Rates of Reaction Test

SCHOAE I 01-02 (TOTAL: /34) Name: _____

Part I: Multiple Choice (10 Marks)

1. Reaction rates generally increase in response to a decrease in...

A. catalyst concentration. B. reagent concentration
C. particle size. D. temperature.

2. For the reaction: $CH_3COCH_3(aq) + I_2(aq) \rightarrow CH_3COCH_2I(aq) + HI(aq)$
it is found experimentally that doubling the concentration of CH_3COCH_3 doubles the reaction rate, tripling the concentration of H^+ triples the rate, and halving the concentration of I_2 has no effect on the rate. It may be concluded that ...

A. iodine is acting as a catalyst in the reaction
B. the slowest step in the reaction involves iodine.
C. the rate of the reaction is independent of the pH of the solution.
D. the rate determining step involves CH_3COCH_3 but not iodine.

3. Which species might be behaving as a catalyst based on the equations below?

$O_3 + Cl \rightarrow ClO + O_2$
$ClO + O \rightarrow Cl + O_2$

A. O_2 B. Cl C. ClO D. O

4. Which of the following can be used to determine the order of a reaction?

I. Studies of reaction rate as a function of reactant concentration
II. Consideration of the balanced equation for the reaction
III. Knowledge of the activation energy for the reaction

A. I only B. II only C. Either I or II D. I, II or III

5. A proposed mechanism for the decomposition of N_2O_5 is ...

$N_2O_5(g) \rightarrow NO_2(g) + NO_3(g)$ (slow)

$NO_2(g) + NO_3(g) \rightarrow NO_2(g) + O_2(g) + NO(g)$ (fast)

$NO(g) + N_2O_5(g) \rightarrow 3NO_2(g)$ (fast)

The stoichiometric equation for the decomposition of N_2O_5 must therefore be ...

A. $N_2O_5(g) \rightarrow NO_2(g) + NO_3(g)$
B. $N_2O_5(g) \rightarrow NO_2(g) + O_2(g) + NO(g)$
C. $N_2O_5(g) + NO_2(g) + NO_3(g) \rightarrow 4NO_2(g) + O_2(g)$
D. $2N_2O_5(g) \rightarrow 4NO_2(g) + O_2(g)$

Question 6 and 7 are about the reaction of hydrogen with nitrogen(II) oxide, which may be represented by the equation ...

$2H_2(g) + 2NO(g) \rightarrow 2H_2O(g) + N_2(g)$

The reaction is known to follow the rate law: $Rate = k\,[NO]^2\,[H_2]^1$

6. The overall order for this reaction is ...

A. 1 B. 2 C. 3 D. 4

7. At 600 ^{0}C the instantaneous rate of reaction is 3.5 mol dm^{-3} s^{-1} when the concentration of nitrogen(II) oxide and hydrogen are each 0.30 mol dm^{-3}. The numerical value of the specific rate constant is ...

A. 1.2 B. 3.5 C. 3.9×10^1 D. 1.3×10^2

8. A certain chemical reaction can be represented by the overall equation:

$$2A(g) + B(g) \longrightarrow C(g)$$

At a particular temperature the initial rate of this reaction was measured for various initial concentrations of A and B, as shown below ...

	Initial conc (mol dm^{-3})		Initial rate (mol of C hr^{-1})
Expt	**A**	**B**	
1	0.5	0.5	2.0 x 10-3
2	1.0	0.5	8.0 x 10-3
3	1.0	1.0	8.0 x 10-3
4	1.5	1.0	18.0 x 10-3

On the basis of the evidence provided, it appears that the mechanism of this reaction would involve two or more steps. In light of the experimental data, a possible rate determining step might be:

A. A + B → intermediate complex
B. A + A → intermediate complex
C. A + AB → C
D. A + B → C

9. For the reaction : $I + I \longrightarrow I_2$
at 25 ^{0}C in CCl_4, k = 8.9×10^9 $dm^3\ mol^{-1}\ s^{-1}$. This reaction is ...

A. First order and endothermic B. First order and exothermic
C. Second order and endothermic D. Second order and exothermic

(Hint: you might be thinking, "How should I know the answer to this __ question?" Apply your knowledge and the answer will be obvious and relatively simple.)

10. For the reversible reaction: $2\ NH_{3(g)} \rightleftharpoons N_{2(g)} + 3\ H_{2(g)}$
ΔH = 92 kJ and the activation energy equals 335 kJ. The activation energy for the reverse reaction will be ...

A. - 335 kJ B. 92 kJ C. 243 kJ D. 427 kJ

Part B: Short Answer (12 Marks)

11. Explain briefly a method that may be employed for measuring the rate of the following reactions:

(a) $CaCO_{3\,(s)} + 2\ HCl_{(aq)} \longrightarrow CaCl_{2(aq)} + H_2O_{(l)} + CO_{2(g)}$ /2

(b) $CH_3COCH_{3\,(aq)} + H^+_{(aq)} + CN^-_{(aq)} \longrightarrow CH_3C(OH))CN)CH_{3(aq)}$ /2

12. In the reaction below:

$$BrO_3^-{}_{(aq)} + 5\ Br^-{}_{(aq)} + 6\ H^+{}_{(aq)} \longrightarrow 3\ Br_{2(l)} + 3\ H_2O_{(l)}$$

The rate of disappearance of $BrO_3^-{}_{(aq)}$ = -10^{-3} mol $dm^{-3}\ s^{-1}$. What will be ...

(a) the rate with respect to Br^- ion? /2

(b) the rate with respect to Br_2 molecules? /2

13. After examining the following kinetic energy distribution curve for a certain reaction, sketch a fully labelled potential energy diagram that could reflect this reaction ...
(Note : I am asking for a sketch, thus numeric values are unimportant.) /4

Part C: Problems (12Marks)

14. The following reaction is a first order reaction: $2\ AB_{(g)} \longrightarrow A_{2\,(g)} + B_{2\,(g)}$
If the concentration of AB was initially 1.00 mol dm^{-3}, and the rate constant, k = 9.355 x 10^{-4} s^{-1} at 25 ^{0}C.
What will be the concentration after 45 minutes?
/4

15. Two gases react according to the following equation: $X_{(g)} + 2Y_{(g)} \longrightarrow XY_{2\,(g)}$
Experiments were performed at 400 K in order to determine the order of the reaction and the following results were obtained ...

Experiment Number	Initial Concentration of X (mol dm^{-3})	Initial Concentration of Y (mol dm^{-3})	Initial Rate of Formation of XY_2 (mol dm^{-3} s^{-1})
1	0.10	0.10	0.0001
2	0.10	0.20	0.0004
3	0.10	0.30	0.0009
4	0.20	0.10	0.0001
5	0.30	0.10	0.0001

a) What is the order of the reaction with respect to: /2

(i) X

(ii) Y

b) Write a rate equation for the reaction between X and Y. /2

c) Using the rate equation predict a possible mechanism for this reaction. /2

d) What further experiment would you carry out to find the activation energy. (Hint: you may find your IB Data Book useful.)

/2