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2. (15 points) 1.00 mol of propane gas, C_3H_8 is combusted at standard conditions. The heat of reaction is measured to be: $\Delta H_{\text{rxn}} = -2.22 \times 10^3 \text{ kJ}$.

(a) Write a balanced combustion reaction for propane

(b) Calculate the heat of formation of propane gas. You will need the tabulated heats of formation data (see page 5.)

(c) What volume of gas is produced in the reaction?

(d) What volume of gas is consumed in the reaction?

(e) What is the work done?

(f) What is ΔU for this reaction?

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3. (15 points)

(a) Use the ideal gas equation of state to prove that $P_i/T_i = P_f/T_f$ for a gas heated or cooled at constant volume.

(b) Use the ideal gas equation of state to prove that the density of a gas is inversely proportional to the temperature if the pressure is held constant.

4. (15 points) Short answers

(a) Assign oxidation numbers to each atom in the following compounds.

i. CH_2F_2

ii. phosphorous pentachloride

iii. BaCrO_4

(b) Label the following solutions as strong acids, weak acids, strong bases, weak bases, strong electrolytes, weak electrolytes, or non-electrolytes. Use all labels that apply.

i. aqueous sodium chloride

ii. octane

iii. aqueous ammonium nitrate

iv. aqueous propylamine

v. aqueous acetic acid

(c) Name the two authors of your textbook. (Last names are sufficient.)

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5. (15 points) For each of the following situations, state what happens, and calculate the concentration of everything in solution after the reaction (if there is one) is complete.

(a) 100.0 mL of 0.125 M HCl is mixed with 250.00 mL of 0.100 M KOH.

(b) 124.0 mL of 0.0500 M NaOH is neutralized by titrating it with 0.250 M hydrochloric acid solution.

(c) 10.0 g NaCl is added to 1.00 L of a solution that is 0.05 M in Ag^+ , 0.025 M in Pb^{2+} , and 0.100 M in K^+ . The volume does not change.

6. (10 points) Fill in the blanks

(a) A good _____ agent is something that is easily oxidized.

(b) The pressure of a gas is _____ its molar mass.

(c) "Equal volumes of gases contain equal numbers of molecules" is a statement of _____'s Hypothesis.

(d) Work of negative sign is work done _____ the system.

(e) Heat and work are both forms of _____.

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7. (15 points)

(a) Write a balanced redox equation for the reduction of solid copper(II) oxide to solid copper by aluminum metal.

(b) Calculate ΔH for this reaction. The necessary heats of formation are in the table at the end of the test.

(c) All of the heat evolved in this reaction can be assumed to go towards making the products *hot*. If the specific heats of aluminum oxide and copper metal are $0.880 \text{ J g}^{-1} \text{ }^\circ\text{C}^{-1}$ and $0.385 \text{ J g}^{-1} \text{ }^\circ\text{C}^{-1}$, what is the final temperature reached by the products?

Tabulated heats of formation

$\text{CO}_2(g)$ $\Delta H_f^\circ = -393.5 \text{ kJ/mol}$

$\text{H}_2\text{O}(l)$ $\Delta H_f^\circ = -187.8 \text{ kJ/mol}$

$\text{CuO}(s)$ $\Delta H_f^\circ = -157.3 \text{ kJ/mol}$

$\text{Al}_2\text{O}_3(s)$ $\Delta H_f^\circ = -1676 \text{ kJ/mol}$