# Answer to Some Selected Problems

## UNIT 1

1.17 ~ $15 \times 10^{-4}$ g , $1.25 \times 10^{-4}$ *m*

1.18 (i) $4.8 \times 10^{-3}$ (ii) $2.34 \times 10^{5}$ (iii) $8.008 \times 10^{3}$ (iv) $5.000 \times 10^{2}$
(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 $6.00 \times 10^{-1}$ m =0.600 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) $2.43 \times 10^{3}$ g (ii) Yes
(iii) Hydrogen will remain unreacted; $5.72 \times 10^{2}$g

1.26 Ten volumes

1.27 (i) $2.87 \times 10^{-11}$m (ii) $1.515 \times 10^{-11}$ m (iii) $2.5365 \times 10^{-2}$kg

1.30 $1.99265 \times 10^{-23}$g

1.31 (i) 3 (ii) 4 (iii) 4

1.32 39.948 g $mol^{-1}$

1.33 (i) $3.131 \times 10^{25}$ atoms (ii) 13 atoms (iii) $7.8286 \times 10^{24}$ 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) $1.099 \times 10^{27}$ electrons (ii) $5.48 \times 10^{-7}$ kg, $9.65 \times 10^{4}$C

2.2 (i) $6.022 \times 10^{24}$electrons
(ii) (a) $2.4088 \times 10^{21}$ neutrons (b) $4.0347 \times 10^{-6}$ kg
(iii) (a) $1.2044 \times 10^{22}$ protons (b) $2.015 \times 10^{-5}$ kg

2.3 7,6: 8,8: 12,12: 30,26: 50, 38

2.4 (i) Cl (ii) U (iii) Be

2.5 $5.17 \times 10^{14}$ $s^{-1}$, $1.72 \times 10^{6}m^{-1}$

2.6 (i) $1.988 \times 10^{-18}$ J (ii) $3.98 \times 10^{-15}$ J

2.7 $6.0 \times 10^{-2}$ m, $5.0 \times 10^{9}$ $s^{-1}$ and 16.66 $m^{-1}$

2.8 $2.012 \times 10^{16}$ photons

2.9 (i) $4.97 \times 10^{-19}$ J (3.10 eV); (ii) 0.97 eV (iii) $5.84 \times 10^{5}$ m $s^{-1}$

2.10 494 kJ $mol^{-1}$

2.11 $7.18 \times 10^{19} s^{-1}$

2.12 $4.41 \times 10^{14} s^{-1}$, $2.91 \times 10^{-19}$J

2.13 486 nm

2.14 $8.72 \times 10^{-20}$J

2.15 15 emission lines

2.16 (i) $8.72 \times 10^{-20}$J (ii) 1.3225 nm

2.17 $1.523 \times 10^{6}$ $m^{-1}$

2.18 $2.08 \times 10^{-11}$ ergs, 950 Å

2.19 3647Å

2.20 $3.55 \times 10^{-11}$m

2.21 8967Å

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; $m_1$=–2, –1,0,+1,+2

(iii) 2*s*, 2*p*

2.29 (a) 1*s*, (b) 3*p*, (c) 4*d* and (d) 4*f*

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 $8.72 \times 10^{-18}$J per atom

2.35 $1.33 \times 10^{9}$

2.36 0.06 nm

2.37 (a) $1.3 \times 10^{2}$ pm (b) $6.15 \times 10^{7}$ 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 positve charges is less than on the lighter nuclei.

2.41 For a given element the number of prontons is the same for the isotopes, whereas the mass number can be different for the given atomic number.

2.42 $^{81}_{35}Br$

2.43 $^{37}_{17}Cl^{-1}$

2.44 $^{56}_{26}Fe^{3+}$

2.45 Cosmic rays > X–rays > amber colour > microwave > FM

2.46 $3.3 \times 10^6$ J

2.47 (a) $4.87 \times 10^{14}$ $s^{-1}$ (b) $9.0 \times 10^9$ m (c) $32.27 \times 10^{-20}$ J
(d) $6.2 \times 10^{18}$ quanta

2.48 10

2.49 $8.28 \times 10^{-10}$ J

2.50 $3.45 \times 10^{-22}$ J

2.51 (a) Threshold wave length 652.46 nm (b) Threshold frequency of radiation $4.598 \times 10^{14}$ $s^{-1}$
(c) Kinetic energy of ejected photoelectron $9.29 \times 10^{-20}$ J, Velocity of photoelectron $4.516 \times 10^5$ $ms^{-1}$

2.52 530.9 nm

2.53 4.48 eV

2.54 $7.6 \times 10^3$ 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 $1.516 \times 10^{-38}$ m

2.61 Cannot be defined as the actual magnitude is smaller than uncertainity.

2.62 (v) < (ii) = (iv) < (vi) = (iii) < (i)

2.63 4*p*

2.64 (i) 2*s* (ii) 4*d* (iii) 3*p*

2.65 Si

2.66 (a) 3 (b) 2 (c) 6
(d) 4 (e) zero

2.67 16

# UNIT 5

5.1 2.5 bar

5.2 0.8 bar

5.4 70 g/mol

5.5 $M_B = 4M_A$

5.6 203.2 mL

5.7 $8.314 \times 10^4$ Pa

5.8 1.8 bar

5.9 $3 g/dm^3$

5.10 1249.8 g $mol^{-1}$

5.11 3/5

5.12 50 K

5.13 $4.2154 \times 10^{23}$ electrons

5.14 $1.90956 \times 10^6$ year

5.15 56.025 bar

5.16 3811.1 kg

5.17 5.05 L

5.18 40 g $mol^{-1}$

5.19 0.8 bar

## UNIT 6

6.1 (ii)

6.2 (iii)

6.3 (ii)

6.4 (iii)

6.5 (i)

6.6 (iv)

6.7 q = + 701 J

w = – 394 J, since work is done by the system

$\Delta U$ = 307 J

6.8 –743.939 kJ

6.9 1.067 kJ

6.10 $\Delta H$ = –7.151 kJ $mol^{-1}$

6.11 – 314.8 kJ

6.12 $\Delta_r H$ = –778 kJ

6.13 – 46.2 kJ $mol^{-1}$

6.14 – 239 kJ $mol^{-1}$

6.15 326 kJ $mol^{-1}$

6.16 $\Delta S > 0$

6.17 2000 K

6.18 $\Delta H$ is negative (bond energy is released) and $\Delta S$ is negative (There is less randomness among the molecules than among the atoms)

6.19 0.164 kJ, the reaction is not spontaneous.

6.20 –5.744 kJ $mol^{-1}$

6.21 NO(g) is unstable, but $NO_2$(g) is formed.

6.22 $q_{surr}$ = + 286 kJ $mol^{-1}$

$\Delta S_{surr}$ = 959.73 J $K^{-1}$

## UNIT 7

7.2 12.229

7.3 2.67 x $10^4$

7.5 (i) $4.33 \times 10^{-4}$ (ii) 1.90

7.6 $1.59 \times 10^{-15}$

7.8 $[N_2]$ = 0.0482 $molL^{-1}$, $[O_2]$ = 0.0933 $molL^{-1}$, $[N_2O] = 6.6 \times 10^{-21}$ $molL^{-1}$

7.9 0.0352mol of NO and 0.0178mol of $Br_2$

7.10 $7.47 \times 10^{11}\ M^{-1}$

7.11 4.0

7.12 $Q_c = 2.379 \times 10^3$. No, reaction is not at equilibrium.

7.14 0.44

7.15 0.068 $molL^{-1}$ each of $H_2$ and $I_2$

7.16 $[I_2] = [Cl_2] = 0.167$ M, [ICl] = 0.446 M

7.17 $[C_2H_6]_{eq} = 3.62$ atm

7.18 (i) $[CH_3COOC_2H_5][H_2O] / [CH_3COOH][C_2H_5OH]$
(ii) 3.92 (iii) value of $Q_c$ is less than $K_c$ therefore equilibrium is not attained.

7.19 0.02$molL^{-1}$ for both.

7.20 $[P_{CO}] = 1.739$atm, $[P_{CO2}] = 0.461$atm.

7.21 No, the reaction proceeds to form more products.

7.22 $3 \times 10^{-4}\ molL^{-1}$

7.23 0.149

7.24 a) – 35.0kJ, b) $1.365 \times 10^6$

7.27 $[P_{H_2}]_{eq} = [P_{Br_2}]_{eq} = 2.5 \times 10^{-2}$bar, $[P_{HBr}] = 10.0$ bar

7.30 b) 120.48

7.31 $[H_2]_{eq} = 0.96$ bar

7.33 $2.86 \times 10^{-28}$ M

7.34 $5.85x10^{-2}$

7.35 $NO_2^-$, HCN, $ClO_4$, HF, $H_2O$, $HCO_3^-$, $HS^-$

7.36 $BF_3$, $H^+$, $NH_4^+$

7.37 $F^-$, $HSO_4^-$, $CO_3^{2-}$

7.38 $NH_3$, $NH_4^+$, HCOOH

7.41 2.42

7.42 1.7 x $10^{-4}$M

7.43 $F^-$= 1.5 x $10^{-11}$, $HCOO^-$= $5.6 \times 10^{-11}$, $CN^-$= 2.08 x $10^{-6}$

7.44 [phenolate ion]= $2.2 \times 10^{-6}$, $\alpha = 4.47 \times 10^{-5}$ , $\alpha$ in sodium phenolate = $10^{-8}$

7.45 $[HS^-]$= 9.54 x $10^{-5}$, in 0.1M HCl $[HS^-] = 9.1 \times 10^{-8}$M, $[S^{2-}] = 1.2 \times 10^{-13}$M, in 0.1M HCl $[S^{2-}]$= $1.09 \times 10^{-19}$M

7.46 $[Ac^-]$= 0.00093, pH= 3.03

7.47 $[A^-] = 7.08\ x10^{-5}$M, $K_a$= $5.08 \times 10^{-7}$, $pK_a$= 6.29

7.48 a) 2.52 b) 11.70 c) 2.70 d) 11.30

7.49 a) 11.65 b) 12.21 c) 12.57 c) 1.87

7.50 pH = 1.88, $pK_a = 2.70$

7.51 $K_b = 1.6 \times 10^{-6}$, $pK_b = 5.8$

7.52 $\alpha = 6.53 \times 10^{-4}$, $K_a = 2.35 \times 10^{-5}$

7.53 a) 0.0018 b) 0.00018

7.54 $\alpha = 0.0054$

7.55 a) $1.48 \times 10^{-7}$M, b) 0.063 c) $4.17 \times 10^{-8}$M d) $3.98 \times 10^{-7}$

7.56 a) $1.5 \times 10^{-7}$M, b) $10^{-5}$M, c) $6.31 \times 10^{-5}$M d) $6.31 \times 10^{-3}$M

7.57 $[K^+] = [OH^-] = 0.05$M, $[H^+] = 2.0 \times 10^{-13}$M

7.58 $[Sr^{2+}] = 0.1581$M, $[OH^-] = 0.3162$M , pH = 13.50

7.59 $\alpha = 1.63 \times 10^{-2}$, pH = 3.09. In presence of 0.01M HCl, $\alpha = 1.32 \times 10^{-3}$

7.60 $K_a = 2.09 \times 10^{-4}$ and degree of ionization = 0.0457

7.61 pH = 7.97. Degree of hydrolysis = $2.36 \times 10^{-5}$

7.62 $K_b = 1.5 \times 10^{-9}$

7.63 NaCl, KBr solutions are neutral, NaCN, $NaNO_2$ and KF solutions are basic and $NH_4NO_3$ solution is acidic.

7.64 (a) pH of acid solution= 1.9 (b) pH of its salt solution= 7.9

7.65 pH = 6.78

7.66 a) 12.6 b) 7.00 c) 1.3

7.67 Silver chromate S= $0.65 \times 10^{-4}$M; Molarity of $Ag^+ = 1.30 \times 10^{-4}$M

Molarity of $CrO_4^{2-} = 0.65 \times 10^{-4}$M; Barium Chromate S = $1.1 \times 10^{-5}$M; Molarity of $Ba^{2+}$ and $CrO_4^{2-}$ each is $1.1 \times 10^{-5}$M; Ferric Hydroxide S = $1.39 \times 10^{-10}$M;

Molarity of $Fe^{3+} = 1.39 \times 10^{-10}$M; Molarity of $[OH^-] = 4.17 \times 10^{-10}$M

Lead Chloride S = $1.59 \times 10^{-2}$M; Molarity of $Pb^{2+} = 1.59 \times 10^{-2}$M

Molarity of $Cl^- = 3.18 \times 10^{-2}$M; Mercurous Iodide S = $2.24 \times 10^{-10}$M;

Molarity of $Hg_2^{2+} = 2.24 \times 10^{-10}$M and molarity of $I^- = 4.48 \times 10^{-10}$M

7.68 Silver chromate is more soluble and the ratio of their molarities = 91.9

7.69 No precipitate

7.70 Silver benzoate is 3.317 times more soluble at lower pH

7.71 The highest molarity for the solution is $2.5 \times 10^{-9}$M

7.72 2.43 litre of water

7.73 Precipitation will take place in cadmium chloride solution