Weekly Quiz 5 take-home CHEM122/124-01 March 4, 2019 Name: KEY

1) For the reaction between sodium carbonate and hydrochloric acid, refer to the following balanced chemical equation to answer the following questions.

$$Na_2CO_3\,(aq) + 2\,HCl\,(aq) \rightarrow 2\,NaCl\,(aq) + H_2O\,(l) + CO_2\,(g)$$

A) What kind of reaction is this? (choose one) (1 pt.)

i) Reduction-oxidation
ii) Precipitation
iii) Acid-base

When 325 mL of 0.354 M Na_2CO_3 (aq) is mixed with 325 mL of 0.683 M HCl(aq): (Show all of your calculation)

B) How many moles of sodium carbonate solution, Na_2CO_3, are present initially? (1 pt.)

$0.325\,L \times 0.354\,M = 0.115\,mol\ Na_2CO_3$

C) How many moles of hydrochloric acid, HCl, are present initially? (1 pt.)

$0.325\,L \times 0.683\,M = 0.222\,mol\ HCl$

D) What is the limiting reagent and how many moles of CO_2 are produced? (1 pt.)

HCl is limiting. $0.222\,mol\ HCl \times \frac{1\,mol\ CO_2}{2\,mol\ HCl} = 0.111\,mol\ CO_2$ produced

E) How many moles of carbonate ion, CO_3^{2-}, remain in solution after the reaction? (1 pt.)

$0.111\,mol\ CO_3^{2-}$ used

0.115 init
0.111 used
0.004 mol remaining

F) What is the concentration of carbonate ion, $[CO_3^{2-}]$, in molarity remaining in the solution after the reaction? (The final volume of the solution is 652 mL.) (1 pt.)

$$[CO_3^{2-}] = \frac{0.004\,mol}{0.652\,L} = 6 \times 10^{-3}\,M$$

or $0.006\,M$

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G) How many moles of sodium ion, Na^+, remain in solution after the reaction? (1 pt.)

Na^+ is a spectator ion and therefore ALL of it remains!

$0.115\ mol\ Na_2CO_3 \times \frac{2\ mol\ Na^+}{1\ mol\ Na_2CO_3} = 0.230\ mol\ Na^+$

H) What is the concentration of sodium ion, $[Na^+]$, in molarity remaining in the solution after the reaction? (The final volume of the solution is 652 mL.) (1 pt.)

$[Na^+] = \frac{0.230\ mol}{0.652\ L} = 0.353$

Extra Credit) Why isn't the total volume of the solution after reaction equal to 325 mL + 325 mL? (1 pt.)

B/C H_2O is one of the products. $0.111\ mol\ H_2O \times 18.015\ g/mol \times \frac{1\ mL}{1\ g} = 2.0\ mL$

2) Consider the two following half-reactions:

Eq. 1 $Fe^{2+}(aq) \rightarrow Fe^{3+}(aq) + e^-$

Eq. 2 $MnO_4^-(aq) + 8\,H^+(aq) + 5\,e^- \rightarrow Mn^{2+}(aq) + 4\,H_2O(\ell)$

A) What is the oxidation state of each element on each side of the equations? (2 pts.)

Element	Reactant side	Product side
Iron	+2	+3
Manganese	+7	+2
Oxygen	-2	-2
Hydrogen	+1	+1

B) Which equation shows oxidation reaction? Eq. 1 (1/2 pt.)

C) Which equation shows the reduction reaction? Eq. 2 (1/2 pt.)

D) What is the oxidizing agent? MnO_4^- (or Mn) (1/2 pt.)

E) What is the reducing agent? Fe^{2+} (or just Fe) (1/2 pt.)

F) Write the balanced redox reaction for the ionic equation of the reaction of iron(II) with permanganate ion in acidic solution. (2pt.)

$5Fe^{2+} + MnO_4^- + 8H^+ \rightarrow 5Fe^{3+} + Mn^{2+} + 4H_2O$