Each multiple choice question is worth 7 points.

Answer questions 1 - 2 about the following reaction

\[ 2 \text{Mg(s)} + \text{O}_2(\text{g}) \rightarrow 2 \text{MgO(s)} \quad \Delta H = -1204 \text{kJ} \]

1. This reaction is
   (a) endothermic  \hspace{1cm} (b) exothermic

2. What is the enthalpy change when 7.50 g of MgO(s) decomposes to Mg(s) and O\(_2\)(g)?
   (a) \(-112 \text{kJ}\) \hspace{1cm} (b) \(+112 \text{kJ}\) \hspace{1cm} (c) \(+223 \text{kJ}\) \hspace{1cm} (d) \(-223 \text{kJ}\) \hspace{1cm} (e) none of these

3. In the "Determination of the Stoichiometry of a Reaction" lab that you did last week, when you calculated the amount of hydrogen gas produced in the reaction you had to correct for
   (a) the vapor pressure of Mg.
   (b) the vapor pressure of water.
   (c) the vapor pressure of air.
   (d) nothing.

4. Assume that you have a sample of gas in a cylinder with a moveable piston, as shown in diagram (1). The initial pressure, number of moles, and temperature of the gas are noted on the diagram. Which diagram (2) – (4) most closely represents the result of doubling the pressure and doubling the temperature while keeping the number of moles of gas constant?
   (a) Diagram (3)
   (b) Diagram (4)
   (c) Diagram (2)

   \[
   \begin{align*}
   T &= 325 \text{K} \\
   n &= 0.6 \text{ mol}
   \end{align*}
   \]

5. What is the oxidation number of chromium in \(\text{K}_2\text{Cr}_2\text{O}_7\)?
   (a) \(+12\)  \hspace{1cm} (b) \(+7\)  \hspace{1cm} (c) \(+2\)  \hspace{1cm} (d) \(-2\)  \hspace{1cm} (e) \(+6\)
6. What is the ground-state valence shell electron configuration of the group of elements indicated by the shaded portion of the periodic table?

(a) \(ns^2\) \((n-2)f^2\)
(b) \(ns^2\) \((n-1)d^2\)
(c) \(ns^2np^2\)
(d) \(ns^2\)
(e) none of these

7. The reaction of \(\text{Cu}(s) + 2 \text{AgNO}_3(aq) \rightarrow \text{Cu(NO}_3)_2(aq) + 2 \text{Ag}(s)\) is best classified as

(a) a precipitation reaction
(b) an acid-base neutralization reaction
(c) an oxidation-reduction reaction
(d) none of the above

8. The demo by Mr. Lee Marek in class last week in which he used a “potato gun” illustrated the relationship between which of the following two properties?

(a) \(V vs T\)
(b) \(P vs n\)
(c) \(P vs V\)
(d) none of these

Answer questions 9 & 10 from the following list of atoms
(a) Na  (b) Cl  (c) K  (d) Br  (e) Mg

9. Which has the lowest electron affinity? C

10. Which has the highest first ionization energy? B

11. What is the molarity of a solution prepared by diluting 43.72 mL of 5.005 M aqueous \(\text{K}_2\text{Cr}_2\text{O}_7\) to a final volume of 500. mL?

(a) 0.0044 M    (b) 0.438 M    (c) 57.2 M    (d) 0.870 M    (e) 0.0879 M

12. Of the following elements, __________ is the least easily oxidized.

(a) O  (b) F  (c) N  (d) Al  (e) Au
13. At 25°C and constant pressure, carbon monoxide gas combines with oxygen gas to give carbon dioxide gas with the evolution of 10.1 kJ per gram of carbon monoxide consumed. What is the value of ΔH for the balanced reaction (smallest whole number coefficients)?

(a) −283 kJ/mol  (b) 283 kJ/mol  (c) 141 kJ/mol  (d) −141 kJ/mol  (e) −566 kJ/mol

14. Hydrogen gas is produced when zinc reacts with sulfuric acid:

\[ \text{Zn}(s) + \text{H}_2\text{SO}_4(aq) \rightarrow \text{ZnSO}_4(aq) + \text{H}_2(g) \]

If 159 mL of wet H₂ is collected over water at 24°C and a barometric pressure of 739 torr, how many grams of Zn have been consumed?

(a) 0.415 g  (b) 0.0124 g  (c) 0.128 g  (d) 0.402 g  (e) none of these

The following questions are free response. Partial credit will be given. You MUST show work in order to receive any credit.

15. Titration of 25.00 mL of an aqueous solution of Ba(OH)₂ requires 18.45 mL of 0.01500 M HCl for its neutralization. What is the molarity of the Ba(OH)₂? (10 points)

\[ \text{Ba(OH)}_2 + 2 \text{HCl} \rightarrow \text{BaCl}_2 + 2 \text{H}_2\text{O} \]

\[ n_{\text{HCl}} = (0.01845 \text{ L})(0.01500 \text{ mol / 1 L}) = 2.7675 \times 10^{-4} \text{ mol HCl} \]
\[ n_{\text{Ba(OH)}_2} = (2.7675 \times 10^{-4} \text{ mol HCl})(1 \text{ mol Ba(OH)}_2/2 \text{ mol HCl}) = 1.3838 \times 10^{-4} \text{ mol Ba(OH)}_2 \]
\[ [\text{Ba(OH)}_2] = 1.3838 \times 10^{-4} \text{ mol / 0.02500 L} = 0.005535 \text{ M or 5.535 \times 10^{-3} M} \]

16. A quantity of N₂ gas originally held at 3.80 atm pressure in a 1.00-L container at 26°C is transferred to a 10.0-L container at 20°C. A quantity of O₂ gas originally at 4.75 atm and 26°C in a 5.00-L container is transferred to this same container. What is the total pressure in the new container? (12 points)

\[ P_{\text{N}_2} = \frac{(3.80 \text{ atm})(1.00\text{L})(293 \text{ K})}{(10.0 \text{ L})(299 \text{ K})} = 0.371 \text{ atm} \]
\[ P_{\text{O}_2} = \frac{(4.75 \text{ atm})(5.00\text{L})(293 \text{ K})}{(10.0 \text{ L})(299 \text{ K})} = 2.33 \text{ atm} \]
\[ P_{\text{total}} = 0.371 \text{ atm} + 2.33 \text{ atm} = 2.70 \text{ atm} \]
BONUS QUESTION

Cyclopropane, a gas used with oxygen as a general anesthetic, is composed of 85.7% C and 14.3% H by mass. If 1.56 g of cyclopropane has a volume of 1.00 L at 0.984 atm and 50°C, what is the molecular formula of cyclopropane? (10 points)

C: \((85.7 \text{ g})(1 \text{ mol} / 12.011 \text{ g}) = 7.13513 \text{ mol C}\)

H: \((14.3 \text{ g})(1 \text{ mol} / 1.0079 \text{ g}) = 14.18792 \text{ mol H}\)

C:H ratio is 1:2 so empirical formula is CH$_2$

\[
M = \frac{mRT}{PV}
\]

\[
M = \frac{(1.56 \text{ g})(0.08206 \text{ L atm/mol K})(323 \text{ K})}{(0.984 \text{ atm})(1.00 \text{ L})} = 42.021 \text{ g/mol}
\]

\(M_{\text{CH}_2} = 14.0268 \text{ g/mol}\)

\(42.021 / 14.0268 = 3\)

Molecular Formula = C$_3$H$_6$