Chemistry 12

Reaction Kinetics Practice Test

Name: Key
Date:
Block:

Multiple Choice.

D 1. Which of the following best describes *activation energy*? Ea

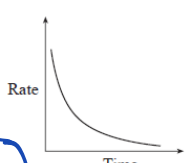
A. PE of activated complex
B. (PE of products) - (PE of reactants)
C. (PE of reactants) - (PE of activated complex)
D. (PE of activated complex) - (PE of reactants)

A 2. Consider the following reaction:

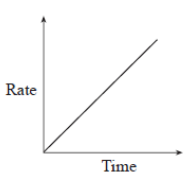
$2\ H_2O_{2(l)} \rightarrow 2\ H_2O_{(l)} + O_{2(g)}$

Which graph shows the relationship between rate of consumption of H_2O_2 and time?

A.



B.



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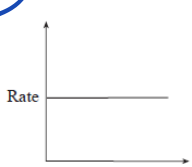
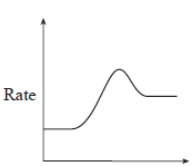


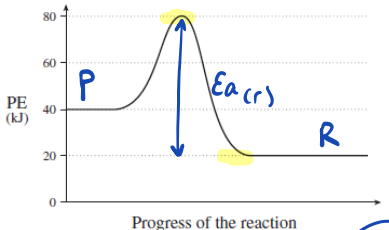
D.



3. Explain your answer to the question above:

As H_2O_2 is used up, the rate slows down

D 4. Consider the following PE diagram:



$E_a = PE_{AC} - PE_R$
$= 80 - 20$
$= +60\ kJ$

What is the activation energy for the reverse reaction?

A. -60 kJ
B. -20 kJ
C. +40 kJ
D. +60 kJ

A 5. Which of the following best describes the E_a of a fast reaction and the stability of its activated complex?

	E_a	Activated Complex
A.	small	unstable
B.	small	stable
C.	large	unstable
D.	large	stable

6. Explain your answer to the question above:

- Small E_a = fast
- Activated complex is always unstable

D 7. Consider the following reaction:

$$Mg_{(s)} + 2\,HCl_{(aq)} \rightarrow H_{2(g)} + MgCl_{2(aq)}$$

The rate of this reaction increases when more magnesium is added. This change is caused by the

A. addition of a catalyst.
B. increase in surface area.
C. change in nature of the reactants.
D. increase in concentration of reactants.

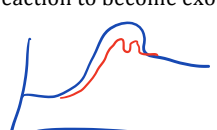
D 8. Which of the following factors affect the rates of reactions?

I.	nature of reactants (state) ✓
II.	presence of a catalyst ✓
III.	temperature of system ✓
IV.	concentrations of reactants ✓

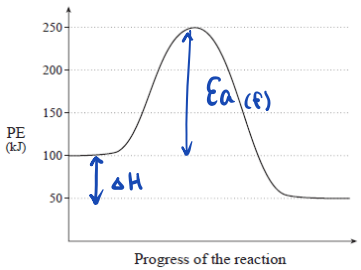
A. I and IV only
B. II and III only
C. II, III and IV only
D. I, II, III and IV

C 9. How does the addition of a catalyst increase the reaction rate of an endothermic reaction?

A. It reduces the ΔH of the reaction.
B. It increases the ΔH of the reaction.
C. It reduces the required activation energy.
D. It causes the reaction to become exothermic.



C 10. Consider the following PE diagram:



$E_a = 250 - 100$
$= 150\ kJ$

$\Delta H = PE_P - PE_R$
$= 50 - 100$
$= -50\ kJ$

Which of the following describes the forward reaction?

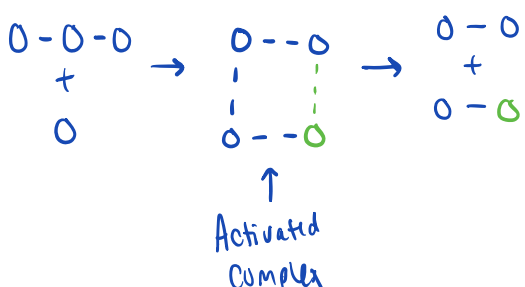
	ΔH (kJ)	Activation Energy (kJ)
A.	+50	250
B.	−50	200
C.	−50	150
D.	+50	150

11. Consider the following reaction mechanism:

Step 1	$O_3 \rightarrow O_2 + O$
Step 2	$O_3 + O \rightarrow 2O_2$

Which of the following could represent the activated complex for Step 2?

A. O
B. O_2
C. O_3
D. O_4



C 12. Given the reaction:

$CaCO_{3(s)} + 2\,HCl_{(aq)} \rightarrow CaCl_{2(aq)} + H_2O_{(l)} + CO_{2(g)} + \text{heat}$

Which of the following will cause the reaction rate to increase?

A. increasing pressure
B. decreasing pressure
C. increasing temperature
D. decreasing temperature

B 13. Consider the following reaction:

$Fe_2O_{3(s)} + 2\,Al_{(s)} \rightarrow Al_2O_{3(s)} + 2\,Fe_{(l)}$

If 0.50 mol of Fe is produced in 10.0 sec, what is the rate of consumption of Fe_2O_3 in mol/s ?

A. 5.0×10^{-2} mol/s
B. 2.5×10^{-2} mol/s
C. 1.0×10^{-1} mol/s
D. 5.0 mol/s

14. Show your calculation the question above:

$\frac{0.50\,mol\,Fe}{10.0\,s} \times \frac{1\,mol\,Fe_2O_3}{2\,mol\,Fe} = \frac{2.5 \times 10^{-2}\,mol\,Fe_2O_3}{1\,s}$

D 15. Which of the following could describe a catalyst?

A. A substance that increases the reaction time. (slower)
B. A substance that provides an alternate mechanism with a higher activation energy.
C. A substance that is formed in one step and used up in a subsequent step in a reaction mechanism.
D. A substance that is used up in one step and reformed in a subsequent step in a reaction mechanism.

C 16. Consider the following 3 step reaction mechanism:

Step 1: $ClO^- + H_2O \rightarrow HClO + OH^-$
Step 2: $I^- + HClO \rightarrow HIO + Cl^-$
Step 3: $HIO + OH^- \rightarrow IO^- + H_2O$

The products of the net reaction are:

(overall rxn) $ClO^- + I^- \rightarrow Cl^- + IO^-$

A. $IO^- + H_2O$
B. $HIO + OH^-$
C. $IO^- + Cl^-$
D. $ClO^- + I^-$

D 17. Consider the following reaction mechanism:

Step 1: $Cl_{(g)} + O_{3(g)} \rightarrow ClO_{(g)} + O_{2(g)}$
Step 2: $O_{(g)} + ClO_{(g)} \rightarrow Cl_{(g)} + O_{2(g)}$

The reaction intermediate is

A. Cl
B. O_2
C. O_3
D. ClO

18. Explain your answer to the question above:

It is produced in one step and consumed in a subsequent step

Problems:

1. At 25°C, zinc is consumed at a rate of 2.82 g per minute according to the following reaction:

$$Zn_{(s)} + 2\ HCl_{(aq)} \rightarrow ZnCl_{2\ (aq)} + H_{2\ (g)}$$

a) Calculate the rate of this reaction in terms of mass of hydrogen gas produced per minute.

$$\frac{2.82\ g\ Zn}{1\ min} \times \frac{1\ mol\ Zn}{65.4\ g\ Zn} \times \frac{1\ mol\ H_2}{1\ mol\ Zn} \times \frac{2.0\ g\ H_2}{1\ mol\ H_2} = \frac{0.0862\ g\ H_2}{1\ min}$$

b) List two ways to **measure** the rate of reaction:

- mass of $Zn_{(s)}$ will ↓
- pressure of $H_{2(g)}$ will ↑
- [HCl] will ↓

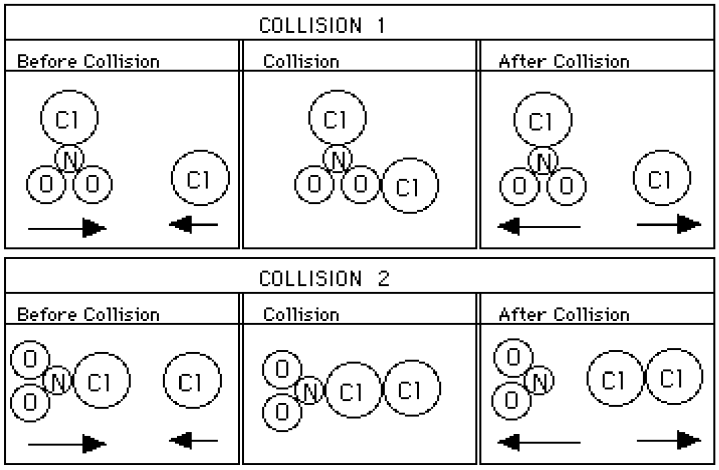
c) List two ways to **increase** the rate of reaction:

- crush up $Zn_{(s)}$
- ↑ [HCl]
- add a catalyst
- ↑ temp

2. The diagrams below represent two collisions between a NO_2Cl molecule and a Cl atom. Using collision theory, state which collision was effective and why it was effective:

A successful collision has 2 requirements:

1. Sufficient energy
2. Favourable geometry



Collision 2 is more effective because it has favourable geometry

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3. Consider this three step reaction mechanism.

- The potential energy (PE) of the reactants is 20 kJ
- The PE of the products is 50 kJ
- The PE of the activated complex in the rate determining step is 70 kJ:

Step 1 $A + B \rightarrow AB$ Very Fast, exothermic

Step 2 $AB + C \rightarrow CAB$ Fast, endothermic

Step 3 $CAB + A \rightarrow CA_2 + B$ Slow, endothermic

a) Write the overall net reaction.

$2A + C \rightarrow CA_2$

b) Which substance(s) would be considered reaction intermediates?

AB , CAB

c) Which substance is the catalyst for this reaction (if there is one)?

B

d) Draw a PE diagram for this multi-step reaction. Provide the following on the graph with labeled arrows:

Labeled axes
Sites of all activated complexes
Sites of all intermediates
E_a for the overall reaction
ΔH for the overall reaction