

## Review D:

1. At 20 °C, a 3% solution of hydrogen peroxide produces 15 ml of oxygen gas in 120 seconds.

a. What is the rate of this reaction?

$$\frac{15 \text{ ml}}{120 \text{ s}} = \boxed{1.25 \times 10^{-1} \frac{\text{ml}}{\text{s}}}$$

- b. How long might it take to produce 15 ml of oxygen at a temperature of 40 °C? 20 °C 30 °C 40 °C

$$1.25 \times 2 \times 2 = \boxed{5 \times 10^{-1} \frac{\text{ml}}{\text{s}}}$$

2. A nitric acid solution is found to have a pH of 2.7. Determine each of the following:

a. the  $[\text{H}_3\text{O}^+]$  and  $[\text{OH}^-]$

$$1 \times 10^{-14} = [2 \times 10^{-3}] [\text{OH}^-]$$

$$[\text{OH}^-] = 5 \times 10^{-12}$$

$$\text{pH} = -\log [\text{H}_3\text{O}^+]$$

$$2.7 = -\log [\text{H}_3\text{O}^+]$$

$$[\text{H}_3\text{O}^+] = \boxed{2.00 \times 10^{-3}}$$

b. the mass of anhydrous  $\text{HNO}_3$  required to prepare 5.5 L of this solution

$$? \text{ g HNO}_3 = 5.5 \text{ L} \times \frac{2 \times 10^{-3} \text{ mol H}^+}{1 \text{ L}} \times \frac{1 \text{ mol HNO}_3}{1 \text{ mol H}^+} \times \frac{63 \text{ g}}{1 \text{ mol HNO}_3} = \boxed{6.03 \times 10^{-1} \text{ g}}$$

3. The reaction:  $\text{Br}_2 + 2\text{NO} \rightarrow 2\text{NOBr}$  is determined experimentally to be first order with respect to  $\text{Br}_2$  and second order with respect to  $\text{NO}$ . At a certain temperature the rate constant is  $0.05 \text{ l}^2/(\text{mol}^2 \text{ s})$ .

a. Write the rate law for this reaction.

$$\text{RATE} = k [\text{Br}_2]^1 [\text{NO}]^2$$

b. What is the overall order of the reaction?

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c. What will be the reaction rate at this temperature when conc.  $\text{Br}_2 = 0.1 \text{ M}$  and conc.  $\text{NO} = 0.05 \text{ M}$ ?

$$\text{RATE} = 0.05 [0.1] [0.05]^2$$

$$= \boxed{1.25 \times 10^{-5}}$$

4. The following data are for the gas phase decomposition of  $\text{CH}_3\text{NO}_2$  at 473 K:

| Time (min) | conc (M) | Time (min) | conc (M) |
|------------|----------|------------|----------|
| 0          | 0.2      | 4          | 0.187    |
| 1          | 0.197    | 8          | 0.175    |
| 2          | 0.193    | 16         | 0.153    |
| 3          | 0.190    |            |          |

a. Plot the data and determine the order of the reaction: