Answer questions 1 - 3 about the following reaction

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

1. This reaction is
   (a) exothermic  (b) endothermic

2. How many grams of MgO are produced during an enthalpy change of -96.0 kJ?
   (a) 80.6 g  (b) 6.43 g  (c) 3.21 g  (d) cannot determine

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

4. In Lab #5 you studied the following reaction:

\[ 2 \text{HCl (aq)} + \text{Na}_2\text{CO}_3 (s) \rightarrow 2 \text{NaCl (aq)} + \text{CO}_2 (g) + \text{H}_2\text{O (l)} \]

How many grams of sodium carbonate must have reacted if 75.0 mL of 0.25 M HCl produced CO\(_2\) with a pressure of 1.5 atm in a volume of 150 mL at 25°C?
   (a) 1.99 g  (b) 1.9 g  (c) 0.995 g  (d) 0.99 g  (e) none of these

5. 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 H\(_2\) is collected over water at 24°C and a barometric pressure of 739 torr, how many grams of Zn have been consumed?
   (a) 0.402 g  (b) 0.415 g  (c) 0.0124 g  (d) 0.128 g  (e) none of these

6. 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 \(\Delta H\) for the balanced reaction?
   (a) -566 kJ/mol  (b) -283 kJ/mol  (c) 283 kJ/mol  (d) 141 kJ/mol  (e) -141 kJ/mol

7. Titration of 25.00 mL of sulfuric acid requires 17.66 mL of 0.358 M sodium hydroxide. What is the molarity of the sulfuric acid?
   (a) 0.126 M  (b) 0.253 M  (c) 0.506 M  (d) 0.0741 M  (e) none of these

Answer questions 8 - 10 from the following information:

A quantity of \(\text{N}_2\) 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 \(\text{O}_2\) gas originally at 4.75 atm and 26°C in a 5.00-L container is transferred to this same container.

8. What is the total pressure in the new container?
   (a) 0.372 atm  (b) 2.327 atm  (c) 2.70 atm  (d) 4.28 atm  (e) none of these
9. What is the partial pressure of O$_2$ gas in the new container?
   (a) 0.372 atm  (b) 2.33 atm  (c) 2.38 atm  (d) none of these

10. What is the mole fraction of N$_2$ gas in the new container?
    (a) 0.138  (b) 0.155  (c) 0.372  (d) none of these

11. Consider the following data:
    | Metal | Al   | Cu   |
    |-------|------|------|
    | Mass (g) | 10   | 30   |
    | Specific Heat (J/g °C) | 0.900 | 0.385 |
    | Temperature (°C) | 40   | 60   |

    When these two metals are placed in contact, which of the following will take place?
    (a) Heat will flow from Al to Cu because Cu has a larger mass.
    (b) Heat will flow from Cu to Al because Cu has a larger mass.
    (c) Heat will flow from Cu to Al because Cu has a larger heat capacity.
    (d) Heat will flow from Cu to Al because Cu is at a higher temperature.
    (e) No heat will flow in either direction.

12. Consider the following reactions. $\Delta H^\circ$ for reaction 3 is
    \[
    \begin{align*}
    \text{IF} (g) + \text{F}_2 (g) & \rightarrow \text{IF}_3 (g) \quad \Delta H^\circ = -390 \text{ kJ} \quad (1) \\
    \text{IF} (g) + 2 \text{F}_2 (g) & \rightarrow \text{IF}_5 (g) \quad \Delta H^\circ = -745 \text{ kJ} \quad (2) \\
    \text{IF}_5 (g) & \rightarrow \text{IF}_3 (g) + \text{F}_2 (g) \quad (3)
    \end{align*}
    \]
    (a) +355 kJ  (b) -1135 kJ  (c) +1135 kJ  (d) +35 kJ  (e) -35 kJ

13. How many grams of water can be heated from 20.0°C to 25.0°C by the addition of 324 J of energy?
    (a) 15  (b) 21  (c) $1.4 \times 10^3$  (d) $6.8 \times 10^3$  (e) 390

Consider these changes for questions 14 & 15:
   I. Hg(l) $\rightarrow$ Hg(g)
   II. 3 O$_2$(g) $\rightarrow$ 2 O$_3$(g)
   III. CuSO$_4$ $\cdot$ 5 H$_2$O(s) $\rightarrow$ CuSO$_4$(s) + 5 H$_2$O(g)
   IV. H$_2$(g) + F$_2$(g) $\rightarrow$ 2 HF(g)

14. At constant pressure, in which of the reactions is work done by the system on the surroundings?
    (a) I only  (b) II only  (c) III only  (d) I and II  (e) I and III
15. In which of them is no work done?
   (a) I only  (b) II only  (c) III only  (d) IV only  (e) I and III

16. The specific heat of bromine liquid is 0.226 J/g K. What is the molar heat capacity (in J/mol K) of bromine liquid?
   (a) 707  (b) 36.1  (c) 18.1  (d) 9.05  (e) 0.226

17. How much heat is required to raise the temperature of 50.0 g of ice at -10.0°C to 40.0°C? (Specific heat of water is 4.184 J/g °C; specific heat of ice is 2.092 J/g °C; ΔH\text{fusion} (H_2O, 0°C) = 6.008 kJ/mol; ΔH\text{vaporization} (H_2O, 100°C) = 40.67 kJ/mol)
   (a) 10.5 kJ  (b) 9.41 kJ  (c) 16.7 kJ  (d) 26.1 kJ  (e) none of these

18. Arrange the following gases in order of decreasing average molecular speed at 25°C.
   argon, fluorine, carbon dioxide, oxygen, helium
   (a) helium > oxygen > fluorine > carbon dioxide > argon
   (b) helium > oxygen > fluorine > argon > carbon dioxide
   (c) argon > oxygen > helium > carbon dioxide > fluorine
   (d) carbon dioxide > argon > fluorine > oxygen > helium
   (e) carbon dioxide > fluorine > argon > oxygen > helium

19. Suppose that in a known volume of He, there are 6.022 \times 10^{23} molecules and 4.00 g at 1.00 atm and 0°C. How many molecules and how many grams of Cl\textsubscript{2} are there under the same conditions?
   (a) 6.022 \times 10^{23} molecules and 35.45 g
   (b) 1.00 molecules and 4.00 g
   (c) 6.022 \times 10^{23} molecules and 70.90 g
   (d) 2(6.022 \times 10^{23}) molecules and 35.45 g
   (e) 8(6.022 \times 10^{23}) molecules and 70.90 g

20. A mixture of H\textsubscript{2} (g) and Cl\textsubscript{2} (g) exerts a total pressure of 2.50 atm. If the mole fraction of H\textsubscript{2} is 0.490, what is the partial pressure (in atm) of H\textsubscript{2}?
   (a) 0.253  (b) 0.396  (c) 0.606  (d) 1.22  (e) 2.50