Chemistry 12

Reaction Rates Worksheet

Name: Key
Date:
Block:

1. Given the reaction: $N_{2(g)}$ + 3 $H_{2(g)}$ → 2 $NH_{3(g)}$

If the rate of formation of NH_3 is 8.0×10^{-3} mol/s, calculate the rate of consumption of H_2 in mol/s.

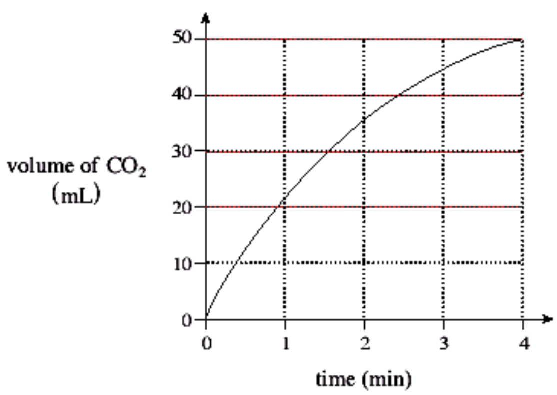
$$\frac{8.0 \times 10^{-3} \text{ mol } NH_3}{1 \text{ s}} \times \frac{3 \text{ mol } H_2}{2 \text{ mol } NH_3} = \boxed{1.2 \times 10^{-2} \text{ mol/s } H_2}$$

2. Given the reaction: $2Al_{(s)}$ + $6HCl_{(aq)}$ → $3H_{2(g)}$ + $2AlCl_{3(aq)}$

If the rate of production of H_2 is 5.50 L/min at STP, calculate the rate of consumption of Al in g/min.

$$\frac{5.50 \text{ L } H_2}{\text{min}} \times \frac{1 \text{ mol } H_2}{22.4 \text{ L } H_2} \times \frac{2 \text{ mol Al}}{3 \text{ mol } H_2} \times \frac{27.0 \text{ g Al}}{1 \text{ mol Al}} = 4.4169 = \boxed{4.42 \text{ g/min Al}}$$

3. Given the following reaction and graph: $CaCO_{3(s)}$ + 2 $HCl_{(aq)}$ → $CaCl_{2(aq)}$ + $CO_{2(g)}$ + $H_2O_{(l)}$



a) Calculate the average rate of reaction in mL CO_2 /min for the time interval 0 – 2 min.

$$\frac{\Delta \text{ volume}}{\Delta \text{ time}} = \frac{35 - 0 \text{ mL}}{2 - 0 \text{ min}} = \boxed{17.5 \text{ mL/min}}$$

b) Calculate the average rate of reaction in mL CO_2 /min for the time interval 2 – 4 min.

$$\frac{\Delta \text{ volume}}{\Delta \text{ time}} = \frac{50 - 35 \text{ mL}}{4 - 2 \text{ min}} = \boxed{7.5 \text{ mL/min}}$$

4. Consider the following reaction:

$$2H_2O_{2\,(l)} \rightarrow 2\,H_2O_{(l)} + O_{2(g)}$$

If the rate of consumption of H_2O_2 is 0.020 g/s, calculate the rate of production of O_2 in mol/min.

$$\frac{0.020\text{ g } H_2O_2}{1\text{ s}} \times \frac{60\text{ s}}{1\text{ min}} \times \frac{1\text{ mol } H_2O_2}{34.0\text{ g } H_2O_2} \times \frac{1\text{ mol } O_2}{2\text{ mol } H_2O_2} = 1.8 \times 10^{-2}\text{ mol/min } O_2$$

5. Consider the following reaction: $Zn_{(s)} + 2HCl_{(aq)} \rightarrow ZnCl_{2\,(aq)} + H_{2(g)}$

Outline 3 procedures you could use to **monitor** the rate of this reaction.

i. mass : ↓ in $Zn_{(s)}$

ii. pressure : ↑ of $H_{2(g)}$

iii. pH : HCl is an acid ; as [HCl]↓ pH will ↑

6. Given the reactions:

a) $2Ag^{+}_{(aq)} + CrO_4^{2-}{}_{(aq)} \rightarrow Ag_2CrO_{4\,(s)}$

b) $Pb_{(s)} + 2HCl_{(aq)} \rightarrow PbCl_{2\,(aq)} + H_{2(g)}$

Which reaction would be faster at room temperature? A. Explain your answer.

A. involves the rxn of two aqueous species, whereas B. involves the rxn of an aqueous and solid species. Aqueous reacts faster than solid

7. Given the same conditions, which of the following reactions is fastest?

a. $H_{2(g)} + I_{2(g)} \rightarrow 2HI_{(g)}$

b. $Ag^{+}_{(aq)} + I^{-}_{(aq)} \rightarrow AgI_{(s)}$

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

d. $5\,C_2O_4^{2-}{}_{(aq)} + 2\,MnO_4^{2-}{}_{(aq)} + 16\,H^{+}_{(aq)} \rightarrow 10\,CO_{2(g)} + 2\,Mn^{2+}{}_{(aq)} + 8\,H_2O_{(l)}$

Explain your answer.

B. is the fastest. Although D. also contains aqueous reactants, the complexity of the arrangements of ions to achieve the desired products will slow down the rxn.

8. Consider the reaction: $Sn_{(s)} + 2\,HCl_{(aq)} \rightarrow H_{2(g)} + SnCl_{2(aq)}$

Give 4 methods by which the rate of this reaction could be increased.

i. ↑ [HCl]

ii. ↑ SA of $Sn_{(s)}$

iii. ↑ temp

iv. add a catalyst

9. . Which of the following reactions will be **slowest** at 25°C?

I. $Cu_{(s)} + S_{(s)} \rightarrow CuS_{(s)}$
II. $H^+_{(aq)} + OH^-_{(aq)} \rightarrow H_2O_{(l)}$
III. $Pb^{2+}_{(aq)} + 2Cl^-_{(aq)} \rightarrow PbCl_{2(s)}$
IV. $2NaOCl_{(aq)} \rightarrow 2NaCl_{(aq)} + O_{2(g)}$

10. Give **two** procedures which could be used to speed up the reaction you identified in the above question.

i. ↑ SA of $Cu_{(s)}$ and/or $S_{(s)}$

ii. add a catalyst