{4.6}{100} = 56 \Rightarrow x = \frac{56 \times 100}{4.6} = 1217.39 \approx 1200u$

87. 1 mole $\text{Al}_2(\text{SO}_4)_3$ contains 12 mol oxygen atom

\therefore .1 mole $\text{Al}_2(\text{SO}_4)_3$ contains 1.2 mol oxygen atom

88. $m = \frac{X_A}{X_B} \times \frac{1000}{M_B} = \frac{0.2}{0.8} \times \frac{1000}{18} = 13.88$

89. 2 g butane \rightarrow moles $= \frac{2}{58}$

Number of atoms $= \frac{2}{58} \times N_A \times 14 = 0.48N_A$

2 g nitrogen \rightarrow moles $= \frac{2}{28}$

Number of atoms $= \frac{2}{28} \times N_A \times 2 = 0.14N_A$

2 g silver \rightarrow moles $= \frac{2}{108}$

Number of atoms $= \frac{2}{108} \times N_A = 0.0185N_A$

2 g water \rightarrow moles $= \frac{2}{18}$

Number of atoms $= \frac{2}{18} \times N_A \times 3 = 0.33N_A$

90. 1 M i.e. 1 mol of NaNO_3 in 1000 mL of solution

Mass of solution = Volume \times Density

$= 1000 \times 1.2 = 1200 \text{ g}$

Mass of solvent = Mass of solution - Mass of solute

$= 1200 - 85 = 1115 \text{ g}$

$m = \frac{1 \times 1000}{1115} = 0.89 \text{ m}$

Answer-Key

1.	4	2.	2	3.	1	4.	1	5.	4	6.	4	7.	1	8.	2	9.	2	10.	4
11.	2	12.	4	13.	3	14.	3	15.	3	16.	2	17.	2	18.	4	19.	1	20.	3
21.	4	22.	2	23.	2	24.	1	25.	4	26.	2	27.	1	28.	1	29.	2	30.	4
31.	3	32.	2	33.	2	34.	2	35.	3	36.	3	37.	4	38.	1	39.	4	40.	4
41.	1	42.	4	43.	2	44.	1	45.	4	46.	4	47.	2	48.	2	49.	3	50.	3
51.	2	52.	2	53.	1	54.	1	55.	1	56.	1	57.	2	58.	2	59.	2	60.	3
61.	4	62.	1	63.	1	64.	1	65.	2	66.	2	67.	2	68.	1	69.	1	70.	2
71.	2	72.	4	73.	2	74.	4	75.	4	76.	3	77.	2	78.	2	79.	2	80.	2
81.	2	82.	1	83.	2	84.	3	85.	2	86.	2	87.	2	88.	4	89.	1	90.	3
91.	4	92.	2	93.	3	94.	2	95.	1	96.	4	97.	1	98.	2	99.	1	100.	2
101.	4	102.	3	103.	2	104.	2	105.	4	106.	2	107.	2	108.	3	109.	4	110.	2
111.	4	112.	3	113.	3	114.	3	115.	1	116.	3	117.	1	118.	2	119.	4	120.	2
121.	3	122.	4	123.	2	124.	3	125.	2	126.	2	127.	1	128.	2	129.	4	130.	4
131.	2	132.	4	133.	3	134.	2	135.	3	136.	4	137.	2	138.	4	139.	4	140.	4
141.	2	142.	3	143.	1	144.	4	145.	4	146.	1	147.	1	148.	4	149.	2	150.	3
151.	1	152.	2	153.	4	154.	1	155.	1	156.	3	157.	3	158.	2	159.	1	160.	1
161.	3	162.	4	163.	4	164.	3	165.	1	166.	2	167.	3	168.	2	169.	1	170.	2
171.	3	172.	2	173.	2	174.	2	175.	3	176.	3	177.	2	178.	2	179.	4	180.	2