CHEMISTRY 3A3B SOLUTIONS

ASSIGNMENT #3

Total Marks: 50

1. Write equations for any reactions that occur in the following procedures. If no reaction occurs write 'no reaction'. If no change is observed, you should state this.

In each case describe **in full** what you would observe, including any
- colours
- odours
- precipitates (give the colour)
- gases evolved (give the colour or colourless).

2 MARKS EACH FOR RXNS
1 MARK OBSERVATIONS.

(a) Ammonium sulfate solution is added to a barium chloride solution.

Equation $Ba^{2+}_{(aq)} + SO_4^{2-}{}_{(aq)} \rightarrow BaSO_{4(s)}$

Observations

TWO CLEAR COLOURLESS SOLNS MIX TO FORM A WHITE PPT.

[3 marks]

(b) Dilute sodium hydroxide is added dropwise to copper (II) nitrate solution.

Equation $Cu^{2+}_{(aq)} + 2OH^-_{(aq)} \rightarrow Cu(OH)_{2(s)}$

Observations

BLUE SOLN TURNS COLOURLESS (OR FADES) AND A PALE BLUE PPT FORMS.

[3 marks]

(c) Sodium metal is added to water.

Equation $2Na_{(s)} + 2H_2O_{(l)} \rightarrow 2Na^+_{(aq)} + 2OH^-_{(aq)} + H_{2(g)}$

Observations

SILVER SOLID DISSOLVES (OR DISAPPEARS) AND A GAS FORMS (OR FIZZING, ETC)

[3 marks]

(d) Glucose ($C_6H_{12}O_6$) is burnt completely in air.

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

Observations

WHITE SOLID TURNS TO A GAS (AND LIQUID CONDENSES - NOT REQUIRED)

[3 marks]

(2.) 50 kg SOLUTION OF 92% HNO_3.

(1) $m(HNO_3) = 50000 \times \frac{92}{100} = 46000\ g.$

(1) $n(HNO_3) = 46000\ g / 63.018\ g\ mol^{-1} = 729.95\ mol.$

(1) $n(NO_2) = \frac{3}{2}\, n(HNO_3)$

$= 1094.9\ mol$

(1) (1)

$n(NO) = \frac{2}{2}\, n(NO_2) \times \frac{100}{80}$ SINCE 80% EFF.

$= 1368.7\ mol$

(1) (1)

$n(NH_3) = \frac{4}{4}\, n(NO) \times \frac{100}{85}$ SINCE 85% EFF.

$= 1610.2\ mol$

(1) $m(NH_3) = n(NH_3) \times M(NH_3)$

$= 1610.2 \times 17.034$ (1)

$= 27428\ g$

$\therefore\ m(NH_3) = 27.4\ kg.$ (1)

(3.) (a) $m(C_8H_{18}) = 45.0 \times \frac{92}{100}$ $(\frac{1}{2})$; $m(C_7H_{16}) = 45.0 \times \frac{8}{100}$ $(\frac{1}{2})$

$= 41.4\ g$; $= 3.6\ g.$

(b) $n(C_8H_{18}) = \frac{m}{M} = \frac{41.4}{114.224}$; $n(C_7H_{16}) = \frac{3.6}{100.198}$

$= 0.36245\ mol$ $(\frac{1}{2})$; $= 0.03593\ mol$ $(\frac{1}{2})$

$n_1(O_2)_{USED} = \frac{25}{2}\, n(C_8H_{18})$ (1) ; $n_2(O_2)_{USED} = 11 \times n(C_7H_{16})$ (1)

$= 4.53\ mol$; $= 0.3952\ mol$

$\therefore\ n(O_2)_{USED,\,TOTAL} = n_1 + n_2$

$= 4.926\ mol$ (1)

ORIGINALLY: $n(O_2) = \frac{PV}{RT} = \frac{100 \times 130}{8.315 \times 298.1} = 5.2447\ mol$ (1)

HENCE $n(O_2)_{LEFT} = n(O_2) - n(O_2)_{USED}$ (1)

$= 0.3189\ mol.$

(4.) (a) $CaCO_{3(s)} + 2HCl_{(aq)} \rightarrow CaCl_{2(aq)} + CO_{2(g)} + H_2O_{(\ell)}$ (2)

OR IONIC: $CaCO_{3(s)} + 2H^+_{(aq)} \rightarrow Ca^{2+}_{(aq)} + CO_{2(g)} + H_2O_{(\ell)}$

(b) $n(CaCO_3) = \frac{m}{M} = \frac{3.125\ g}{100.9\ g\ mol^{-1}} = 0.0312\ mol$ (1)

$n(HCl) = c \times V = 2.00 \times \frac{20}{1000} = 0.0400\ mol$ (1)

MOLE RATIO IS 2:1 ($HCl : CaCO_3$) HENCE HCl IS LIMITING REAGENT. (1)

$n(CaCO_3)_{REACTED} = \frac{1}{2} n(HCl) = 0.0200\ mol$ (1)

$n(CaCO_3)_{LEFT} = n(CaCO_3) - n(CaCO_3)_{REACTED}$ (1)

$= 0.0312 - 0.0200$

$= 0.0112\ mol.$ OF XS $CaCO_3$. (1)

(c) $n(CO_2) = \frac{1}{2} \times n(HCl)$

$= 0.0200\ mol.$ (1)

$V(CO_2) = \frac{nRT}{P} = \frac{0.0200 \times 8.315 \times 298.1}{101.3}$

$= 0.4894\ L.$

HENCE $V(CO_2)$ PRODUCED $= 489\ mL.$ (1)

5. (a) $n(C) = n(CO_2) = \frac{1.334}{44.01} = 0.0303$ mol. (1)

$n(H) = 2\,n(H_2O) = 2 \times \frac{0.233}{18.016} = 0.02587$ mol (1)

$m(C) = n(C) \times M(C) = 0.364$ g
$m(H) = n(H) \times M(H) = 0.02607$ g (1)

$\therefore m(O) = 0.5991 - (0.364 + 0.02607) = 0.209$ g (1)
$n(O) = \frac{0.209}{16.00} = 0.01306$ mol.

	C	H	O
n	0.0303	0.02587	0.01306
RATIO	2.32	2	1
(×3)	7	6	3

(1)

$\therefore$ E.F. IS $C_7H_6O_3$. (1)

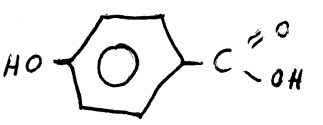
(b) $n = \frac{PV}{RT} = 2.35 \times 10^{-3}$ mol (1)
$M = \frac{m}{n} = \frac{0.3301}{2.35 \times 10^{-3}} = 140$ g mol^{-1}. (1)

(c) $M(EF) = 138$ g mol^{-1} $\frac{M}{M(EF)} \approx 1$

(1)

$\therefore$ $C_7H_6O_3$ IS M.F.

(d) AROMATIC – CONTAINS C_6H_5 (BENZENE RING)
SS, BUT DISSOLVES IN NaOH – ACIDIC – COOH

HENCE :  (1)

4 - HYDROXYBENZOIC ACID.
(OR 2 OR 3 -)