Unit 7: Equilibria

Subunit 7.1: Chemical equilibria: reversible reactions, dynamic equilibrium

Topical Question No: 1

3 Two moles of compound P were placed in a sealed container. The container was heated and P was partially decomposed to produce Q and R only. A dynamic equilibrium between P, Q and R was established.

At equilibrium *x* moles of R were present and the total number of moles present was $\left(2+\frac{x}{2}\right)$.

What is the equation for this reversible reaction?

A $P \rightleftharpoons 2Q + R$

B $2P \rightleftharpoons 2Q + R$

C $2P \rightleftharpoons Q + R$

D $2P \rightleftharpoons Q + 2R$

Topical Question No: 2

11 Ammonia is manufactured from nitrogen and hydrogen using the Haber process.

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$$

What is the expression for K_c for this equilibrium?

A $\frac{2[NH_3(g)]}{[N_2(g)] + 3[H_2(g)]}$

B $\frac{2[NH_3(g)]}{[N_2(g)] \times 3[H_2(g)]}$

C $\frac{[NH_3(g)]^2}{[N_2(g)] + [H_2(g)]^3}$

D $\frac{[NH_3(g)]^2}{[N_2(g)] \times [H_2(g)]^3}$

Topical Question No: 3

34 Sulfur dioxide and oxygen react in the gas phase.

$$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g) \qquad \Delta H = -197\,\text{kJ mol}^{-1}$$

Which statements are correct?

1 Increasing the pressure increases the equilibrium yield of SO_3.

2 Increasing the temperature lowers the value of the equilibrium constant K_p.

3 The presence of a vanadium(V) oxide catalyst increases the equilibrium yield of SO_3.

Topical Question No: 4

11 The reaction between sulfur dioxide and oxygen is reversible.

$$2SO_2 + O_2 \rightleftharpoons 2SO_3 \qquad \Delta H^{\ominus} = -196\,kJ\,mol^{-1}$$

Which conditions of pressure and temperature favour the **reverse** reaction?

	pressure	temperature
A	high	high
B	high	low
C	low	high
D	low	low

Topical Question No: 5

18 Sulfur trioxide is manufactured from sulfur dioxide and oxygen, using the Contact process.

Which condition affects the value of the equilibrium constant, K_c?

A adjusting the temperature

B increasing the pressure

C removing SO_3 from the equilibrium mixture

D using a catalyst

Topical Question No: 6

8 The reaction between sulfur dioxide and oxygen is a dynamic equilibrium.

$$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$$

What happens when the pressure of the system is increased?

A The rate of reaction will decrease and the position of the equilibrium will move to the left.

B The rate of reaction will decrease and the position of the equilibrium will move to the right.

C The rate of reaction will increase and the position of the equilibrium will move to the left.

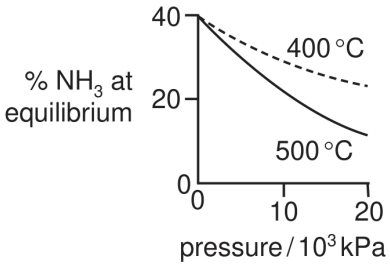
D The rate of reaction will increase and the position of the equilibrium will move to the right.

Topical Question No: 7

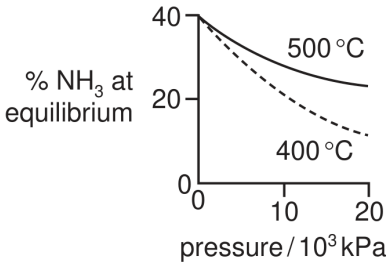
17 Graphs can be drawn to show the percentage of ammonia at equilibrium when nitrogen and hydrogen are mixed at different temperatures and pressures.

Which diagram correctly represents these two graphs?

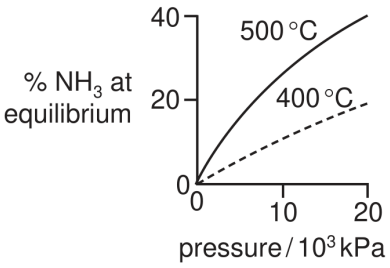
A



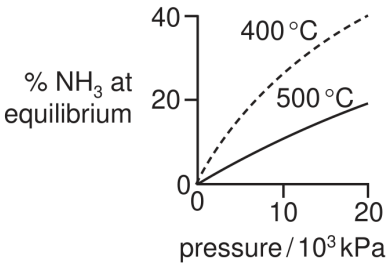
B



C



D



Topical Question No: 8

7 The Contact process is used in the manufacture of sulfuric acid. The equation for the main reaction is shown below.

$$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g) \qquad \Delta H = -196\,kJ\,mol^{-1}$$

Which statement about this reaction is **incorrect**?

A Increased pressure gives a higher yield of SO_3.

B Increased temperature gives a higher yield of SO_3.

C In the forward reaction the oxidation state of sulfur changes from +4 to +6.

D Vanadium(V) oxide is used as a catalyst.

Topical Question No: 9

10 The equilibrium constant, K_c, for the reaction $H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$, is 60 at 450 °C.

What is the number of moles of hydrogen iodide in equilibrium with 2 mol of hydrogen and 0.3 mol of iodine at 450 °C?

A $\frac{1}{100}$ **B** $\frac{1}{10}$ **C** 6 **D** 36

4 Hydrogen and carbon dioxide gases are mixed in equal molar amounts at 800 K. A reversible reaction takes place.

$$H_2(g) + CO_2(g) \rightleftharpoons H_2O(g) + CO(g)$$

At equilibrium, the partial pressures of H_2 and CO_2 are both 10.0 kPa. K_p is 0.288 at 800 K.

What is the partial pressure of CO in the equilibrium mixture?

A 5.37 kPa **B** 18.6 kPa **C** 28.8 kPa **D** 347 kPa

Answer Key

1. Error
2. Error
3. Error
4. Error
5. Error
6. Error
7. Error
8. Error
9. Error
10. Error