Question One  

(10 Marks)

Choose the right answer from the followings:

1. Which of the following liquids would make a good solvent for iodine, I₂?
   A. HCl  
   B. H₂O  
   C. CH₃OH  
   D. CS₂

2. Calculate the molality of a solution containing 14.3 g of NaCl in 42.2 g of water.
   A. 2.45 × 10⁻⁴ m  
   B. 5.80 × 10⁻⁴ m  
   C. 5.80 m  
   D. 103 m

3. The solubility of nitrogen gas at 25°C and a nitrogen pressure of 522 mmHg is 4.7 × 10⁻⁴ mol/L. What is the value of the Henry's Law constant in mol/L·atm?
   A. 9.0 × 10⁻⁷ mol/L·atm  
   B. 4.7 × 10⁻⁴ mol/L·atm  
   C. 3.2 × 10⁻⁴ mol/L·atm  
   D. 1.5 × 10⁻³ mol/L·atm

4. Dissolving a solute such as KOH in a solvent such as water results in
   A. an increase in the melting point of the liquid.  
   B. a decrease in the boiling point of the liquid.  
   C. a decrease in the vapor pressure of the liquid.  
   D. no change in the boiling point of the liquid.

5. How much heat is required to raise the temperature of 1,500 g of water from 25°C to 52°C? The specific heat of water is 4.184 J/g·°C.
   A. 1,500 kJ  
   B. 169 kJ  
   C. 6.27 kJ  
   D. 40.5 J

6. Which of these processes is endothermic?
   A. O₂(g) + 2H₂(g) → 2H₂O(g)  
   B. H₂O(g) → H₂O(l)  
   C. 3O₂(g) + 2CH₃OH(g) → 2CO₂(g) + 2H₂O(g)  
   D. H₂O(s) → H₂O(l)

7. Which of these species has the highest entropy (S°) at 25°C?
   A. CO(g)  
   B. CH₃OH(l)  
   C. MgCO₃(s)  
   D. H₂O(l)
8. A negative sign for $\Delta G$ indicates that, at constant $T$ and $P$,

A. the reaction is exothermic.  B. the reaction is endothermic.
C. the reaction is fast.  D. the reaction is spontaneous.

9. During osmosis

A. pure solvent diffuses through a membrane but solutes do not.
B. pure solutes diffuse through a membrane but solvent does not.
C. pure solvent and a solution both diffuse at the same time through a membrane.
D. gases diffuse through a membrane into a solution and build up pressure.

10. The combustion of pentane produces heat according to the equation

$$\text{C}_5\text{H}_{12}(l) + 8\text{O}_2(g) \rightarrow 5\text{CO}_2(g) + 6\text{H}_2\text{O}(l) \quad \Delta H_{\text{rxn}}^\circ = -3510 \text{ kJ/mol}. $$

How many grams of $\text{CO}_2$ are produced per $2.50 \times 10^3 \text{ kJ}$ of heat released?

A. 0.0809 g  B. 157 g  C. 31.3 g  D. 3.56 g

**Question Two**  
(5 Marks)

Solve the following problems:

1. Hydrogen peroxide ($\text{H}_2\text{O}_2$) decomposes according to the equation

$$\text{H}_2\text{O}_2(l) \rightarrow \text{H}_2\text{O}(l) + (1/2)\text{O}_2(g).$$

Calculate $K_p$ for this reaction at 25°C. ($\Delta H^\circ = -98.2 \text{ kJ/mol}, \Delta S^\circ = 70.1 \text{ J/K}\cdot\text{mol}$)
2. When 12.1 g of the sugar sucrose (a nonelectrolyte) are dissolved in exactly 800 g of water, the solution has a freezing point of -0.082°C. What is the molar mass of sucrose? 

\( K_f \) of water is 1.86°C/m.

(2 marks)

3. The osmotic pressure of a 0.010 M \( \text{MgSO}_4 \) solution at 25°C is 0.318 atm. Calculate \( i \), the van't Hoff factor, for this \( \text{MgSO}_4 \) solution.

(1 mark)

Constants:

\[ R = 8.314 \text{ J K}^{-1}\text{.mol}^{-1}, \quad R = 0.082 \text{ atm. L}.\text{K}^{-1}\text{.mol}^{-1} \]

\( C = 12 \text{ g mol}^{-1}, \quad O = 16 \text{ g.mol}^{-1}, \quad \text{Na} = 23 \text{ g.mol}^{-1}, \quad \text{Cl} = 35.5 \text{ g mol}^{-1} \)

*With my best wishes*