Chemistry

Standard level

Paper 1A

Practice paper

Topic: Chemical Kinetics

Chemistry

Standard level

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Specimen paper

45 minutes

Instructions to candidates

- Do not open this examination paper until instructed to do so.
- Answer all questions.
- For each question, choose the best answer.
- A clean copy of the chemistry data booklet is required.
- The maximum mark for this paper is [20 marks].

Section A

1. Which unit is the most appropriate for measuring the rate of a chemical reaction?
   A. mol dm^{-3}
   B. s^{-1}
   C. mol dm^{-3} s^{-1}
   D. dm^3 mol^{-1} s^{-1}

2. According to collision theory, what two conditions must be met for a collision between reactant molecules to be successful?
   A. High temperature and appropriate collision geometry
   B. Activation energy ≥ kinetic energy and high pressure
   C. Appropriate collision geometry and kinetic energy ≥ activation energy
   D. High pressure and appropriate collision geometry

3. How does increasing the temperature increase the rate of a chemical reaction?
   A. It decreases the activation energy of the reaction.
   B. It increases the frequency of collisions only.
   C. It slightly increases collision frequency and significantly increases the proportion of particles with energy ≥ E_a.
   D. It increases the average potential energy of the particles.

4. Which experimental method is most suitable for measuring the rate of reaction between calcium carbonate and hydrochloric acid?
   A. Colorimetry
   B. Change in mass over time
   C. Change in pH over time
   D. Change in electrical conductivity

5. An increase in the surface area of a solid reactant will:
   A. Increase the activation energy.
   B. Decrease the activation energy.
   C. Increase the frequency of collisions.
   D. Increase the proportion of successful collisions per unit time, but decrease total products.

6. What is represented by the area under a Maxwell-Boltzmann distribution curve?
   A. The total activation energy
   B. The total number of particles
   C. The total kinetic energy

D. The rate of the reaction

7. A catalyst speeds up a chemical reaction by:
A. Increasing the average kinetic energy of the particles.
B. Providing an alternative reaction pathway with a lower activation energy.
C. Increasing the collision frequency.
D. Increasing the yield of the reaction.

8. In an endothermic reaction, the activation energy of the forward reaction is:
A. Equal to the activation energy of the reverse reaction.
B. Less than the activation energy of the reverse reaction.
C. Greater than the activation energy of the reverse reaction.
D. Equal to the enthalpy change of the reaction.

9. Which factor does NOT change the value of the activation energy for a specific reaction?
A. Addition of an inhibitor.
B. Addition of a solid catalyst.
C. Addition of an aqueous catalyst.
D. An increase in temperature.

10. Zinc metal reacts with excess hydrochloric acid. Which change would increase the initial rate of reaction but leave the total volume of hydrogen gas produced unchanged?
A. Using powdered zinc instead of a zinc lump of the same mass.
B. Using a larger mass of zinc lump.
C. Increasing the volume of the hydrochloric acid.
D. Decreasing the concentration of the hydrochloric acid.

11. What happens to the peak of the Maxwell-Boltzmann distribution curve as temperature increases?
A. It moves to the left and gets higher.
B. It moves to the right and gets lower.
C. It moves to the left and gets lower.
D. It moves to the right and gets higher.

12. The activation energy for a reaction can be defined as:
A. The energy difference between reactants and products.
B. The minimum kinetic energy required by colliding particles to initiate a reaction.
C. The average kinetic energy of the system.

D. The energy released when products form.

13. Which process occurs when a reaction mixture is cooled?
A. The activation energy increases.
B. The collision frequency increases.
C. The proportion of particles with energy ≥ E_a decreases.
D. The kinetic energy of all particles becomes identical.

14. If a gas-phase reaction occurs in a closed syringe, pressing the plunger to halve the volume will:
A. Decrease the collision frequency.
B. Increase the rate of reaction by increasing the concentration of gases.
C. Decrease the rate of reaction by decreasing the activation energy.
D. Have no effect on the collision frequency.

15. In an energy profile diagram, what does the highest point on the curve represent?
A. The products.
B. The transition state.
C. The reactants.
D. The enthalpy change.

16. Which variables can be measured continuously to determine the rate of a reaction?
I. Volume of gas evolved
II. Mass of the reaction mixture
III. Initial color intensity (for colorimetry)
A. I and II only
B. I and III only
C. II and III only
D. I, II and III

17. Which statements are true regarding a catalyst?
I. It is fully consumed during the reaction.
II. It provides an alternative pathway of lower activation energy.
III. It increases the yield of the reaction products.
A. I and II only
B. II only
C. II and III only
D. I, II and III

18. Which factors increase the frequency of collisions between reacting particles?

I. Increasing the temperature
II. Increasing the concentration of reactants
III. Adding a suitable catalyst

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

19. According to the Maxwell-Boltzmann distribution, what occurs when temperature is increased?

I. The average kinetic energy of the particles increases.
II. The area under the curve increases.
III. The fraction of particles with energy $\geq E_a$ increases.

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

20. Which of the following must be true for a collision between two particles to lead to a reaction?

I. The particles must have $E \geq E_a$.
II. The particles must be of the same element.
III. The particles must collide with the correct stereochemical orientation.

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