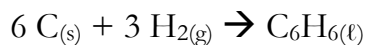
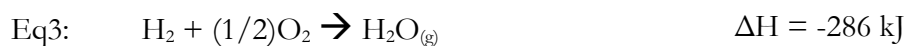
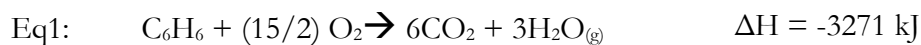


1. a) Find benzene's 'standard heat of formation' (the ΔH of a reaction where the product is formed from its constituent elements)

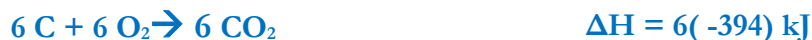


$$\Delta H = ?$$

Use the following:



Eq2 X 6

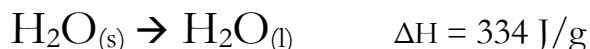


- b) In the formation of $\text{C}_6\text{H}_{6(l)}$ how many kJ are absorbed per mole of hydrogen gas?



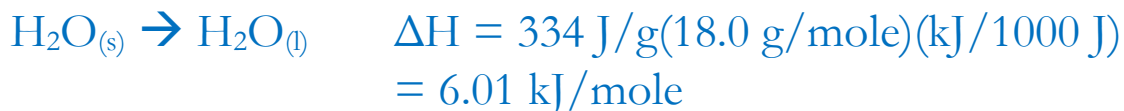
Then $\Delta H/\text{mole of H}_2 = \Delta H = 49.0 \text{ kJ} / 3 \text{ mole of H}_2 = 16.3 \text{ kJ/mole of H}_2$

2. To get 1.0 g of ice to turn to 1.0 g of liquid water at 0°C , it takes 334 J.



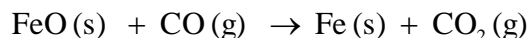
The heat of vaporization at 0°C for liquid water is 45.054 kJ/mole.

At that temperature, use Hess Law to figure out the heat of sublimation of ice in kJ/mole.

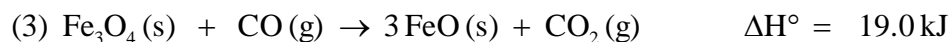
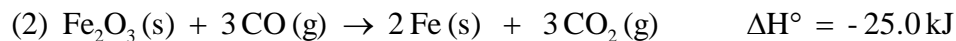
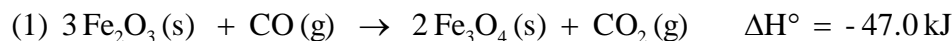


Sum: $\text{H}_2\text{O}_{(s)} \rightarrow \text{H}_2\text{O}_{(g)} \Delta H = 6.01 \text{ kJ/mole} + 45.054 \text{ kJ/mole} = 51.1 \text{ kJ/mole}$

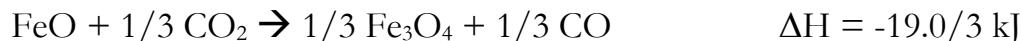
3.



Calculate the standard enthalpy change for this reaction from these reactions of iron oxides with CO :



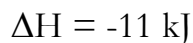
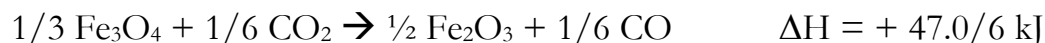
Take 1/3 of the last one (only one with FeO) and flip it:



Take 1/2 of the second one (only one with Fe) $\Delta H = -25.0/2 \text{ kJ}$



To get rid of Fe₂O₃ take 1/6 of first equation and flip it.



Part 2 Flashbacks

1. You cook some hot soup and place the leftover in a Tupperware container and cover it with a lid. You place the container in the fridge, and the next day, the container is difficult to open. Why?

(1) The condensation of the steam inside the container initially pushed some air out.

(2) But then upon condensation in the fridge, the pressure drops because there are now less gas molecules inside the sealed container.

(3) The atmospheric pressure is higher than the pressure inside; the net downward force on top of the lid (and all around the container) makes it harder to open

2. What is the molar mass of gas X if its molecules move 1.13137 times faster than those of SO_2 ? Both gases are at the same temperature. Derive the formula relating molar mass to molecular velocity before you attempt the problem.

Same temp, same kinetic energy for molecules A and B:

$$\frac{1}{2} m_A v_A^2 = \frac{1}{2} m_B v_B^2$$

$$m_A v_A^2 = m_B v_B^2$$

$$\frac{v_B^2}{v_A^2} = \frac{m_A}{m_B}$$

$$\frac{v_B}{v_A} = \sqrt{\frac{m_A}{m_B}}$$

Let B be the faster molecule and $\text{SO}_2 = \text{A}$, the slower one.

$$\frac{v_B}{v_A} = \sqrt{\frac{m_{SO_2}}{m_B}}$$

$$\frac{v_B}{v_A} = 1.13137 = \sqrt{\frac{64}{m_B}}$$

$$1.13137^2 = (64 \text{ g/mole})/m_B$$

$$m_B = 64/1.13137^2 = 50 \text{ g/mole}$$

3. Carbon dioxide at 24.0 °C leaked out of a 100.0 L tank, causing its pressure to drop from 1250 kPa to 1225 kPa. How many grams of gas leaked out?

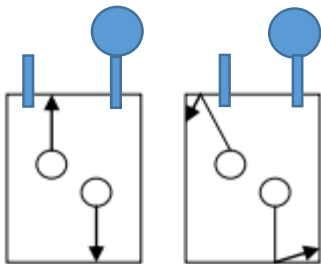
In this case, change in pressure comes from the change in moles, so

$$\Delta PV = \Delta n RT$$

$$\Delta n = \Delta PV / RT = (1250 \text{ kPa} - 1225 \text{ kPa})(100.0 \text{ L}) / (8.31 \text{ LkPa}/(\text{Kmol})) / (273 + 24) \text{ K}$$

$$= 1.01 \text{ moles of CO}_2 (44.0 \text{ g/mole}) = 44.6 \text{ g of CO}_2$$

4. a) When will the relationship between P and T be linear?
When n and V are constant
- b) Draw containers to show what the molecules would look like while you are heating the gas to measure pressure. Also draw the thermometer and manometer.



5. a) If for a real gas you enter its P, V, n and T, will you, in solving for R, obtain 8.31 L kPa/(K mole)?

No

- b) Convert 8.31 L kPa/(K mole) to mL Pa/ K mole.

$$= 8.31 \times 10^6 \text{ mL Pa/ K mole.}$$

Part 3 Lab Exam Type Questions

1. Give the number of significant figures for each measurement.

- | | |
|---|---|
| a) Canada's population is 35 million. | 2 |
| b) Canada has 3.516×10^7 people. | 4 |
| c) 1.0000 ± 0.0005 g | 5 |
| d) 35.00 ± 0.02 g | 4 |

2. A student named Saleintesta based a prediction for the volume of hydrogen produced on a measurement of 0.050 ± 0.002 g of Mg while Sciaquato used a different balance and quantity: 0.010 ± 0.001 g. Which measurement is more accurate? Show why.

Saleintesta's only has a $0.002/0.050 * 100\% = 4\%$ error

Sciaquato has a 10% error

3. If you had no information on the numbered divisions of a 5 mL buret and of a 5 mL graduated cylinder, how would you match the glassware with these uncertainties: ± 0.01 and ± 0.10 mL? (Which has which and why?)

The 5 mL buret is thinner and has a lower uncertainty ± 0.01

4. After doing an experiment and having also calculated theoretical yield, what is the difference in the way we calculate percent error and percent yield?

$$\text{Percent yield} = \frac{\text{Actual yield}}{\text{Theoretical yield}} \times 100\%$$

$$\% \text{ error} = 100\% - \text{percent yield}$$