1) The osmotic pressure of 1.00 g of a polymer dissolved in benzene to give 200 mL of solution is 1.50 kPa at 25°C. Estimate the average molar mass of the polymer. The gas law constant is 0.0821 L-atm-mol⁻¹-K⁻¹.

- A. 41 300 g mol⁻¹
- B. 8260 g mol⁻¹
- C. 693 g mol⁻¹
- D. 1650 g mol⁻¹
- E. 62 000 g mol⁻¹

Answer: B

2) Consider the reaction
\[ 2\text{HI}(g) \rightleftharpoons \text{H}_2(g) + \text{I}_2(g) \]
At 298 K, \( K_c = 1.3 \times 10^{-3} \), whereas at 783 K, \( K_c = 2.2 \times 10^{-2} \). Which of the following is true?

- A. The reaction is exothermic.
- B. The reaction is endothermic.
- C. At 298 K, \( K = 3.2 \times 10^{-2} \).
- D. At 298 K, the reaction is likely to be spontaneous.
- E. At 783 K, more HI(g) is produced.

Answer: B

3) At 25°C, \( \Delta G_m^0 \) for the reaction \( 2\text{SO}_2(g) + \text{O}_2(g) \rightleftharpoons 2\text{SO}_3(g) \) is \(-141.74 \text{ kJ·mol}^{-1} \). Calculate the value of \( K_c \) for this reaction.

- A. \( 1.74 \times 10^{26} \)
- B. \( 7.01 \times 10^{24} \)
- C. \( 2.65 \times 10^{12} \)
- D. \( 6.56 \times 10^{13} \)
4) Consider the gas-phase reaction, 
\[ 2 \text{SO}_2(g) + \text{O}_2(g) \rightleftharpoons 2 \text{SO}_3(g) \]
for which \( K_p = 2 \) at a given temperature. If the mixture is analyzed and found to contain 2.3 bar of \( \text{SO}_2 \), 4.9 bar of \( \text{O}_2 \) and 7.2 bar of \( \text{SO}_3 \), describe the situation:

- A. \( Q < K \) and more reactants will be made to reach equilibrium.
- B. \( Q < K \) and more products will be made to reach equilibrium.
- C. \( Q > K \) and more reactants will be made to reach equilibrium.
- D. \( Q > K \) and more products will be made to reach equilibrium.
- E. \( Q = K \) and the reaction is at equilibrium

Answer: E

5) For the reaction

\[ \text{NH}_3(g) + \text{H}_2\text{S}(g) \rightleftharpoons \text{NH}_4\text{HS}(s) \]

\( K_c = 9.7 \) at 900 K. If the initial concentrations of \( \text{NH}_3(g) \) and \( \text{H}_2\text{S}(g) \) are 2.0 \( M \), what is the equilibrium concentration of \( \text{H}_2\text{S}(g) \)?

- A. 1.9 \( M \)
- B. 0.20 \( M \)
- C. 1.7 \( M \)
- D. 0.10 \( M \)
- E. 0.32 \( M \)

Answer: E

6) As you examine a chemical reaction to determine which compounds would you exclude from the mass expression? I) pure water II) liquid mercury III) metallic iron IV) solid NaCl

- A. I
- B. III, IV
- C. I, II
- D. all of them would be excluded
7) Consider the reaction

\[ 3\text{Fe(s)} + 4\text{H}_2\text{O(g)} \rightleftharpoons 4\text{H}_2\text{(g)} + \text{Fe}_3\text{O}_4(s) \]

If the volume of the container is reduced,

- A. the equilibrium constant increases.
- B. more \( \text{H}_2\text{(g)} \) is produced.
- C. no change occurs.
- D. more \( \text{H}_2\text{O(g)} \) is produced.
- E. more \( \text{Fe(s)} \) is produced.

**Answer:** C

8) Of the following five materials, which has the lowest freezing point and the highest boiling point?

- A. 1.5 m magnesium phosphate
- B. 2.0 m potassium chloride
- C. 1.0 m sodium chloride
- D. 1.5 m aluminum nitrate
- E. 1.5 m calcium chloride

**Answer:** A