

12CHE Equilibrium Test 2017 Answers – Total mark 48

Answers

1. a. $K = \frac{[\text{NH}_3]^2}{[\text{H}_2]^3 \times [\text{N}_2]}$ 1
- b. $K = [\text{Ca}^{2+}] \times [\text{CO}_3^{2-}]$ 1
- c. $K = \frac{[\text{Br}_2]}{[\text{HBrO}] \times [\text{H}^+] \times [\text{Br}^-]}$ 1
- d. $K = \frac{[\text{H}^+]^2 \times [\text{Cl}^-]^2}{[\text{BiCl}_3]}$ 1

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2. a) The rate of the reverse reaction is initially zero as no product is present. It's rate increases steadily as more product is produced. 1

The rate of the forward reaction decreases steadily as reactants are used up. 1

Eventually the rate of the forward and reverse reactions equal each other and the system is at equilibrium. 1

6

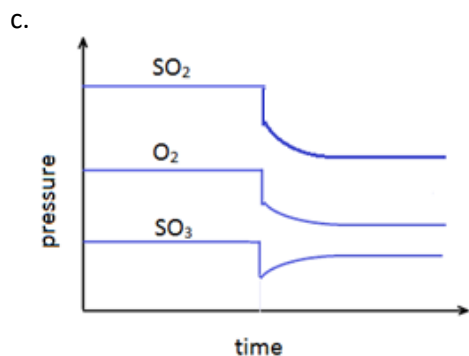
- b) Adding the fluoride ions means that the species FeF^{2+} is formed this decreases the concentration of Fe^{3+} ions in solution. 1

This decreases the rate of the forward reaction, and the reverse overtakes the forward. 1

FeSCN^{2+} concentration decreases as a result, as more Fe^{3+} and SCN^- is produced. 1

3. a. $K = \frac{[\text{SO}_3]^2}{[\text{SO}_2]^2 \times [\text{O}_2]}$ 1

- b. i. No change
 ii. K decreases 1 each
 iii. No change
 iv. No change



3

1. Sudden drop for all.
2. Increase for SO_2 and O_2 , decrease for SO_3
3. 2:1 curve ratio between SO_2 and O_2

1

4. Le Chateliers Principle – If a system is at equilibrium and a change is made, then a net reaction will occur in a direction that partially counteracts that change. 1

5. a. The equilibrium would shift to the RIGHT. More NaNO₃ would dissolve. 1

b. 4

- Increasing the temperature will increase the motion of ALL particles, leading to a greater FREQUENCY of collision and thus the rate of BOTH the forward and reverse reactions increase.
- In addition both reaction rates increase as they both have a greater proportion of particles with higher energy, as more particles possess the minimum activation energy.
- However, the rate of the FORWARD reaction will be increased proportionately more.
- The forward reaction then OVERTAKES the reverse reaction and as a result, more products are produced.

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6.

a. LEFT
The addition of SO₂ will mean that there are more frequent collisions between product molecules. This will cause the rate of the reverse reaction to overtake the forward reaction, leading to more reactants being formed. 3

b. NO EFFECT
Adding solid to a saturated system, increases the rate of dissolving as there is more surface area, however, there is a corresponding and equal increase in the rate of recrystallization, so there is no net effect to the rates of reaction, and no change to the position of equilibrium. 3

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c. LEFT
Reducing the volume results in an increase in the pressure of the gaseous components of the system (i.e. the SO₂), this means there are more collisions involving this molecule, and the rate of the reverse reaction overtakes the rate of the forward leading to a decrease in the amount of product and the restoration of equilibrium. 3

d. RIGHT
Given that the SO₂ ionises when water is added, this leads to a decrease in the amount of SO₂ in the gaseous form. This means the rate of the reverse reaction drops, the forward reaction overtakes the reverse, and more SO₂ is produced. 3

7. a. i. Decrease pressure → DECREASE YIELD
ii. Decrease temperature → INCREASE YIELD
iii. Catalyst → NO EFFECT ON YIELD 1 each

6

b. i. Increase pressure → INCREASE RATE OF ATTAINMENT
ii. Increase temperature → INCREASE RATE OF ATTAINMENT
iii. Removing Catalyst → DECREASE RATE OF ATTAINMENT

8. a. 3 x 10⁴ years. (30 000) 1

b. $K = \frac{[\text{CO}_2]}{[\text{Ca}^{2+}] \times [\text{HCO}_3^{-1}]^2}$

1

- c.
- i. Not Favoured.
 - ii. Favoured.
 - iii. Favoured.
 - iv. Favoured.

1 each

6