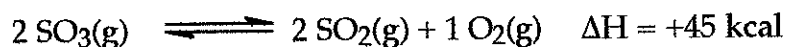


- (4) 1. A system, $1 A_2B(s) \rightleftharpoons 2 A(g) + 1 B(g)$, already at equilibrium is perturbed at a given temperature. If the new equilibrium concentration of $A(g)$ at the given temperature is one half its original equilibrium value, then the new equilibrium concentration of $B(g)$ will be:

- a) one quarter of its original equilibrium value
- b) four times its original equilibrium value
- c) one half of its original equilibrium value
- d) twice its original equilibrium value

Questions (2)-(4) pertain to the equilibrium reaction shown below:



- (4) 2. Which one of the following sets of conditions would **maximize product** formation:

- a) low temperature/low volume
- b) low temperature/high volume
- c) high temperature/low volume
- d) high temperature/high volume

- (4) 3. In the above equilibrium reaction, the number of moles of $SO_3(g)$ will increase if:

- a) the temperature of the system is increased at constant volume
- b) $O_2(g)$ is removed from the system at constant temperature and volume
- c) the pressure of the system is increased by adding Ar gas
- d) the volume of the system is increased at constant temperature
- e) None of the above choices is correct

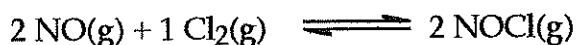
- (4) 4. The numerical value of K_C for the above equilibrium reaction will increase if:

- a) the temperature of the system is increased at constant volume
- b) the volume of the system is increased at constant temperature
- c) $O_2(g)$ is added to the system at constant temperature and volume
- d) $SO_3(g)$ is added to the system at constant temperature and volume
- e) None of the above choices is correct

(4) 5. For the system, $1 A(g) + 1 B(g) \rightleftharpoons 1 C(g) + 1 D(g)$, $K_p = 10$
At equilibrium, it must always be true that:

- a) $P_A P_B = P_C P_D$ b) $P_A = P_C$
c) $P_A P_B = 0.10 P_C P_D$ d) $P_A P_B = 10 P_C P_D$
e) None of the above choices is correct

Questions (6)-(8) pertain to the equilibrium reaction and data shown below:



At a given temperature, 0.30 moles of NO(g), 0.20 moles of Cl₂(g), and 0.50 moles of NOCl(g) are introduced into a 25 liter reaction flask. When equilibrium is established, 0.60 moles of NOCl(g) are present.

(4) 6. The equilibrium concentration of Cl₂(g) is:
a) 0.006M b) 0.008M c) 0.100M d) 0.150M e) 0.200M

(4) 7. The equilibrium concentration of NO(g) is:
a) 0.006M b) 0.008M c) 0.012M d) 0.060M e) 0.100M

(4) 8. The numerical value of K_c for the above equilibrium is:
a) 0.202 b) 60 c) 900 d) 1500 e) 2000

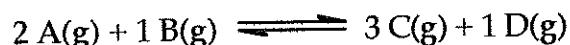
9. For the equilibrium reaction $2 NO_2(g) \rightleftharpoons 1 N_2O_4(g)$, NO₂(g) is a reddish-brown color, whereas N₂O₄(g) is colorless. At 0°C, an equilibrium mixture of the two gases is almost colorless, whereas, at 100°C, the equilibrium mixture is reddish-brown in appearance.

(4) a) Based on the above data, at which temperature, (0°C, 100°C), is product formation favored?

(4) b) Based on the above data, product formation is an (endothermic, exothermic) reaction.

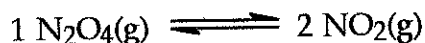
(4) c) If, at 0°C, the volume of the system is increased significantly, the appearance of the reaction mixture will (lighten, darken).

- (4) 10. Consider the following equilibrium reaction:



If equal numbers of moles of A(g) and B(g) are added to an empty reaction vessel at a given temperature, then the following must always be true for the above system when equilibrium is achieved:

- a) $P_B = P_D$ b) $P_C > P_A$ c) $P_B < P_A$ d) $P_B > P_A$
e) None of the above must always be true for the above system at equilibrium
- (4) 11. Consider the following equilibrium reaction:



At 30°C, an equilibrium mixture of N₂O₄(g) and NO₂(g) exerts a total pressure of 0.750 atm. If the partial pressure of N₂O₄(g) is 0.500 atm, then K_p for the above equilibrium is:

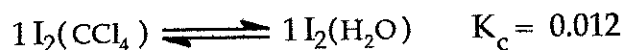
- a) 1.50 b) 1.00 c) 0.750 d) 0.500 e) 0.125
- (4) 12. At a given temperature, for the equilibrium reaction



If, initially, one mole of NH₃(g) and one mole of H₂S(g) are introduced into a 10.0 liter evacuated reaction vessel, how many moles of NH₄SH(s) will be present when equilibrium is established?

[Hint: 1) Determine how many moles of NH₃(g) and H₂S(g) are present at equilibrium, and 2) determine the number of moles of each that must have reacted to produce NH₄SH(s)]

- a) 1.00 mole b) 0.50 mole c) 0.40 mole d) 0.10 mole e) 0.05 mole
- (3) 13. Consider the following equilibrium reaction at a given temperature:



Relative to its solubility in CCl₄, I₂ is (more, less) soluble in water.

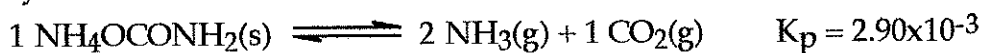
- (4) 14. Consider the following equilibrium reaction:



For the above equilibrium, it must **always** be true that:

- a) $K_p = K_c$ b) $K_p > K_c$ c) $K_p < K_c$
- d) The relative numerical values of the equilibrium constant will depend on P_{total} for the system
- e) None of the above choices is correct
- (4) 15. If, at 25°C , $K_c = 2.50$ for $2 \text{A}(\text{g}) + 1 \text{B}(\text{g}) \rightleftharpoons 3 \text{D}(\text{g})$, then, at 25°C , K_c for $3 \text{D}(\text{g}) \rightleftharpoons 2 \text{A}(\text{g}) + 1 \text{B}(\text{g})$ will be:
- a) -2.50 b) 2.50 c) 0.25 d) -0.40 e) 0.40

- (6) 16. When a sample of $\text{NH}_4\text{OCONH}_2(\text{s})$ is introduced into an empty reaction vessel at 25°C , the following equilibrium system is established:



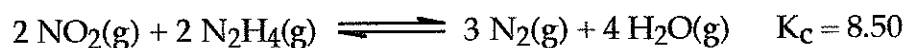
Determine the **total pressure** of the equilibrium system shown above. Show all work in the space provided.

- (6) 17. Consider the following equilibrium reaction:



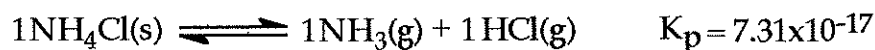
If 1.0 mole $\text{N}_2(\text{g})$ and 1.0 mole $\text{O}_2(\text{g})$ are introduced into an empty 20 liter reaction vessel, determine the concentration (in M) of all species present at equilibrium. Show all work in the space provided.

- (4) 18. Consider the following equilibrium reaction at a given temperature:

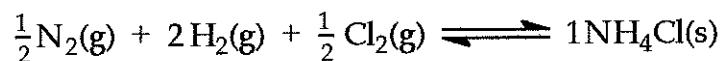


Initially, 0.10 moles of $\text{NO}_2(\text{g})$, 2.00 moles of $\text{N}_2\text{H}_4(\text{g})$, 4.00 moles of $\text{N}_2(\text{g})$, and 1.00 mole of $\text{H}_2\text{O}(\text{g})$ are introduced into a 2.0 liter vessel. The system:

- a) is at equilibrium initially b) will shift to create more products
c) will shift to create more reactants
d) From the data given, one cannot tell what the system will do
19. Given the following equilibria at 25°C :



- (9) a) Determine K_p for the following equilibrium at 25°C :



Show all work in the space provided.

- (4) b) Based on the K_p value obtained in Part (a), determine the corresponding K_c value. Show all work in the space provided.

- (4) c) Determine ΔG° , in kJ, for the equilibrium reaction shown in Part (a) based on its calculated K_p value. Show all work in the space provided.