



CHEMISTRY 2021

Unit 3

Key Topic Test 5 – Rates and Reversible Reactions

Recommended writing time*: 45 minutes

Total number of marks available: 50 marks

SOLUTIONS

SECTION A: Multiple-choice questions (1 mark each)

Question 1

Answer: C

Explanation:

Sealing the test tube will not increase the rate of reaction, while all of the other options will.

Question 2

Answer: C

Explanation:

There is no change to the activation energy and there is still a range of particle speeds. The shaded area is increased and there are more particles with enough energy to overcome the activation energy.

Question 3

Answer: D

Explanation:

Only some particles need to have enough energy to overcome the activation energy. Some of these particles need to be orientated in a way that allows particles to break bonds.

Question 4

Answer: D

Explanation:

When the particles are heated they move faster. They collide more often and with more energy so a collision is more likely to result in a reaction.

Question 5

Answer: A

Explanation:

The catalyst is a heterogeneous catalyst as it is in a different state to the reactants and products.

Question 6

Answer: C

Explanation:

The sudden increase in the rate of reaction is caused by the addition of a catalyst.

Question 7

Answer: D

Explanation:

The grinding up of marble increases the surface area resulting in more collisions between the marble surface and the acid.

Question 8

Answer: A

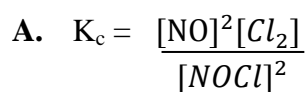
Explanation:

$$1 / \sqrt{(2.00 \times 10^4)} = 0.00707$$

Question 9

Answer: D

Explanation:



Question 10

Answer: A

Explanation:

K_c is very low so equilibrium lies well to the left.

SECTION B: Short-answer questions

Question 1

- a. Increasing the temperature
Increasing the pressure
Adding a catalyst

3 marks

- b. $K = \frac{[\text{NH}_3]^2}{[\text{H}_2]^3 [\text{N}_2]}$ *
 $0.052 = \frac{[\text{NH}_3]^2}{.275^3 \times .11}$ *
 $[\text{NH}_3]^2 = 0.052 \times .275^3 \times .11$ *
 $[\text{NH}_3]^2 = 0.000119$ *
 $[\text{NH}_3] = 0.0109 \text{ M}$ *

5 marks

- c. Equilibrium reactions have both the forwards and backwards reactions occurring at the same time* including at equilibrium. *

2 marks

Total 10 marks

Question 2

- a. There is an increase in surface area* which increases the number of collisions between particles.*

2 marks

- b. The particles will move more slowly* so the collisions between particles occur less frequently and with less energy.*

2 marks

- c. FeCl_3 acts as a catalyst lowering the activation energy.* A greater proportion of collisions will result in a reaction.*

2 marks

- d. The shirt is in an open system* where molecules are removed from near the shirt allowing more molecules to evaporate.*

2 marks

Total 8 marks

Question 3

- a. **i.** lowered
ii. increases
iii. no change

1 + 1 + 1 = 3 marks

- b. **i** no change
ii. increases
iii. shifts to the right. (Same shape but a bit stretched out.)

1 + 1 + 1 = 3 marks

- c. The average speed of the particles increases* but while some particles will move faster, others may move more slowly.

2 marks

Total 8 marks

Question 4

	CO _(g)	3H _{2(g)}	CH _{4(g)}	H _{2O_(g)}
Initial	.020	0.50	-	-
Change	-0.10	-0.30	+0.10	+0.10
Equilibrium	0.10	0.20 *	0.10	0.10*

$$K_c = [\text{CH}_4] [\text{H}_2\text{O}] / [\text{CO}] [\text{H}_2]^3 *$$

$$K_c = 0.10 \times 0.10 / 0.10 \times 0.20^3$$

$$K_c = 12.5\text{M}^{-2} *$$

Total 4 marks

Question 5

- a. i. 100 kJmol⁻¹
ii. 296 kJmol⁻¹

1 + 1 = 2 marks

- b. i. equilibrium lies to the left (reactants)

ii. $K_c = [\text{SO}_3]^2 / [\text{SO}_2]^2 [\text{O}_2] *$

$$K_c = 0.30^2 / 0.002^2 \times 0.004 *$$

$$K_c = 0.09 / 0.000004 \times 0.0040$$

$$K_c = 5.6 \times 10^6 \text{M}^{-1} *$$

So, equilibrium needs to move to the left. *

1 + 4 = 5 marks

- c. i. +196 kJmol⁻¹
ii. $1/1 \times 10^6 * = 1 \times 10^{-6} \text{M} *$

1 + 2 = 3 marks

Total 10 marks