

# 7.1 Equilibrium

## Question Paper

|            |                 |
|------------|-----------------|
| Course     | DPIB Chemistry  |
| Section    | 7. Equilibrium  |
| Topic      | 7.1 Equilibrium |
| Difficulty | Hard            |

**Time allowed:** 20  
**Score:** /10  
**Percentage:** /100

**Question 1**

Study the following equilibrium reaction and determine which of the statements must be true.

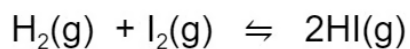


- A  $[X] \gg [Y]$
- B  $[X] > [Y]$
- C  $[X] = [Y]$
- D  $[X] < [Y]$

[1 mark]

**Question 2**

Hydrogen reacts with iodine according to the following equation



The value of  $K_c$  for this reaction has been measured at different temperatures

$$K_c = 60 \text{ at } 355 \text{ }^\circ\text{C}$$

$$K_c = 47 \text{ at } 450 \text{ }^\circ\text{C}$$

From the information given which of the following must be true?

- A** The reaction is exothermic
- B** The reaction is endothermic
- C** The reaction barely proceeds at 355 °C
- D** The reaction almost goes to completion at 450 °C

[1 mark]

**Question 3**

The following  $K_c$  values were obtained for a reaction carried out at different temperatures,  $T_1$  to  $T_4$ .

| Temperature | $K_c$ value        |
|-------------|--------------------|
| $T_1$       | $1 \times 10^{-2}$ |
| $T_2$       | $1 \times 10^1$    |
| $T_3$       | 1                  |
| $T_4$       | $1 \times 10^2$    |

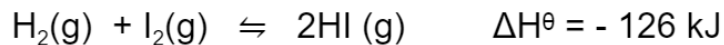
Which of the following gives the correct amount of products in the mixtures from least to most?

- A**  $T_1 < T_2 < T_3 < T_4$
- B**  $T_4 < T_3 < T_2 < T_1$
- C**  $T_4 < T_2 < T_3 < T_1$
- D**  $T_1 < T_3 < T_2 < T_4$

[1 mark]

**Question 4**

Which of the following conditions and reasons will increase the amount of hydrogen iodide produced?

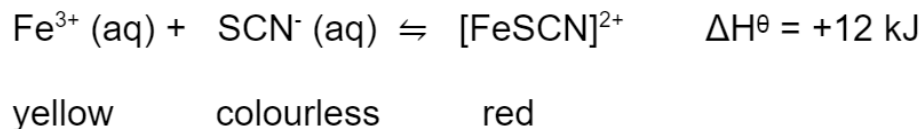


|          | Condition  | Reason               | Condition      | Reason  |
|----------|------------|----------------------|----------------|---|
| <b>A</b> | increase T | exothermic reaction  | increase P     | two gaseous reactants but only one gaseous product                      |
| <b>B</b> | increase T | endothermic reaction | no change in P | equal numbers of moles of gases   |
| <b>C</b> | decrease T | exothermic reaction  | decrease P     | two moles of gaseous product but only one mole of each gaseous reactant |
| <b>D</b> | decrease T | exothermic reaction  | no change in P | equal numbers of moles of gases   |

[1 mark]

**Question 5**

The blood-red complex iron(III)thiocyanate,  $[\text{FeSCN}]^{2+}$  is formed when iron(III) ions react with thiocyanate ions in the following equilibrium reaction:



Which of the following changes would make the solution go darker?

- I. raising the temperature of the solution
- II. adding iron(III)chloride solution
- III. adding a catalyst

- A** I and II only
- B** I and III only
- C** II and III only
- D** I, II and III

[1 mark]

**Question 6**

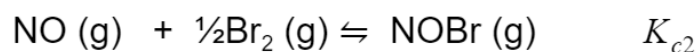
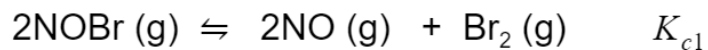
Which of the following features is not a characteristic of a state of equilibrium?

- A Equilibrium is dynamic
- B Equilibrium is achieved in a closed system
- C Concentrations of reactants and products are equal
- D Equilibrium can be reached from either direction

[1 mark]

**Question 7**

What is the relationship between  $K_{c1}$  and  $K_{c2}$  in the following reactions?

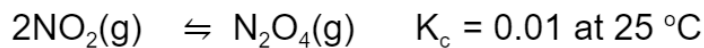


- A  $2K_{c2} = K_{c1}$
- B  $(K_{c2})^2 = K_{c1}$
- C  $K_{c2} = \frac{1}{\sqrt{K_{c1}}}$
- D  $K_{c2} = \frac{1}{2K_{c1}}$

[1 mark]

**Question 8**

Nitrogen dioxide can react with itself to produce a dimer molecule called dinitrogen tetroxide in the following equilibrium reaction



In an experiment,  $100 \text{ cm}^3$  of nitrogen dioxide is placed in a gas syringe and the barrel is pushed in, meaning the volume is reduced to  $50 \text{ cm}^3$  at constant temperature.

Which of the following are true?

- I. The value of  $K_c$  increases
- II. More  $\text{N}_2\text{O}_4$  is formed
- III. The ratio of  $\frac{[\text{NO}_2]}{[\text{N}_2\text{O}_4]}$  decreases

- A** I and II only
- B** I and III only
- C** II and III only
- D** I, II and III

[1 mark]



**Question 9**

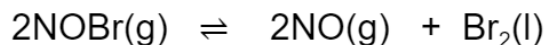
One of the characteristics of a state of equilibrium, is that equilibria are said to be *dynamic*. What is the meaning of *dynamic* in this context?

- A The position of equilibrium is constantly changing
- B The rates of forward and backward reactions change
- C The reactants and products are continually reacting
- D The concentrations of the reactants and products continue to change

[1 mark]

**Question 10**

The reaction shown below has a value of  $K_c = 1.0 \times 10^{-4}$  at 25 °C



Which of the following relationships is correct about this equilibrium at 25 °C?

- A  $[\text{NO}] \gg [\text{NOBr}]$
- B  $[\text{NOBr}] \gg [\text{Br}_2]$
- C  $2 \times [\text{NOBr}] = [\text{Br}_2]$
- D  $[\text{NO}] = [\text{NOBr}]$

[1 mark]