COLLISION THEORY

CHEMISTRY / REACTION RATES / STUDENT WORKSHEET

Name: _____ Class: _____ Date: _____

Instructions: Answer in full sentences where appropriate. Use the diagrams and data to justify your explanations.

A | What makes a collision successful?

1. State the main idea of collision theory.

2. Give TWO conditions that must be met for a collision to produce a reaction.

3. Explain why two particles can collide without forming any new substances.

4. Complete: A faster reaction has more _____ collisions per _____.

5. In the reaction A + BC → AB + C, explain what “correct orientation” means.

B | Investigating collision orientation

Both diagrams show particles with enough kinetic energy to overcome the activation-energy barrier. The arrows show A moving towards BC.

Collision 1



A approaches the nearest end

Collision 2



A approaches the nearest end

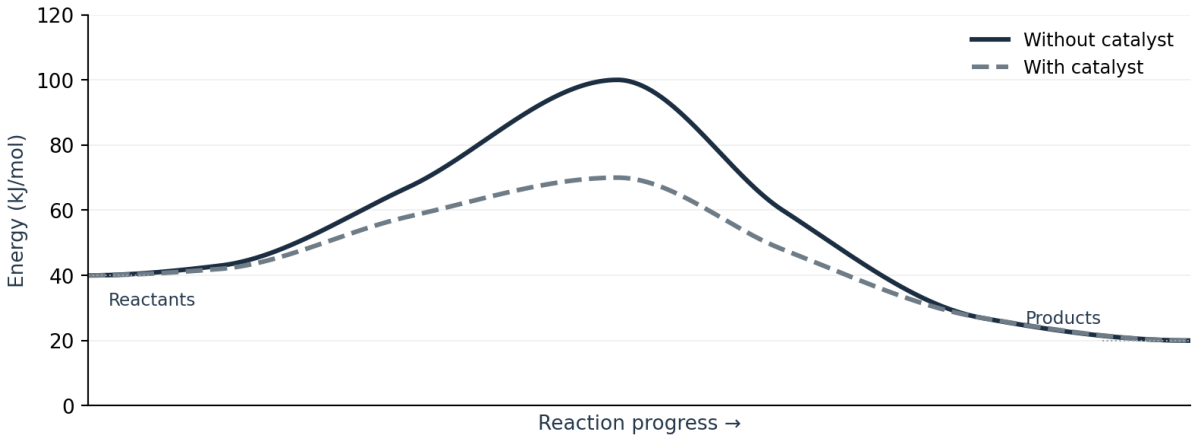
6. Which collision is more likely to form AB + C? Give a reason.

7. If the particles had the correct orientation but too little energy, would they react? Explain.

8. Why does an increase in the total number of collisions not mean that every collision will be successful?

C | Activation energy and catalysts

Use this energy-profile diagram. The energy values are illustrative.



9. Define activation energy.

10. Calculate the activation energy WITHOUT a catalyst. Show your subtraction and units.

11. Calculate the activation energy WITH a catalyst. Show your subtraction and units.

12. Use collision theory to explain why the catalyst increases the reaction rate.

13. Does the catalyst change the energy of the reactants or products in this diagram? Explain.

D | Successful collisions and reaction rate

The table represents a simplified particle simulation. Each trial differs from the baseline by the condition shown; other conditions remain constant.

Condition	Total collisions per second	Successful collisions per second
Baseline	100	12
Higher concentration	200	24
Higher temperature	120	36
With a catalyst	100	30

14. Calculate the percentage of baseline collisions that are successful.

15. Compare baseline with higher concentration. Explain the change in successful collisions per second.

16. Compare baseline with higher temperature. Why is the successful-collision count much higher?

17. The catalyst trial has the same total collisions per second as baseline. Why are more successful?

18. Which condition has the highest rate in this simulation? What number supports your answer?

E | Explaining experimental observations

19. Powdered calcium carbonate reacts faster with acid than equal-mass large chips. Explain using collision theory.

20. Magnesium reacts faster with warm acid than with cold acid. Explain using particle energy and activation energy.

21. A reaction slows down as a soluble reactant is used up. Explain the decrease in rate.

22. Hydrogen peroxide decomposes much faster after a suitable catalyst is added. Explain without saying the catalyst "adds energy."

F | Connecting collision theory to measured data

Two trials use the same initial amounts of reactants and both eventually produce 60 cm^3 of gas. Trial A is warmer; Trial B is cooler.

Time (s)	Trial A: gas (cm^3)	Trial B: gas (cm^3)
0	0	0
10	24	12
20	42	24
30	54	36
40	60	48
50	60	60

23. Calculate the average gas-production rate from 0–20 s for BOTH trials (cm^3/s).

24. Which trial is faster initially? Explain using collision theory, not just the numbers.

25. Both trials produce 60 cm^3 in total. Why can their rates differ while the final gas volume is the same?

G | Plan and evaluate an investigation

26. A student tests how temperature affects the rate of magnesium reacting with acid. Identify the independent variable, the measured dependent variable, and TWO control variables.

27. Describe how the student could measure the rate and make the results reliable (mention timing, repeated trials, and one source of error).

28. Evaluate this claim: “A catalyst makes the particles move faster, so every collision succeeds.” Refer to activation energy and orientation.