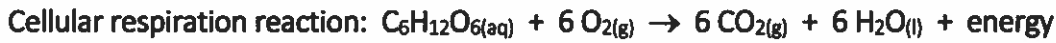


Ideal gas law and combined gas law
4 marks each

Name: Answers
Due: Monday (01/02) Tuesday (03)

1. Hummingbirds have an extremely rapid metabolic rate. In order to maintain it, they must consume approximately one third their body mass in sugar every day. Energy is produced when sugar is broken down during cellular respiration.



If a hummingbird burns 1.00 gram of sugar, $C_6H_{12}O_6$, during cellular respiration, what is the volume of $CO_{2(g)}$ produced at $37.0^\circ C$ and 101.3 kPa ?

$$\frac{1 \text{ mol } C_6H_{12}O_6 = 180.18 \text{ g}}{x} = \frac{1.00 \text{ g}}{1.00 \text{ g}}$$

$$x = 0.005550 \text{ mol } C_6H_{12}O_6$$

1:6 ratio

$$0.005550 \times 6 = 0.03330 \text{ mol } CO_2$$

$$PV = nRT \quad T = 37.0 + 273 = 310 \text{ K}$$

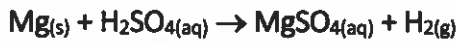
$$V = \frac{nRT}{P}$$

$$= \frac{(0.0330)(8.31)(310)}{101.3}$$

$$V = 0.8468 \text{ L}$$

$$\boxed{V = 847 \text{ mL}}$$

2. In an experiment, a student places magnesium metal in aqueous sulfuric acid, H_2SO_4 , according to the following equation:



The student must produce 174.1 mL of hydrogen gas by reacting magnesium with an excess of $H_2SO_{4(aq)}$, at a temperature of $30.0^\circ C$ and a pressure of 100 kPa . What mass of magnesium is needed?

$$PV = nRT \quad T = 30.0 + 273 = 303 \text{ K}$$

$$1 \text{ mol } H_2 = 1 \text{ mol } Mg \quad \therefore 0.006914 \text{ mol } Mg$$

$$n = \frac{PV}{RT}$$

$$= \frac{(100)(0.1741)}{(8.31)(303)}$$

$$\frac{1 \text{ mol } Mg = 24.3 \text{ g}}{0.006914} \quad x = 0.1681$$

$$\boxed{0.168 \text{ g } Mg}$$

$$n = 0.006914 \text{ mol } H_2$$

3. A science student would like to identify a pure gas sample. She finds the following information:

Mass of empty container	4.40 g
Mass of container + unknown gas	6.03 g
Volume	1210 mL
Temperature	$18^\circ C$
Pressure	102 kPa

Which of the following is the unknown gas?

H_2 O_2 CO_2 BCl_3
2g/mol 32g/mol

$$Temp = 18 + 273 = 291 \text{ K}$$

$$\begin{array}{r} \text{Mass of gas } 6.03 \text{ g} \\ - 4.40 \text{ g} \\ \hline 1.63 \text{ g} \end{array} \quad \text{Liters!}$$

$$PV = nRT$$

$$n = \frac{PV}{RT} = \frac{(102)(1.210)}{(8.31)(291)} = 0.05104$$

$$\frac{1 \text{ mol}}{0.05104 \text{ mol}} = \frac{x}{1.63 \text{ g}}$$

$$x = 31.9 \text{ g/mol}$$

4. Inside the school, a balloon occupies a volume of $1.50 \times 10^3 \text{ mL}$ at $22.0^\circ C$ and 101.8 kPa . The balloon is taken outside, where the temperature is $33.0^\circ C$ and the pressure is 102.3 kPa .

What is the volume of the balloon when it is outside? $\frac{P_1 V_1}{n_1 T_1} = \frac{P_2 V_2}{n_2 T_2}$

$$V_1 = 1.50 \times 10^3$$

$$T_1 = 22.0 + 273 = 295 \text{ K}$$

$$P_1 = 101.8 \text{ kPa}$$

$n = \text{constant}$

$$\frac{(101.8)(1.50 \times 10^3)}{295} = \frac{(102.3)(V_2)}{306}$$

$$46726.200 = 30178.5 V_2$$

$$V_2 = ?$$

$$T_2 = 33.0 + 273 = 306 \text{ K}$$

$$V_2 = 1548.33 \text{ mL}$$

$$P_2 = 102.3 \text{ kPa}$$

$$\boxed{V_2 = 1.55 \text{ L}}$$