Access Tuition

A-Level Chemistry

Rate Equations
(Multiple Choice)

Question Paper

Time available: 14 minutes
Marks available: 12 marks

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1. The rate expression for the reaction between **X** and **Y** is

$$rate = k\,[\mathbf{X}]^2\,[\mathbf{Y}]$$

Which statement is correct?

A The rate constant has units $mol^{-1}\ dm^3\ s^{-1}$ ⬭

B The rate of the reaction is halved if the concentration of **X** is halved and the concentration of **Y** is doubled. ⬭

C The rate increases by a factor of 16 if the concentration of **X** is tripled and the concentration of **Y** is doubled. ⬭

D The rate constant is independent of temperature. ⬭

(Total 1 mark)

2. What are the units of the rate constant for a third order reaction?

A $mol\ dm^{-3}\ s^{-1}$ ⬭

B $mol^{-1}\ dm^3\ s^{-1}$ ⬭

C $mol^2\ dm^{-6}\ s^{-1}$ ⬭

D $mol^{-2}\ dm^6\ s^{-1}$ ⬭

(Total 1 mark)

3. What is the pH of 0.015 $mol\ dm^{-3}$ sulfuric acid?

A −1.82 ⬭

B −1.52 ⬭

C 1.52 ⬭

D 1.82 ⬭

(Total 1 mark)

4. The results of an investigation of the reaction between P and Q are shown in this table.

Experiment	Initial [P] / mol dm^{-3}	Initial [Q] / mol dm^{-3}	Initial rate / mol dm^{-3} s^{-1}
1	0.200	0.500	0.400
2	0.600	To be calculated	0.800

The rate equation is: $rate = k\,[\mathbf{P}]\,[\mathbf{Q}]^2$

What is the initial concentration of **Q** in experiment 2?

A 0.167 ○

B 0.333 ○

C 0.408 ○

D 0.612 ○

(Total 1 mark)

5. Solutions of two compounds, **W** and **X**, react together in the presence of a soluble catalyst, **Y**, as shown in the equation

$$2\mathbf{W} + \mathbf{X} \rightarrow \mathbf{Z}$$

When the concentrations of **W**, **X** and **Y** are all doubled, the rate of reaction increases by a factor of four.

Which is a possible rate equation for this reaction?

A rate = $k\,[\mathbf{W}]^2\,[\mathbf{X}]$ ○

B rate = $k\,[\mathbf{W}]^2\,[\mathbf{Y}]$ ○

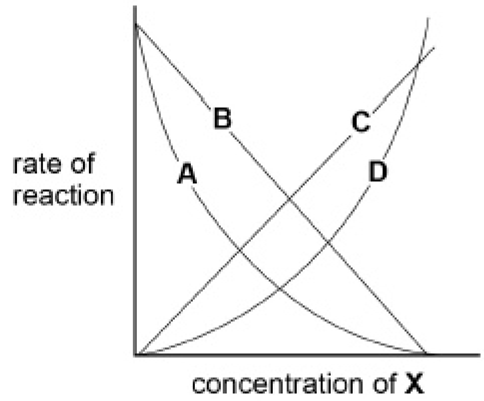
C rate = $k\,[\mathbf{X}]\,[\mathbf{Y}]$ ○

D rate = $k\,[\mathbf{X}]\,[\mathbf{Z}]$ ○

(Total 1 mark)

6. A series of experiments was carried out to find the order of reaction with respect to reactant **X**. In these experiments, only the concentration of **X** was changed.

Which graph would show that the reaction is second-order with respect to **X**?



A ○

B ○

C ○

D ○

(Total 1 mark)

7. The rate equation for the acid-catalysed reaction between iodine and propanone is:

$$\text{rate} = k\,[H^+]\,[C_3H_6O]$$

The rate of reaction was measured for a mixture of iodine, propanone and sulfuric acid at pH = 0.70

In a second mixture the concentration of the sulfuric acid was different but the concentrations of iodine and propanone were unchanged. The new rate of reaction was a quarter of the original rate.

What was the pH of the second mixture?

A 1.00 ○

B 1.30 ○

C 1.40 ○

D 2.80 ○

(Total 1 mark)

8. A rate investigation was carried out on a reaction involving three reactants, **X**, **Y** and **Z**. The concentrations of the reactants were varied and the relative rate for each mixture determined.

Experiment	[**X**]/mol dm^{-3}	[**Y**]/mol dm^{-3}	[**Z**]/mol dm^{-3}	Relative rate
1	1×10^{-3}	1×10^{-3}	2×10^{-3}	1
2	2×10^{-3}	2×10^{-3}	2×10^{-3}	4
3	5×10^{-4}	2×10^{-3}	4×10^{-3}	0.5

The reaction is zero order with respect to **Y**.

What is the overall order of reaction?

A 0 ⬭

B 1 ⬭

C 2 ⬭

D 3 ⬭

(Total 1 mark)

9. The rate equation for the hydrogenation of ethene

$$C_2H_4(g) + H_2(g) \longrightarrow C_2H_6(g)$$

is $Rate = k[C_2H_4][H_2]$

At a fixed temperature, the reaction mixture is compressed to triple the original pressure.

What is the factor by which the rate of reaction changes?

A 6 ⬭

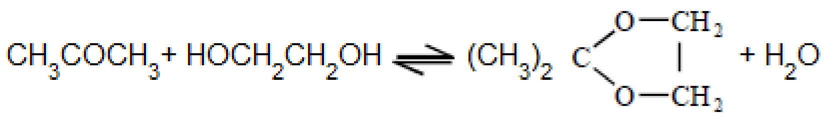
B 9 ⬭

C 12 ⬭

D 27 ⬭

(Total 1 mark)

10. This question is about the reaction between propanone and an excess of ethane-1,2-diol, the equation for which is given below.



Y

In a typical procedure, a mixture of 1.00 g of propanone, 5.00 g of ethane-1,2-diol and 0.100 g of benzenesulphonic acid, $C_6H_5SO_3H$, is heated under reflux in an inert solvent. Benzenesulphonic acid is a strong acid.

When the concentration of benzenesulphonic acid is doubled, the rate of the reaction doubles. It can be deduced that

A the reaction is first order overall.

B the reaction is third order overall.

C the reaction is acid-catalysed.

D units for the rate constant, k, are $mol^{-2}\ dm^{6}\ s^{-1}$.

(Total 1 mark)

11. The equation and rate law for the reaction of substance P with substance Q are given below.

$$2P + Q \rightarrow R + S$$
$$rate = k[P]^2[H^+]$$

Under which one of the following conditions, all at the same temperature, would the rate of reaction be slowest?

	[P] / $mol\ dm^{-3}$	pH
A	0.1	0
B	1	2
C	3	3
D	10	4

(Total 1 mark)

12. Rate = k $[A]^2$ [B]

Correct units for the rate constant in the rate equation above are

A mol dm^{-3} s^{-1}

B mol^{-1} dm^{-3} s^{-1}

C mol^{2} dm^{-6} s^{-1}

D mol^{-2} dm^{6} s^{-1}

(Total 1 mark)