1. In parallel, emf across both inductors are same

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

2. $U_E = U_B$

3. Value of average current depends on interval chosen.

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

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

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

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

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

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

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

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

Flux with smaller loop

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

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

So at $t = 0, i = \frac{V}{R_2}$ and at $t = \infty$, inductor behaves 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. $|V_P| = \frac{d\phi}{dt} = \frac{d}{dt}(40t + 5) = 40V$

Now $\frac{V_S}{V_P} = \frac{N_S}{N_P} \Rightarrow V_S = 40 \times \frac{500}{100} = 200V$

14. $v = \frac{C}{\sqrt{\mu_r \varepsilon_r}} = \frac{3 \times 10^8}{\sqrt{8 \times 2}} = \frac{3}{4} \times 10^8 = 7.5 \times 10^7$ 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. $V_{rms} = \sqrt{\frac{\int_0^{\frac{T}{2}} V^2 dT}{\frac{T}{2}} dT}$

18. All inductors are parallel.

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

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

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

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

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

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

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

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

$P + \frac{1}{2}Pv^2$ constant and $A_1 V_1 = A_2 V_2$

Where area is less, pressure be less.

33. $\frac{1}{r} = \frac{1}{r_1} - \frac{1}{r_2} \Rightarrow \frac{1}{r} = \frac{1}{6} - \frac{1}{8} \Rightarrow r = \frac{8\times 6}{2} = 24\,cm$

34. $\frac{dV_1}{dt} = \alpha \Rightarrow \frac{dV_2}{dt} = av$; 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 = $\frac{p}{\rho g}$

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

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, $\frac{F}{A} = Y \times$ 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 $Y = \frac{FL}{A\Delta L}$ $\quad \therefore \Delta L = \frac{FL}{\pi r^2 Y}$

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

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, $Q = \frac{dV}{dt} = \frac{\pi p r^4}{8\eta\ell}$

46. 1 mole $Al_2(SO_4)_3$ contains 12 mol oxygen atom 0

$\therefore$ .1 mole $Al_2(SO_4)_3$ 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 → moles = $= \frac{2}{58}$

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

2 g nitrogen → moles $= \frac{2}{28}$

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

2 g silver → moles $= \frac{2}{108}$

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

2 g water → moles = $= \frac{2}{18}$

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

49. 1 M i.e. 1 mol of $NaNO_3$ in 1000 mL of solution

Mass of solution = Volume x Density

= 1000 ×1.2 = 1200g

Mass of solvent= Mass of solution – Mass of solute

= 1200–85 = 1115g

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

50. $CaCO_3 + 2HCl \rightarrow CaCl_2 + 2H_2O + CO_2$

Moles of $CaCO_3$ = Moles of CO_2

Moles of $CaCO_3 = \frac{448}{22400} = 0.02$

Mass of $CaCO_3$ = 0.02 × 100 g =2g

$\therefore$ Percentage of $CaCO_3 = \frac{2}{5} \times 100 = 40\%$

51. At STP 11.2 L NH_3 = 0.5 mole NH_3 = 8.5 g NH_3

52. Rate of diffusion $\propto \frac{1}{\sqrt{M}}$

$\frac{r_{H_2}}{r_{O_2}} = \sqrt{\frac{M_{O_2}}{M_{H_2}}} = \sqrt{\frac{32}{2}} \Rightarrow \frac{r_{H_2}}{r_{O_2}} = 4:1$

53. $N_2 + 3H_2 \rightarrow 2NH_3$

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.

54. $E_{metal} = \frac{3.4 \times 8}{1.6} = 17$; Valencey of metal = $\frac{51}{17}$
Formula of metal oxide M_2O_3

55. $2KMnO_4 \xrightarrow{\Delta} K_2MnO_4 + MnO_2 + O_2$
$4Al + 3O_2 \rightarrow 2Al_2O_3$
From equation (i) and (ii)
3 mole of O_2 ≡ 6 mole of $KMnO_4$ ≡ 4 mole of Al
0.1 mole of Al ≡ 0.15 mole of $KMnO_4$
= 0.15 × 158 = 23.7 g

56. For minimum molecular mass, atleast one atom of Fe should be present in the molecule.
$$x \times \frac{4.6}{100} = 56 \Rightarrow x = \frac{56 \times 100}{4.6} = 1217.39 \approx 1200u$$

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 ΔT = 0
$dU = nCvdT = 0 \rightarrow U = 0$; $dH = nCpdT = 0 \rightarrow H = 0$

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

60. Increase in gaseous moles makes ΔS positive.

61. $\Delta U = q + w \Rightarrow q = +50\,J, W = -P_{ext}\Delta V$
$W = -2 \times 0.8 = -1.6 \text{ Litre atm} = -162.11 J$
$\because$ 1 litre atm = 101.32 J)
$\Delta U = (+50) + (-162.11) = -112.11 J$

62. $C_6H_5COOH(s) + \frac{15}{2}O_2(g) \rightarrow 7CO_2(g) + 3H_2O(l)$
$\Delta n_g = 7 - \frac{15}{2} = -\frac{1}{2}$; $\Delta H = \Delta E + \Delta n_g RT$
$-x = \Delta E - \frac{RT}{2}$; $\Delta E = -x + \frac{RT}{2} = -x + \frac{2 \times 300 \times 10^{-3}}{2}$

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. $W_{rev.} = -2.303 nRT \log \frac{V_f}{V_i}$
$= -2.303 \times 2 \times 8.314 \times 400 \log \frac{20}{2} = -15.3 kJ$

66. $W = -P_{ext}(V_2 - V_1)$
$= -0.2 \text{ atm}(20 - 10)L = -0.2 \times 10 L - atm = -2 Latm$

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. $\Delta H_{reaction} = \Sigma(BE)_{reactants} - \Sigma(BE)_{products}$
$= [4 \times (BE)_{c-H} + (BE)_{cl-Cl}]$
$[3 \times (BE)_{c-H} n\& + (BE)_{c-Cl} + (BE)_{H-Cl}]$
$= [4 \times 414 + 243] - [3 \times 414 + 331 + 431] = .105 kJ$

69. $C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$
$\Delta H = \Delta H_{f(\text{product})} - \Delta H_{f(\text{reactants})}$
$-2220 = [3 \times (-390) + 4 \times (-240)] - \Delta H_{f(C_3H_8)}$
or $\Delta H_{f(C_3H_8)} = +2220 - 2130 = 90 kJmol^{-1}$

70. ΔH = B.E. (reactants) - B.E. (products)
$\Delta H = [4 \times 715 + 4 \times 431] - [8 \times 410 + 1 \times 606 + 2 \times 336]$
$= 26 kJ$

71. $C_2H_6 + \frac{7}{2}O_2 \rightarrow 2CO_2 + 3H_2O$
$\Delta H_{comb} = [2 \times -94.1 + 3 \times -68.3] - [1 \times -21.1]$

72. If ΔH < 0 and ΔS > 0 then reaction is always spontaneous because ΔG is always negative

73. $H_2O(\ell) \rightarrow H_2O(g)$ $x kJmol^{-1}$ ....(i)
$H_2(g) + \frac{1}{2}O_2(g) + H_2O(g)$ $y kJmol^{-1}$ ....(ii)
Subtracting (1) from (2)
$H_2(g) + \frac{1}{2}O_2(g) \rightarrow H_2O(\ell)$ $(y - x) kJmol^{-1}$

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

75. $V_2 = \frac{P_1V_1 \times T_2}{T_1 \times P_2} = \frac{700 \times 50 \times 273}{300 \times 760}$
$V_2 = 41.9 ml$
% of nitrogen $= \frac{28}{22400} \times \frac{41.9}{0.3} \times 100 = 17.46\%$

76. $\underset{(\text{From } K_2Cr_2O_7)}{(Cr^{+6})_2} + \underset{(\text{From} FeSO_4)}{6Fe^{2+}} \rightarrow 2Cr^{3+} + 6Fe^{3+}$

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

$$2MnO_4^- + 5H_2O_2 + 6H^+ \rightarrow 2Mn^{2+} + 5O_2 + 8H_2O$$

$a = 2, b = 5, c = 6$ and $e = 5$.

80. $\overset{-3+1}{NH_3} + \overset{+1\ -2}{H_2O} \rightarrow \overset{-3+1\ -2+1}{NH_4OH}$

There is no change in the oxidation state.

81. $\overset{0}{P_4}(s) + 3OH^-(aq) + 3H_2O(\ell)$

$$\downarrow$$

$$\overset{-3}{PH_3}(g) + 3H_2\overset{+1}{PO_2^-}(aq)$$

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 CH_4 = 1 mole CH_4 contains 10 × 6.02 × 10^{23} electrons = 60.2 × 10^{23}

1 g H_2 = 0.5 mole H_2 gas occupy 11.35 litre volume at STP

1 mole of N_2 = 28g 0.5 mole of SO_2 = 32g

84. $C_6H_{12}O_{6(s)} + 6O_{2(g)} \rightarrow 6CO_{2(g)} + 6H_2O_{(\ell)}$

$\frac{900}{180}$

= 5 mol 30 mol

Mass of O_2 required = 30 × 32 = 960 gm

85. Statement I is correct but statement II is incorrect

S_1: $S_8 + 12\ OH^- \rightarrow 4S^{2-} + 2S_2O_3^{2-} + 6H_2O$

S_2 : ClO_4^- cannot undergo disproportionation reaction as chlorine is present in it's hightest oxidation state.

86. Bromine is a stronger oxidant than iodine

88. $C_2H_4(g) + 3O_2(g) \rightarrow 2CO_2(g) + 2H_2O(l)$

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

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

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

= −1406 − 4.98

= −1410.98 KJ mol^{-1} ≈ −1411

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

89. $2Fe(s) + \frac{3}{2}O_2(g) \rightarrow Fe_2O_3(s), \Delta H^o = -822$ kJ/mol ...(i)

$C(s) + \frac{1}{2}O_2(s) \rightarrow CO(g), \Delta H^o = -110$ kJ/mol ....(ii)

$3C(s) + Fe_2O_3(s) \rightarrow 2Fe(s) + 3CO(g), \Delta H_3 = z$

(3) = 3× (2) −(1) ⇒ $\Delta H_3 = 3 \times \Delta H_2 - \Delta H_1$

= 3(−110) + 822 = 492 kJ/mol

90. 6C(graphite)+$3H_2(g) \rightarrow C_6H_6(\ell)$; $\Delta H = 48.5$ kJ/mol

C(graphite)+$O_2(g) \rightarrow CO_2(g)$; $\Delta H = -393.5$ kJ/mol

$H_2^{(g)} + \frac{1}{2}(g) \rightarrow H_2O(\ell); \Delta H = -286 kJ/mol$

equation −(1) × 1 + (2) × 6 + (3) × 3

− 48.5 − 6 × 393.5 − 3 × 286

= − 3267.5 kJ for 1 mol

= − 6535 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. $B = 4\times\frac{\mu_0 i}{4\pi d}\left[\sin\alpha+\sin\beta\right] = 4\times\frac{\mu_0 i}{4\pi}\left(\frac{2}{L}\right)2\sin 45^\circ$

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

Flux with smaller loop

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

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 $i = \frac{V}{R_{eq}} = \frac{V(R_1+R_2)}{R_1R_2}$

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

5. All inductors are parallel.

6.

7. Value of average current depends on interval chosen.

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

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

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

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

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

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

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

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

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

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

14. From continuity equation and Bernoulli's Principle.

$P + \frac{1}{2}Pv^2$ constant and $A_1 V_1 = A_2 V_2$

Where area is less, pressure be less.

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

16. Pascal's law.

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

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

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

18. Conservation of mass

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

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

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

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

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

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

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

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

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

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

29. $d\varepsilon = \int_R^{2R} B\omega x dx = \frac{B\omega}{2}\left[x^2\right]_R^{2R} = \frac{3B\omega R^2}{2}$

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. $\frac{dV_1}{dt} = \alpha \Rightarrow \frac{dV_2}{dt} = av$; 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, $Q = \frac{dV}{dt} = \frac{\pi p r^4}{8\eta\ell}$

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. $v = \frac{C}{\sqrt{\mu_r \varepsilon_r}} = \frac{3\times10^8}{\sqrt{8\times2}} = \frac{3}{4}\times10^8 = 7.5 \times 10^7$ m/s

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

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

39. $M = \sqrt{L_1 L_2} = \sqrt{4\times9} = 6mH$ $= \sqrt{4\times9} = 6mH$

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. $E_{metal} = \frac{3.4\times8}{1.6} = 17$; Valencey 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 × 158 = 23.7 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. $W_{rev.} = -2.303 nRT \log\frac{V_f}{V_i}$

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

52. $\Delta H =$ B.E. (reactants) - B.E. (products)

$\Delta H = [4\times715 + 4\times431] - [8\times410 + 1\times606 + 2\times 336]$

$= 26kJ$

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. $H_2O(\ell) \rightarrow H_2O(g)$ $x kJmol^{-1}$ ....(i)

$H_2(g) + \frac{1}{2}O_2(g) + H_2O(g)$ $y kJmol^{-1}$ ....(ii)

Subtracting (1) from (2)

$H_2(g) + \frac{1}{2}O_2(g) \rightarrow H_2O(\ell)$ $(y-x) kJmol^{-1}$

56. $\overset{-3\,+1}{NH_3} + \overset{+1\,-2}{H_2O} \rightarrow \overset{-3+1\;-2+1}{NH_4OH}$

There is no change in the oxidation state.

57. $\overset{0}{P_4}(s) + 3OH^-(aq) + 3H_2O(\ell)$

$$\downarrow$$

$$\overset{-3}{P}H_3(g) + 3H_2\overset{+1}{P}O_2^-(aq)$$

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. $C_2H_4(g) + 3O_2(g) \rightarrow 2CO_2(g) + 2H_2O(l)$
$\Delta U = -1406$ KJ mol^{-1}, T = 300 K
$\Delta H = \Delta U + \Delta n_gRT$
$\Delta H = -1406 + (-2) \times 8.3 \times 300$
$= -1406 - 4.98$
$= -1410.98$ KJ $mol^{-1} \approx -1411$
$\Delta H = T\Delta S = -1411$ KJ mol^{-1}

62. 16g CH_4 = 1 mole CH_4 contains $10 \times 6.02 \times 10^{23}$ electrons = 60.2×10^{23}
1 g H_2 = 0.5 mole H_2 gas occupy 11.35 litre volume at STP
1 mole of N_2 = 28g 0.5 mole of SO_2 = 32g

63. $C_6H_{12}O_{6(s)} + 6O_{2(g)} \rightarrow 6CO_{2(g)} + 6H_2O_{(\ell)}$

$\frac{900}{180}$

= 5 mol 30 mol
Mass of O_2 required = 30 × 32 = 960 gm

64. Statement I is correct but statement II is incorrect
S_1: $S_8 + 12\ OH^- \rightarrow 4S^{2-} + 2S_2O_3^{2-} + 6H_2O$
S_2 : ClO_4^- cannot undergo disproportionation reaction as chlorine is present in it's hightest 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

$$2MnO_4^- + 5H_2O_2 + 6H^+ \rightarrow 2Mn^{2+} + 5O_2 + 8H_2O$$

$a = 2, b = 5, c = 6$ and $e = 5$.

68. $W = -P_{ext}(V_2 - V_1)$
$= -0.2\,atm(20 - 10)L = -0.2 \times 10L - atm = -2Latm$

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

$= \left[4 \times (BE)_{c-H} + (BE)_{cl-Cl]}\right]$

$\left[3 \times (BE)_{c-H} n\& + (BE)_{c-Cl} + (BE)_{H-Cl]}\right]$

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

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

72. In isothermal process dT = 0 so $\Delta T = 0$
$dU = nCvdT = 0 \rightarrow U = 0$; $dH = nCpdT = 0 \rightarrow H = 0$

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

74. $CaCO_3 + 2HCl \rightarrow CaCl_2 + 2H_2O + CO_2$
Moles of $CaCO_3$ = Moles of CO_2

Moles of $CaCO_3 = \frac{448}{22400} = 0.02$

Mass of $CaCO_3$ = 0.02 × 100 g = 2g

$\therefore$ Percentage of $CaCO_3 = \frac{2}{5} \times 100 = 40\%$

75. At STP 11.2 L NH_3 = 0.5 mole NH_3 = 8.5 g NH_3

76. Rate of diffusion $\propto \frac{1}{\sqrt{M}}$

$$\frac{r_{H_2}}{r_{O_2}} = \sqrt{\frac{M_{O_2}}{M_{H_2}}} = \sqrt{\frac{32}{2}} \Rightarrow \frac{r_{H_2}}{r_{O_2}} = 4:1$$

77. Increase in gaseous moles makes ΔS positive.

78. $\Delta U = q + w \Rightarrow q = +50\,J, W = -P_{ext}\Delta V$
$W = -2 \times 0.8 = -1.6\,Litre\,atm = -162.11J$
$\because$ 1litre atm = 101.32 J)
$\Delta U = (+50) + (-162.11) = -112.11J$

79. $C_6H_5COOH(s) + \frac{15}{2}O_2(g) \rightarrow 7CO_2(g) + 3H_2O(l)$

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

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

80. $2Fe(s)+\frac{3}{2}O_2(g) \rightarrow Fe_2O_3(s), \Delta H^o = -822$ kJ/mol ...(i)

$C(s)+\frac{1}{2}O_2(s) \rightarrow CO(g), \Delta H^o = -110$kJ/mol ....(ii)

$3C(s) + Fe_2O_3(s) \rightarrow 2Fe(s) + 3CO(g), \Delta H_3 = z$

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

= 3(−110) + 822 = 492 kJ/mol

81. $6C(graphite)+3H_2(g) \rightarrow C_6H_6(\ell); \Delta H = 48.5$ kJ/mol

$C(graphite)+O_2(g) \rightarrow CO_2(g); \Delta H = -393.5$ kJ/mol

$H_2^{(g)} + \frac{1}{2}(g) \rightarrow H_2O(\ell); \Delta H = -286 kJ/mol$

equation −(1) × 1 + (2) × 6 + (3) × 3

− 48.5 − 6 × 393.5 − 3 × 286

= − 3267.5 kJ for 1 mol

= − 6535 kJ for 2 mol Ans. 6535 kJ

82. $Fe_{0.94}O = x \times Fe^{3+} + (0.94-x)Fe^{2+} + O^{2-}$

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

83. $V_2 = \frac{P_1V_1 \times T_2}{T_1 \times P_2} = \frac{700 \times 50 \times 273}{300 \times 760}$

$V_2 = 41.9ml$

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

84. $\underset{(From\ K_2Cr_2O_7)}{(Cr^{+6})_2} + \underset{(From FeSO_4)}{6Fe^{2+}} \rightarrow 2Cr^{3+} + 6Fe^{3+}$

85. $C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$

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

$-2220 = [3\times(-390)+4\times(-240)] - \Delta H_{f(C_3H_8)}$

or $\Delta H_{f(C_3H_8)} = +2220 - 2130 = 90 kJmol^{-1}$

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 $Al_2(SO_4)_3$ contains 12 mol oxygen atom 0

$\therefore$ .1 mole $Al_2(SO_4)_3$ 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 →moles = $= \frac{2}{58}$

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

2 g nitrogen →moles $= \frac{2}{28}$

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

2 g silver → moles $= \frac{2}{108}$

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

2 g water →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 x Density

= 1000 ×1.2 = 1200g

Mass of solvent= Mass of solution – Mass of solute

= 1200−85 = 1115g

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

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