

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



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.)

$$0.325 \text{ L} \times 0.354 \text{ M} = 0.115 \text{ mol } \text{Na}_2\text{CO}_3$$

C) How many moles of hydrochloric acid, HCl , are present initially?

(1 pt.)

$$0.325 \text{ L} \times 0.683 \text{ M} = 0.222 \text{ mol } \text{HCl}$$

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

(1 pt.)

$$\text{HCl is limiting. } 0.222 \text{ mol HCl} \times \frac{1 \text{ mol CO}_2}{2 \text{ mol HCl}} = 0.111 \text{ mol CO}_2 \text{ produced}$$

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

(1 pt.)

$$0.111 \text{ mol CO}_3^{2-} \text{ used} \quad \begin{array}{r} 0.115 \text{ init} \\ 0.111 \text{ used} \\ \hline 0.004 \text{ mol remaining} \end{array}$$

F) What is the concentration of carbonate ion, $[\text{CO}_3^{2-}]$, in molarity remaining in the solution after the reaction? (The final volume of the solution is 652 mL.)

(1 pt.)

$$[\text{CO}_3^{2-}] = \frac{0.004 \text{ mol}}{0.652 \text{ L}} = 6 \times 10^{-3} \text{ M} \text{ or } 0.006 \text{ M}$$

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

Na^+ is a spectator ion and therefore ALL of it remains!
 $0.115 \text{ mol Na}_2\text{CO}_3 \times \frac{2 \text{ mol Na}^+}{1 \text{ mol Na}_2\text{CO}_3} = 0.230 \text{ mol Na}^+$

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

(1 pt.)

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

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

(1 pt.)

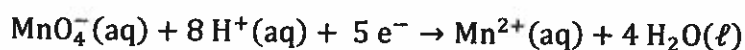
B/c H_2O is one of the products. $0.111 \text{ mol H}_2\text{O} \times 18.015 \frac{\text{g}}{\text{mol}}$
 $\times \frac{1 \text{ mL}}{1 \text{ g}} = 2.0 \text{ mL}$

2) Consider the two following half-reactions:

Eq. 1



Eq. 2



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.)

