

Answer to Some Selected Problems

UNIT 1

- 1.17 $\sim 15 \times 10^{-4} \text{ g}$, $1.25 \times 10^{-4} \text{ m}$
- 1.18 (i) 4.8×10^{-3} (ii) 2.34×10^5 (iii) 8.008×10^3 (iv) 5.000×10^2
(v) 6.0012
- 1.19 (i) 2 (ii) 3 (iii) 4 (iv) 3
(v) 4 (vi) 5
- 1.20 (i) 34.2 (ii) 10.4 (iii) 0.0460 (iv) 2810
- 1.21 (a) law of multiple proportion (b) (i) Ans : (10^6 mm , 10^{15} pm)
(ii) Ans : (10^{-6} kg , 10^6 ng)
(iii) Ans : (10^{-3} L , 10^{-3} dm^3)
- 1.22 $6.00 \times 10^{-1} \text{ m} = 0.600 \text{ m}$
- 1.23 (i) B is limiting (ii) A is limiting
(iii) Stoichiometric mixture –No (iv) B is limiting
(v) A is limiting
- 1.24 (i) $2.43 \times 10^3 \text{ g}$ (ii) Yes
(iii) Hydrogen will remain unreacted; $5.72 \times 10^2 \text{ g}$
- 1.26 Ten volumes
- 1.27 (i) $2.87 \times 10^{-11} \text{ m}$ (ii) $1.515 \times 10^{-11} \text{ m}$ (iii) $2.5365 \times 10^{-2} \text{ kg}$
- 1.30 $1.99265 \times 10^{-23} \text{ g}$
- 1.31 (i) 3 (ii) 4 (iii) 4
- 1.32 $39.948 \text{ g mol}^{-1}$
- 1.33 (i) $3.131 \times 10^{25} \text{ atoms}$ (ii) 13 atoms (iii) $7.8286 \times 10^{24} \text{ atoms}$
- 1.34 Empirical formula CH , molar mass 26.0 g mol^{-1} , molecular formula C_2H_2
- 1.35 0.94 g CaCO_3
- 1.36 8.40 g HCl

UNIT 2

- 2.1 (i) $1.099 \times 10^{27} \text{ electrons}$ (ii) $5.48 \times 10^{-7} \text{ kg}$, $9.65 \times 10^4 \text{ C}$
- 2.2 (i) $6.022 \times 10^{24} \text{ electrons}$
(ii) (a) $2.4088 \times 10^{21} \text{ neutrons}$ (b) $4.0347 \times 10^{-6} \text{ kg}$
(iii) (a) $1.2044 \times 10^{22} \text{ protons}$ (b) $2.015 \times 10^{-5} \text{ kg}$
- 2.3 7,6: 8,8: 12,12: 30,26: 50, 38
- 2.4 (i) Cl (ii) U (iii) Be
- 2.5 $5.17 \times 10^{14} \text{ s}^{-1}$, $1.72 \times 10^6 \text{ m}^{-1}$
- 2.6 (i) $1.988 \times 10^{-18} \text{ J}$ (ii) $3.98 \times 10^{-15} \text{ J}$

- 2.7 $6.0 \times 10^{-2} \text{ m}$, $5.0 \times 10^9 \text{ s}^{-1}$ and 16.66 m^{-1}
- 2.8 2.012×10^{16} photons
- 2.9 (i) $4.97 \times 10^{-19} \text{ J}$ (3.10 eV); (ii) 0.97 eV (iii) $5.84 \times 10^5 \text{ m s}^{-1}$
- 2.10 494 kJ mol^{-1}
- 2.11 $7.18 \times 10^{19} \text{ s}^{-1}$
- 2.12 $4.41 \times 10^{14} \text{ s}^{-1}$, $2.91 \times 10^{-19} \text{ J}$
- 2.13 486 nm
- 2.14 $8.72 \times 10^{-20} \text{ J}$
- 2.15 15 emission lines
- 2.16 (i) $8.72 \times 10^{-20} \text{ J}$ (ii) 1.3225 nm
- 2.17 $1.523 \times 10^6 \text{ m}^{-1}$
- 2.18 $2.08 \times 10^{-11} \text{ ergs}$, 950 Å
- 2.19 3647 Å
- 2.20 $3.55 \times 10^{-11} \text{ m}$
- 2.21 8967 Å
- 2.22 Na^+ , Mg^{2+} , Ca^{2+} ; Ar, S^{2-} and K^+
- 2.23 (i) (a) $1s^2$ (b) $1s^2 2s^2 2p^6$; (c) $1s^2 2s^2 2p^6$ (d) $1s^2 2s^2 2p^6$
- 2.24 $n = 5$
- 2.25 $n = 3$; $l = 2$; $m_l = -2, -1, 0, +1, +2$ (any one value)
- 2.26 (i) 29 protons
- 2.27 1, 2, 15
- 2.28 (i) l m_l
 0 0
 1 -1, 0, +1
 2 -2, -1, 0, +1, +2
 (ii) $l = 2$; $m_l = -2, -1, 0, +1, +2$
 (iii) 2s, 2p
- 2.29 (a) 1s, (b) 3p, (c) 4d and (d) 4f
- 2.30 (a), (c) and (e) are not possible
- 2.31 (a) 16 electrons (b) 2 electrons
- 2.33 $n = 2$ to $n = 1$
- 2.34 $8.72 \times 10^{-18} \text{ J per atom}$
- 2.35 1.33×10^9
- 2.36 0.06 nm
- 2.37 (a) $1.3 \times 10^2 \text{ pm}$ (b) $6.15 \times 10^7 \text{ pm}$
- 2.38 1560
- 2.39 8
- 2.40 More number of K-particles will pass as the nucleus of the lighter atoms is small, smaller number of K-particles will be deflected as a number of positive charges is less than on the lighter nuclei.
- 2.41 For a given element the number of protons is the same for the isotopes, whereas the mass number can be different for the given atomic number.
- 2.42 $^{81}_{35}\text{Br}$
- 2.43 $^{37}_{17}\text{Cl}^{-1}$

- 2.44 ${}^{56}_{26}\text{Fe}^{3+}$
- 2.45 Cosmic rays > X-rays > amber colour > microwave > FM
- 2.46 $3.3 \times 10^6 \text{ J}$
- 2.47 (a) $4.87 \times 10^{14} \text{ s}^{-1}$ (b) $9.0 \times 10^9 \text{ m}$ (c) $32.27 \times 10^{-20} \text{ J}$
(d) 6.2×10^{18} quanta
- 2.48 10
- 2.49 $8.28 \times 10^{-10} \text{ J}$
- 2.50 $3.45 \times 10^{-22} \text{ J}$
- 2.51 (a) Threshold wave length 652.46 nm (b) Threshold frequency of radiation $4.598 \times 10^{14} \text{ s}^{-1}$
(c) Kinetic energy of ejected photoelectron $9.29 \times 10^{-20} \text{ J}$, Velocity of photoelectron $4.516 \times 10^5 \text{ ms}^{-1}$
- 2.52 530.9 nm
- 2.53 4.48 eV
- 2.54 $7.6 \times 10^3 \text{ eV}$
- 2.55 infrared, 5
- 2.56 434 nm
- 2.57 455 pm
- 2.58 494.5 ms^{-1}
- 2.59 332 pm
- 2.60 $1.516 \times 10^{-38} \text{ m}$
- 2.61 Cannot be defined as the actual magnitude is smaller than uncertainty.
- 2.62 (v) < (ii) = (iv) < (vi) = (iii) < (i)
- 2.63 4p
- 2.64 (i) 2s (ii) 4d (iii) 3p
- 2.65 Si
- 2.66 (a) 3 (b) 2 (c) 6
(d) 4 (e) zero
- 2.67 16

UNIT 5

- 5.1 (ii)
- 5.2 (iii)
- 5.3 (ii)
- 5.4 (iii)
- 5.5 (i)
- 5.6 (iv)
- 5.7 $q = + 701 \text{ J}$
 $w = - 394 \text{ J}$, since work is done by the system
 $\Delta U = 307 \text{ J}$
- 5.8 -743.939 kJ
- 5.9 1.067 kJ
- 5.10 $\Delta H = -7.151 \text{ kJ mol}^{-1}$

- 5.11 -314.8 kJ
 5.12 $\Delta_r H = -778 \text{ kJ}$
 5.13 $-46.2 \text{ kJ mol}^{-1}$
 5.14 -239 kJ mol^{-1}
 5.15 326 kJ mol^{-1}
 5.16 $\Delta S > 0$
 5.17 2000 K
 5.18 ΔH is negative (bond energy is released) and ΔS is negative (There is less randomness among the molecules than among the atoms)
 5.19 0.164 kJ , the reaction is not spontaneous.
 5.20 $-5.744 \text{ kJ mol}^{-1}$
 5.21 NO(g) is unstable, but $\text{NO}_2\text{(g)}$ is formed.
 5.22 $q_{\text{surr}} = +286 \text{ kJ mol}^{-1}$
 $\Delta S_{\text{surr}} = 959.73 \text{ J K}^{-1}$

UNIT 6

- 6.2 12.229
 6.3 2.67×10^4
 6.5 (i) 4.33×10^{-4} (ii) 1.90
 6.6 1.59×10^{-15}
 6.8 $[\text{N}_2] = 0.0482 \text{ mol L}^{-1}$, $[\text{O}_2] = 0.0933 \text{ mol L}^{-1}$, $[\text{N}_2\text{O}] = 6.6 \times 10^{-21} \text{ mol L}^{-1}$
 6.9 0.0352 mol of NO and 0.0178 mol of Br_2
 6.10 $7.47 \times 10^{11} \text{ M}^{-1}$
 6.11 4.0
 6.12 $Q_c = 2.379 \times 10^3$. No, reaction is not at equilibrium.
 6.14 0.44
 6.15 0.068 mol L^{-1} each of H_2 and I_2
 6.16 $[\text{I}_2] = [\text{Cl}_2] = 0.167 \text{ M}$, $[\text{ICl}] = 0.446 \text{ M}$
 6.17 $[\text{C}_2\text{H}_6]_{\text{eq}} = 3.62 \text{ atm}$
 6.18 (i) $[\text{CH}_3\text{COOC}_2\text{H}_5][\text{H}_2\text{O}] / [\text{CH}_3\text{COOH}][\text{C}_2\text{H}_5\text{OH}]$
 (ii) 3.92 (iii) value of Q_c is less than K_c therefore equilibrium is not attained.
 6.19 0.02 mol L^{-1} for both.
 6.20 $[\text{P}_{\text{CO}}] = 1.739 \text{ atm}$, $[\text{P}_{\text{CO}_2}] = 0.461 \text{ atm}$.
 6.21 No, the reaction proceeds to form more products.
 6.22 $3 \times 10^{-4} \text{ mol L}^{-1}$
 6.23 0.149
 6.24 a) -35.0 kJ , b) 1.365×10^6
 6.27 $[\text{P}_{\text{H}_2}]_{\text{eq}} = [\text{P}_{\text{Br}_2}]_{\text{eq}} = 2.5 \times 10^{-2} \text{ bar}$, $[\text{P}_{\text{HBr}}] = 10.0 \text{ bar}$
 6.30 b) 120.48
 6.31 $[\text{H}_2]_{\text{eq}} = 0.96 \text{ bar}$
 6.33 $2.86 \times 10^{-28} \text{ M}$
 6.34 5.85×10^{-2}
 6.35 NO_2^- , HCN , ClO_4^- , HF , H_2O , HCO_3^- , HS^-
 6.36 BF_3 , H^+ , NH_4^+

- 6.37 F^- , HSO_4^- , CO_3^{2-}
- 6.38 NH_3 , NH_4^+ , HCOOH
- 6.41 2.42
- 6.42 $1.7 \times 10^{-4}\text{M}$
- 6.43 $\text{F}^- = 1.5 \times 10^{-11}$, $\text{HCOO}^- = 5.6 \times 10^{-11}$, $\text{CN}^- = 2.08 \times 10^{-6}$
- 6.44 [phenolate ion] = 2.2×10^{-6} , $\alpha = 4.47 \times 10^{-5}$, α in sodium phenolate = 10^{-8}
- 6.45 $[\text{HS}^-] = 9.54 \times 10^{-5}$, in 0.1M HCl $[\text{HS}^-] = 9.1 \times 10^{-8}\text{M}$, $[\text{S}^{2-}] = 1.2 \times 10^{-13}\text{M}$, in 0.1M HCl $[\text{S}^{2-}] = 1.09 \times 10^{-19}\text{M}$
- 6.46 $[\text{Ac}^-] = 0.00093$, pH = 3.03
- 6.47 $[\text{A}^-] = 7.08 \times 10^{-5}\text{M}$, $K_a = 5.08 \times 10^{-7}$, $\text{p}K_a = 6.29$
- 6.48 a) 2.52 b) 11.70 c) 2.70 d) 11.30
- 6.49 a) 11.65 b) 12.21 c) 12.57 c) 1.87
- 6.50 pH = 1.88, $\text{p}K_a = 2.70$
- 6.51 $K_b = 1.6 \times 10^{-6}$, $\text{p}K_b = 5.8$
- 6.52 $\alpha = 6.53 \times 10^{-4}$, $K_a = 2.35 \times 10^{-5}$
- 6.53 a) 0.0018 b) 0.00018
- 6.54 $\alpha = 0.0054$
- 6.55 a) $1.48 \times 10^{-7}\text{M}$, b) 0.063 c) $4.17 \times 10^{-8}\text{M}$ d) 3.98×10^{-7}
- 6.56 a) $1.5 \times 10^{-7}\text{M}$, b) 10^{-5}M , c) $6.31 \times 10^{-5}\text{M}$ d) $6.31 \times 10^{-3}\text{M}$
- 6.57 $[\text{K}^+] = [\text{OH}^-] = 0.05\text{M}$, $[\text{H}^+] = 2.0 \times 10^{-13}\text{M}$
- 6.58 $[\text{Sr}^{2+}] = 0.1581\text{M}$, $[\text{OH}^-] = 0.3162\text{M}$, pH = 13.50
- 6.59 $\alpha = 1.63 \times 10^{-2}$, pH = 3.09. In presence of 0.01M HCl, $\alpha = 1.32 \times 10^{-3}$
- 6.60 $K_a = 2.09 \times 10^{-4}$ and degree of ionization = 0.0457
- 6.61 pH = 7.97. Degree of hydrolysis = 2.36×10^{-5}
- 6.62 $K_b = 1.5 \times 10^{-9}$
- 6.63 NaCl, KBr solutions are neutral, NaCN, NaNO_2 and KF solutions are basic and NH_4NO_3 solution is acidic.
- 6.64 (a) pH of acid solution = 1.9 (b) pH of its salt solution = 7.9
- 6.65 pH = 6.78
- 6.66 a) 12.6 b) 7.00 c) 1.3
- 6.67 Silver chromate S = $0.65 \times 10^{-4}\text{M}$; Molarity of $\text{Ag}^+ = 1.30 \times 10^{-4}\text{M}$
 Molarity of $\text{CrO}_4^{2-} = 0.65 \times 10^{-4}\text{M}$; Barium Chromate S = $1.1 \times 10^{-5}\text{M}$; Molarity of Ba^{2+} and CrO_4^{2-} each is $1.1 \times 10^{-5}\text{M}$; Ferric Hydroxide S = $1.39 \times 10^{-10}\text{M}$;
 Molarity of $\text{Fe}^{3+} = 1.39 \times 10^{-10}\text{M}$; Molarity of $[\text{OH}^-] = 4.17 \times 10^{-10}\text{M}$
 Lead Chloride S = $1.59 \times 10^{-2}\text{M}$; Molarity of $\text{Pb}^{2+} = 1.59 \times 10^{-2}\text{M}$
 Molarity of $\text{Cl}^- = 3.18 \times 10^{-2}\text{M}$; Mercurous Iodide S = $2.24 \times 10^{-10}\text{M}$;
 Molarity of $\text{Hg}_2^{2+} = 2.24 \times 10^{-10}\text{M}$ and molarity of $\text{I}^- = 4.48 \times 10^{-10}\text{M}$
- 6.68 Silver chromate is more soluble and the ratio of their molarities = 91.9
- 6.69 No precipitate
- 6.70 Silver benzoate is 3.317 times more soluble at lower pH
- 6.71 The highest molarity for the solution is $2.5 \times 10^{-9}\text{M}$
- 6.72 2.43 litre of water
- 6.73 Precipitation will take place in cadmium chloride solution

NOTES

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