

Chapter 13 HW #2

Write the letter of the best answer on the line in front of the question.

1. _____ $\text{PCl}_3(\text{g}) + \text{Cl}_2(\text{g}) \rightleftharpoons \text{PCl}_5(\text{g}) + \text{energy}$
Some PCl_3 and Cl_2 are mixed in a container at 200°C and the system reaches equilibrium according to the equation above. Which of the following causes an increase in the number of moles of PCl_5 present at equilibrium?

- I. Decreasing the volume of the container
II. Raising the temperature
III. Adding a mole of He gas at constant volume

(A) I only (B) II only (C) I and III only (D) II and III only (E) I, II, and III

2. _____ $2\text{SO}_2(\text{g}) + \text{O}_2(\text{g}) \rightleftharpoons 2\text{SO}_3(\text{g}) + \text{heat}$
When 0.40 mole of SO_2 and 0.60 mole of O_2 are placed in an evacuated 1.00-liter flask, the reaction represented above occurs. After the reactants and the product reach equilibrium and the initial temperature is restored, the flask is found to contain 0.30 mole of SO_3 . Based on these results, the expression for the equilibrium constant, K_c , of the reaction is:

(A) $(0.30)^2 / [(0.45)(0.10)^2]$ (B) $(0.30)^2 / [(0.60)(0.40)^2]$ (C) $(2 \times 0.30) / [(0.45)(2 \times 0.10)]$
(D) $(0.30) / [(0.45)(0.10)]$ (E) $(0.30) / [(0.60)(0.40)]$

3. _____ After the equilibrium represented above (in question 2) is established, some pure $\text{O}_2(\text{g})$ is injected into the reaction vessel at constant temperature. After equilibrium is reestablished, which of the following has a lower value compared to its value at the original equilibrium?

- (A) K_{eq} for the reaction (B) The total pressure in the reaction vessel.
(C) The amount of $\text{SO}_3(\text{g})$ in the reaction vessel. (D) The amount of $\text{O}_2(\text{g})$ in the reaction vessel.
(E) The amount of $\text{SO}_2(\text{g})$ in the reaction vessel.

4. _____ Which of the following changes alone would cause a decrease in the value of K_{eq} for the reaction represented above (in question 2)?

- (A) Decreasing the temperature (B) Increasing the temperature
(C) Decreasing the volume of the reaction vessel (D) Increasing the volume of the reaction vessel
(E) Adding a catalyst

5. _____ Given the equation $2\text{A}(\text{g}) \rightleftharpoons 2\text{B}(\text{g}) + \text{C}(\text{g})$. At a particular temperature, $K = 1.6 \times 10^4$.
If you mixed 5.0 mol B, 0.10 mol C, and 0.0010 mol A in a one-liter container, which direction would the reaction initially proceed?

- (A) To the left. (B) To the right. (C) The above mixture is the equilibrium mixture.
(D) Cannot tell from the information given. (E) None of these (A-D).

6. _____ A 1.00-g sample of a gaseous compound of boron and hydrogen occupies 0.820 L at 1.00 atm and 3°C . What could be the molecular formula for the compound?

- (A) BH_3 (B) B_2H_6 (C) B_4H_{10} (D) B_3H_{12} (E) B_5H_{14}

7. _____ The partial pressures of CH_4 , N_2 , and O_2 in a sample of gas were found to be 135 mmHg, 508 mmHg, and 571 mmHg, respectively. Calculate the mole fraction of nitrogen.

- (A) 20.4 (B) 0.470 (C) 0.418 (D) 0.751 (E) 0.359

8. _____ Which of the following statements correctly describes the signs of q and w for the following process at $P = 1$ atm and $T = 370$ K?
 $\text{H}_2\text{O}(\text{g}) \rightarrow \text{H}_2\text{O}(\text{l})$

- (A) q and w are negative. (B) q is positive, w is negative. (C) q is negative, w is positive.
(D) q and w are both positive. (E) q and w are both zero.

9. _____ The valve between a 5-L tank containing a gas at 9 atm and a 10-L tank containing a gas at 6 atm is opened. Calculate the final pressure in the tanks.

- (A) 3 atm (B) 4 atm (C) 7 atm (D) 15 atm (E) none of these

10. _____ Consider the following gas samples:

Sample A	Sample B
$S_2(g)$	$O_2(g)$
$n = 1 \text{ mol}$	$n = 2 \text{ mol}$
$T = 800 \text{ K}$	$T = 400 \text{ K}$
$P = 0.20 \text{ atm}$	$P = 0.40 \text{ atm}$

Which of the following statements is *false*?

- (A) The volume of sample A is twice the volume of sample B.
(B) The average kinetic energy of the molecules in sample A is twice the average kinetic energy of the molecules in sample B.
(C) The fraction of molecules in sample A, having a kinetic energy greater than some high fixed value, is larger than the fraction of molecules in sample B, having kinetic energies greater than that same high fixed value.
(D) The mean square velocity of molecules in sample A is twice as large as the mean square velocity of molecules in sample B.
(E) Assuming identical intermolecular forces in both samples, sample A should be more nearly ideal than sample B.

11. _____ Two metals of equal mass with different heat capacities are subjected to the same amount of heat. Which undergoes the smallest change in temperature?

- (A) The metal with the higher heat capacity. (B) The metal with the lower heat capacity.
(C) Both undergo the same change in temperature. (D) You need to know the initial temperatures of the metals.
(E) You need to know which metals you have.

12. _____ Consider the following processes:

	ΔH (kJ/mol)
$3B \rightarrow 2C + D$	-125
$\frac{1}{2}A \rightarrow B$	150
$E + A \rightarrow D$	350

Calculate ΔH for: $B \rightarrow E + 2C$

- (A) 325 kJ/mol (B) 525 kJ/mol (C) -175 kJ/mol
(D) -325 kJ/mol (E) none of these

13. _____ The heat combustion of acetylene, $C_2H_2(g)$, at $25^\circ C$ is -1299 kJ/mol . At this temperature, ΔH_f° values for $CO_2(g)$ and $H_2O(l)$ are -393 and -286 kJ/mol , respectively. Calculate ΔH_f° for acetylene.

- (A) 2376 kJ/mol (B) 625 kJ/mol (C) 227 kJ/mol
(D) -625 kJ/mol (E) -227 kJ/mol

14. _____ At $25^\circ C$, a sample of NH_3 (molar mass 17 grams) effuses at the rate of 0.050 mole per minute. Under the same conditions, which of the following gases effuses at approximately one-half that rate?

- (A) O_2 (B) He (C) CO_2 (D) Cl_2 (E) CH_4

Free Response

Write the correct numeric value on the line for each of the following free response questions

15. A 6.19 gram sample of PCl_5 is placed in an evacuated 2.00 liter flask and is completely vaporized at $252^\circ C$.

(a) _____ Calculate the pressure in the flask if no chemical reaction were to occur.

Actually at $252^\circ C$ the PCl_5 is partially dissociated according to the following equation: $PCl_5(g) \leftrightarrow PCl_3(g) + Cl_2(g)$
The observed pressure is found to be 1.00 atmosphere. In view of this observation

(b) _____ Calculate the partial pressure of PCl_3 in the flask at $252^\circ C$.

(c) _____ Calculate the partial pressure of PCl_5 in the flask at $252^\circ C$.

(d) _____ Calculate K_p

(e) _____ Calculate K_c .