Unit 3 · Chemical Kinetics

WORKSHEET

Full marks 33

Name _____ Class _____ Roll no. _____ Date _____ Marks _____ / 33

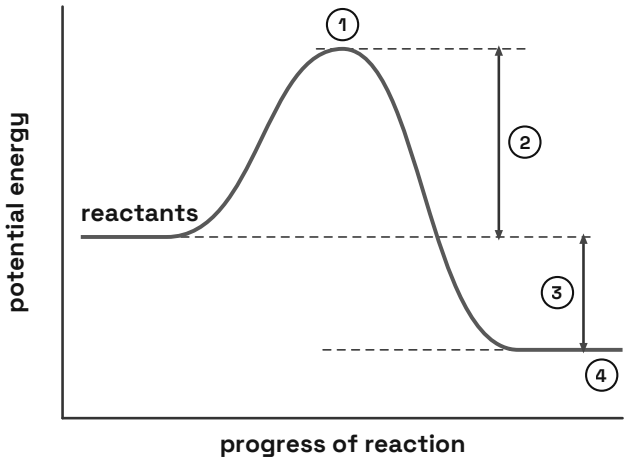
1 Key words [4]

Match each term in column A with its meaning in column B. Two meanings in column B are not needed. Each match carries 0.5 mark.

Column A		Column B
1. rate constant	☐	**a.** a substance that speeds up a reaction by giving it a path of lower activation energy
2. order of reaction	☐	**b.** the least energy colliding particles need for a reaction
3. molecularity	☐	**c.** the short-lived, high-energy arrangement at the top of the energy profile
4. activation energy	☐	**d.** the time in which half of a reactant is used up
5. activated complex	☐	**e.** the rate of a reaction when every reactant is at 1 mol/L
6. half-life	☐	**f.** the slowest step of a reaction's mechanism
7. catalyst	☐	**g.** the change in concentration of a reactant in unit time
8. rate-determining step	☐	**h.** the energy given out when the products form
		i. the number of particles that collide in an elementary step
		j. the sum of the powers of the concentrations in the rate law

2 Label the diagram [2]

The diagram is the energy profile of a reaction. Write what belongs in place of 1 to 4. Each carries 0.5 mark.



1. _____ **2.** _____

3. _____ **4.** _____

3 Multiple choice [5]

Choose the correct option for each of the following questions.

i. The unit of the rate constant of a first-order reaction is: [1]

a. mol L^{-1} s^{-1} **b.** s^{-1}

c. L mol^{-1} s^{-1} **d.** L^2 mol^{-2} s^{-1}

ii. In the reaction $2NO + O_2 \rightarrow 2NO_2$, nitrogen monoxide is used up at 6.0×10^{-5} mol L^{-1} s^{-1}. At what rate is oxygen used up? [1]

a. 1.2×10^{-4} mol L^{-1} s^{-1} **b.** 6.0×10^{-5} mol L^{-1} s^{-1}

c. 3.0×10^{-5} mol L^{-1} s^{-1} **d.** 1.5×10^{-5} mol L^{-1} s^{-1}

iii. A first-order reaction has a half-life of 25 min. What percentage of the reactant is left after 75 min? [1]

a. 33.3% **b.** 25%

c. 12.5% **d.** 6.25%

iv. A catalyst speeds up a reaction because it: [1]

a. raises the energy of the products

b. makes ΔH of the reaction more negative

c. gives the reaction a path of lower activation energy

d. shifts the equilibrium towards the products

v. For a zero-order reaction, the half-life is: [1]

a. independent of the starting concentration

b. directly proportional to the starting concentration

c. inversely proportional to the starting concentration

d. always 0.693/k

4 Short answers [7]

Write short answers to the following questions.

a. Write two differences between the order and the molecularity of a reaction. [2]

b. A rise of 10 °C makes the collisions in a gas only a little more frequent, yet it can double the rate of a reaction. Explain why. [2]

c. For a reaction $A + B \rightarrow$ products, the initial rates were measured at 25 °C: **[3]**

Experiment	[A] (mol/L)	[B] (mol/L)	Initial rate (mol L^{-1} s^{-1})
1	0.10	0.10	2.0×10^{-3}
2	0.20	0.10	8.0×10^{-3}
3	0.10	0.20	4.0×10^{-3}

Find the order with respect to A and to B, and the rate constant with its unit.

5 Long answer **[4]**

Write a long answer to the following question.

What are enzymes? Write two characteristics of enzyme catalysis, and explain the mechanism of enzyme action by the lock and key model, with an equation.

6 Numerical problems **[8]**

Solve the following problems. Show your working. Take $R = 8.314$ J mol^{-1} K^{-1}.

a. The decomposition of a compound in solution is first order, with a half-life of 35.0 min. **[4]**

i. Find the rate constant.
ii. How long does it take for 90% of the compound to decompose?
iii. What fraction of it is left after 2.00 hours?
iv. If it starts at 0.80 mol/L, what is its concentration after 50.0 min?

Answer:

b. The rate constant of a reaction is $2.0 \times 10^{-4}\ s^{-1}$ at 290 K and $6.0 \times 10^{-4}\ s^{-1}$ at 310 K. **[4]**

i. Write the Arrhenius equation and say what A and E_a stand for.

ii. Find the activation energy of the reaction.

iii. Find the rate constant at 330 K.

iv. How many times faster is the reaction at 330 K than at 290 K?

Answer: _____

7 Think **[3]**

Wood burning in air gives out a great deal of heat, yet a stack of firewood can lie in the air for years without catching fire. A match sets it alight, and then it goes on burning by itself. Explain both, using the idea of activation energy.

8 Activity: Temperature and the speed of a fizz (not marked)

Drop a quarter of a fizzy antacid or vitamin C tablet into each of three glasses of the same amount of water: cold from the fridge, at room temperature, and warm (not hot). Time how long each takes to stop fizzing, and measure each temperature if you have a thermometer.

Glass	Temperature (°C)	Time to stop fizzing (s)	Faster or slower than room temperature?
Cold			
Room temperature			
Warm			

How would breaking the tablet piece into powder first change the times, and why?