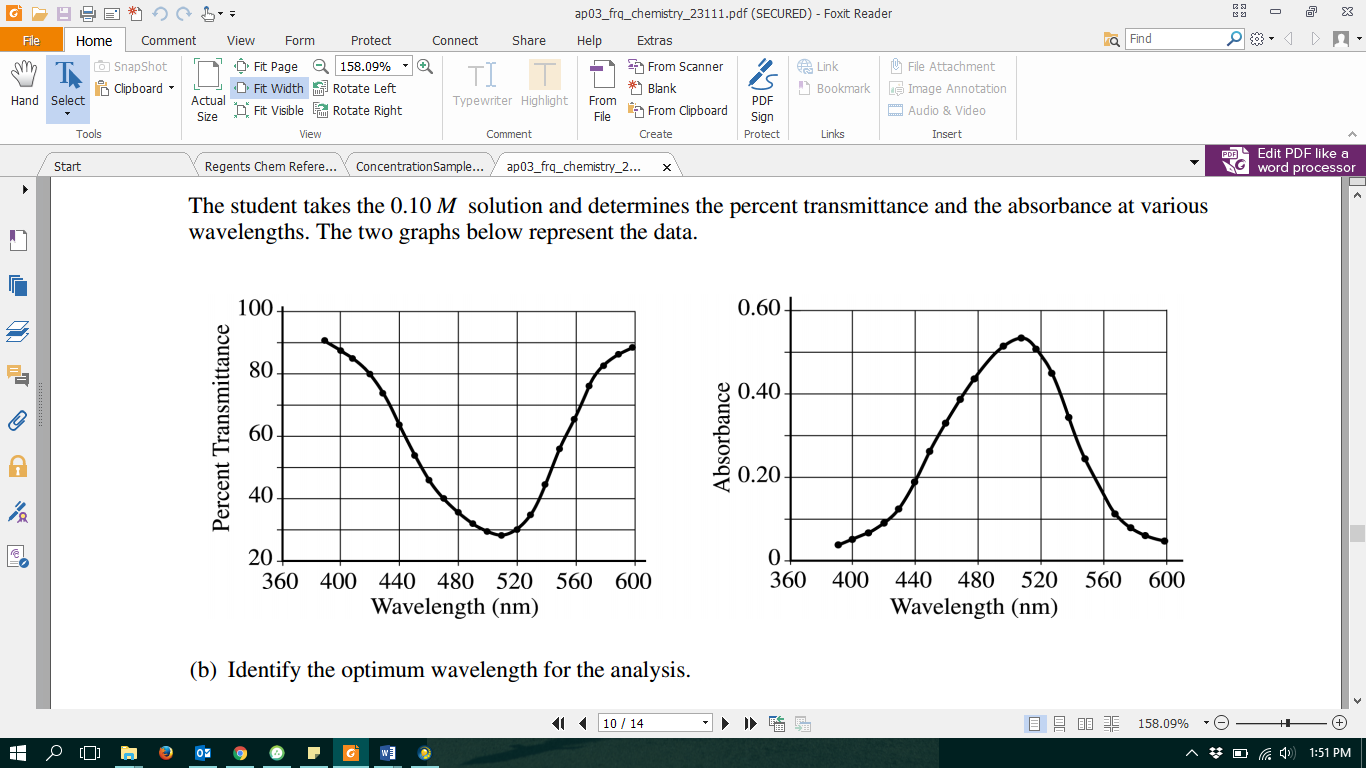
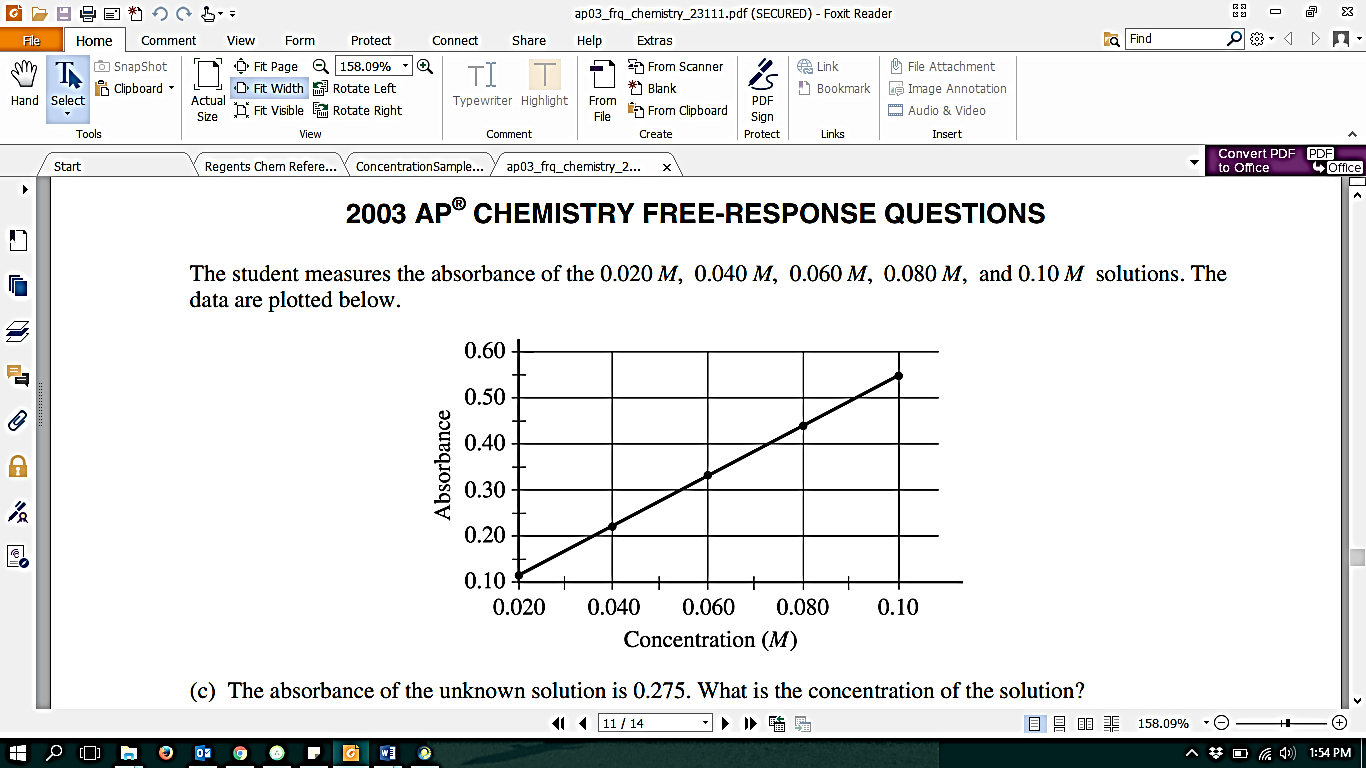
**Unit 2 FRQ Practice**

* + 1. A student is instructed to determine the concentration of a solution of CoCl2 based on absorption of light (spectrometric/colorimetric method). The student is provided with a 0.10 M solution of CoCl2 with which to prepare standard solutions with concentrations of 0.020 M, 0.040 M, 0.060 M, and 0.080 M.
       1. Describe the procedure for diluting the 0.10 M solution to a concentration of 0.020 M using distilled water, a 100 mL volumetric flask, and a pipet or buret. Include specific amounts where appropriate.

The student takes the 0.10 M solution and determines the percent transmittance and the absorbance at various wavelengths. The two graphs below represent the data.



* + - 1. Identify the optimum wavelength for analysis

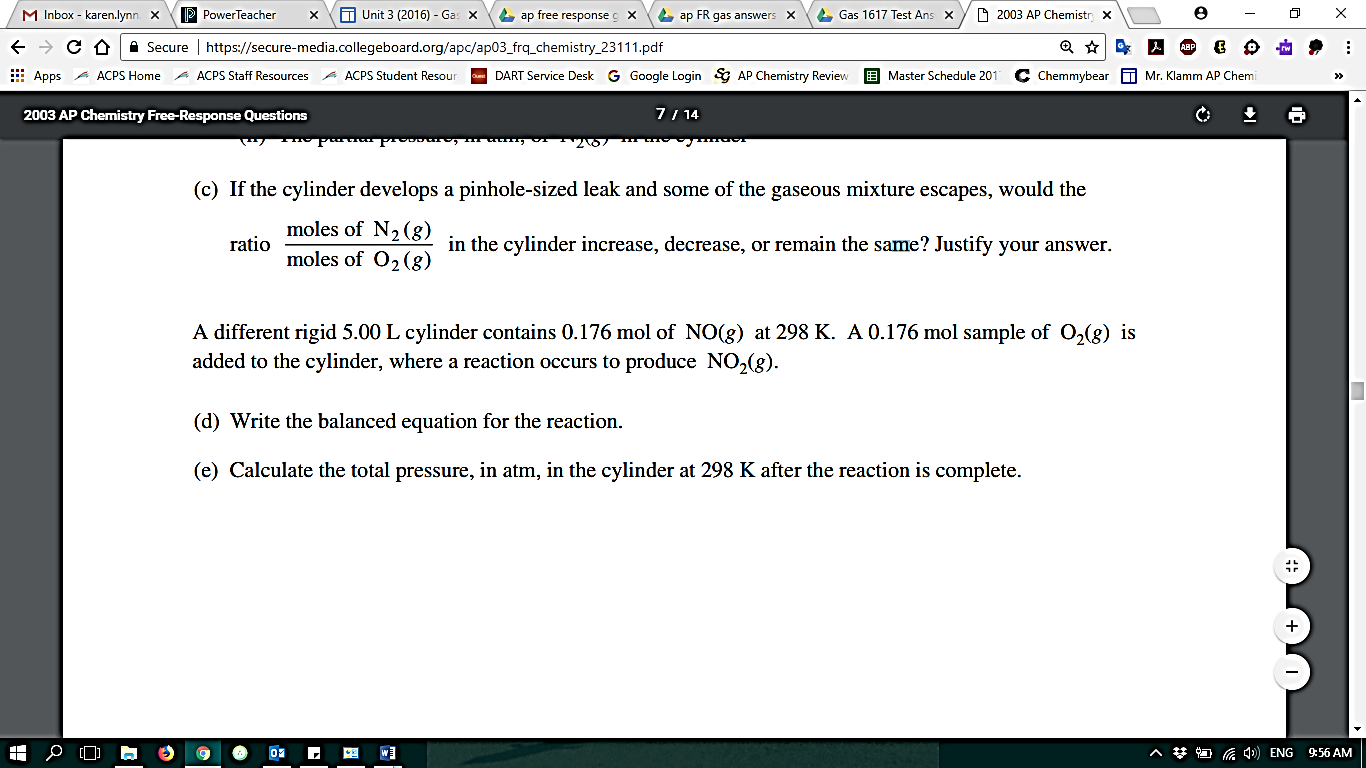


The student measures the absorbance of the 0.020 M, 0.040 M, 0.060 M, 0.080 M, and 0.10 M solutions. The data are plotted below.

* + - 1. The absorbance of the unknown solution is 0.275. What is the concentration of the solution?
      2. The student handles the sample container (e.g. test tube or cuvette) that holds the unknown solution and leaves fingerprints in the path of the light beam. How will this affect the calculated concentration of the unknown? Explain your answer.
    1. A rigid 5.00 L cylinder contains 24.5 g of N2 (g) and 28.0 g of O2 (g).
       1. Calculate the total pressure, in atm, of the gas mixture in the cylinder at 298 K
       2. The temperature of the gas mixture in the cylinder is decreased to 280 K. calculate each of the following

1. The mole fraction of N2 (g) in the cylinder

The partial pressure, in atm, of N2 (g) in the cylinder

* + - 1. If the cylinder develops a pinhole-sized leak and some of the gaseous mixture escapes, would the ratio of in the cylinder increase, decrease, or remain the same? Justify your answer

A different rigid 5.00 L cylinder contains 0.176 mol of NO (g) at 298 K. a 0.176 mol sample of O2 (g) is added to the cylinder, where a reaction occurs to produce NO2(g)

* + - 1. Write the balanced equation for the reaction
      2. Calculate the total pressure, in atm, in the cylinder at 298 K after the reaction is complete.

**Unit 3 FRQ Practice**

* + 1. Propane, C3H8, is a hydrocarbon that is commonly used as fuel for cooking.

1. The heat of combustion of propane is -2,220.1 kJ/mol. Calculate the heat of formation, Δ*H°*f, of propane given that Δ*H°*f of H2O*(l)* = -285.3 kJ/mol and Δ*H°*f of CO2*(g)* = -393.5 kJ/mol.
2. Assuming that all of the heat evolved in burning 30.0 grams of propane is transferred to 8.00 kilograms of water (specific heat = 4.18 J/g**.**K), calculate the increase in temperature of water.
   * 1. Hydrogen gas burns in air according to the equation below:

2 H2 (g) + O2 (g) 🡪 2 H2O (l)

* + - 1. Calculate the standard enthalpy change, ΔH°298, for the reaction represented by the equation above (The molar enthalpy of formation, ΔH°f, for H2O (l) is -285.8 kJ mol-1 at 298 K).
      2. Calculate the amount of heat, in kJ, that is released when 10.0 g of H2 (g) is burned in air.
      3. Given that the molar enthalpy of vaporization, ΔH°vap, for H2O (l) is 44.0 kJ mol-1 at 298 K, what is the standard enthalpy change, ΔH°298, for the reaction 2 H2 (g) + O2 (g) 🡪 2 H2O (g)?

|  |  |  |  |
| --- | --- | --- | --- |
| **Experiment** | **Salt** | **T1** | **T2** |
| **1** | NaCl | 20°C | 20°C |
| **2** | NH4Cl | 20°C | 5°C |
| **3** | CaCl2 | 20°C | 35°C |

* + 1. A 5.0 g sample of sodium chloride is added to 10.0 mL of water at 20°C. Upon mixing, the salt dissolves and the temperature of the mixture is measured. The experiment is repeated with ammonium chloride and again with calcium chloride. The data in the table summarizes the results:

1. Predict the signs of ΔG, ΔS, and ΔH for each of the 3 experiments. Explain your reasoning.

|  |  |  |  |
| --- | --- | --- | --- |
| **Experiment** | **ΔG** | **ΔS** | **ΔH** |
| **1** |  |  |  |
| **2** |  |  |  |
| **3** |  |  |  |

1. Consider the dissolution of ammonium chloride in water
   1. Write a thermochemical equation, including the heat term, for the dissolution of ammonium chloride
   2. Discuss the nature and relative magnitudes of the bonds and intermolecular forces that break, and of those that form, when ammonium chloride dissolves in water.
   3. What is the driving force for the change? Use the equation ΔG = ΔH - T ΔS to explain your reasoning.
2. Is there a temperature at which an equilibrium will be established for the dissolution of ammonium chloride? Justify your answer.