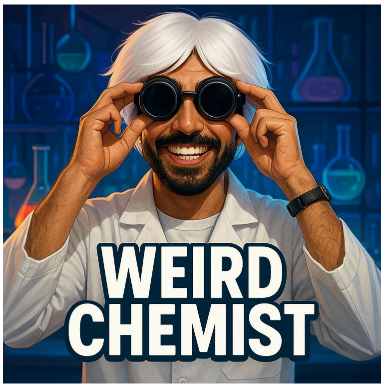

Chemical Kinetics

DPP-4 (Order & Molecularity)

"I don't rush. I don't panic. I understand… step by step. Clarity is my strength."

Quick Revision — Order vs Molecularity

Molecularity: The number of reacting species (atoms, molecules, ions) colliding simultaneously to bring about a chemical reaction in an *elementary* reaction.

Examples:

- **Unimolecular:** $NH_4NO_2 \longrightarrow N_2 + 2\,H_2O$
- **Bimolecular:** $2\,HI \longrightarrow H_2 + I_2$
- **Trimolecular:** $2\,NO + O_2 \longrightarrow 2\,NO_2$

Molecularity of 4 is rare — probability of more than 3 species colliding at once is negligible. For a complex reaction like:

$$6\,FeSO_4 + KClO_3 + 3\,H_2SO_4 \longrightarrow 3\,Fe_2(SO_4)_3 + KCl + 3\,H_2O$$

molecularity is **not defined** (molecularity applies *only* to elementary reactions).

Order	Molecularity
Defined for both elementary & complex reactions	Only for elementary reactions
Can be 0, fractional or negative	Cannot be zero or non-integer
Experimentally determined quantity	Theoretical quantity

TYPE–1 : Order & Molecularity — Conceptual MCQs

1. Which of the following statements is not correct about order of a reaction?

(1) The order of a reaction can be a fractional number.

(2) Order of a reaction is experimentally determined quantity.

(3) The order of a reaction is always equal to the sum of the stoichiometric coefficients of reactants in the balanced chemical equation for a reaction.

(4) The order of a reaction is the sum of the powers of molar concentration of the reactants in the rate law expression.

2. Rate law cannot be determined from balanced chemical equation if ______.

(1) reverse reaction is involved.

(2) it is an elementary reaction.

(3) it is a sequence of elementary reactions.

(4) any of the reactants is in excess.

3. Which of the following statements are applicable to a balanced chemical equation of an elementary reaction?

(1) Order is same as molecularity.

(2) Order is less than the molecularity.

(3) Order is greater than the molecularity.

(4) Molecularity can never be zero.

4. In any unimolecular reaction ______.

(1) only one reacting species is involved in the rate determining step.

(2) the order and the molecularity of slowest step are equal to one.

(3) the molecularity of the reaction is one and order is zero.

(4) both molecularity and order of the reaction are one.

5. For a complex reaction ______.

(1) order of overall reaction is same as molecularity of the slowest step.

(2) order of overall reaction is less than the molecularity of the slowest step.

(3) order of overall reaction is greater than molecularity of the slowest step.

(4) molecularity of the slowest step is never zero or non-integer.

6. How can the rate law of the reaction $2\,NO(g) + O_2(g) \longrightarrow 2\,NO_2(g)$ be determined?

(1) Directly from the stoichiometric coefficients of the balanced equation.

(2) By experimentally measuring how the rate changes with the concentration of each reactant.

(3) By assuming the reaction is elementary and writing rate = $k[NO]^2[O_2]$ without verification.

(4) From the molecularity of the overall reaction alone.

7. For which type of reactions do order and molecularity have the same value?

(1) Complex multi-step reactions.

(2) Reactions involving a catalyst.

(3) Simple (single-step) elementary reactions.

(4) Zero order reactions only.

8. For a zero order reaction, will the molecularity be equal to zero?

(1) Yes, because order and molecularity are always equal.
(2) Yes, because the rate is independent of concentration.
(3) No, because molecularity cannot be zero — at least one species must collide.
(4) No, because zero order reactions have molecularity equal to two.

9. Why can the molecularity of any reaction never be equal to zero?

(1) Because molecularity is determined experimentally and experiments always give a non-zero value.
(2) Because molecularity is the number of species colliding, and at least one species must be present for a reaction to occur.
(3) Because zero molecularity would mean a fractional order.
(4) Because the balanced equation always has at least one reactant.

10. Why is molecularity applicable only to elementary reactions, while order is applicable to both elementary and complex reactions?

(1) Because molecularity is a theoretical quantity defined only for a single-step (elementary) process, whereas order is experimentally determined from the rate law of any reaction.
(2) Because complex reactions have no reactants to count.
(3) Because order can only be a whole number, but molecularity can be fractional.
(4) Because molecularity depends on temperature, but order does not.

11. Why can we not determine the order of a reaction by taking into consideration the balanced chemical equation?

(1) Because the balanced equation does not reveal the actual mechanism or the rate determining step.
(2) Because stoichiometric coefficients always equal the order.
(3) Because the balanced equation gives molecularity, not order — and order must be determined experimentally.
(4) Both (1) and (3).

TYPE–2 : Assertion & Reason

Instructions for Q.12 & Q.13

In the following questions a statement of **Assertion** followed by a statement of **Reason** is given. Choose the correct answer out of the following choices:

(1) Both assertion and reason are correct and the reason is the correct explanation of assertion.

(2) Both assertion and reason are correct but reason does not explain assertion.

(3) Assertion is correct but reason is incorrect.

(4) Both assertion and reason are incorrect.

(5) Assertion is incorrect but reason is correct.

12. **Assertion:** Order of the reaction can be zero or fractional.
Reason: We cannot determine order from balanced chemical equation.

13. **Assertion:** Order and molecularity are same.
Reason: Order is determined experimentally and molecularity is the sum of the stoichiometric coefficient of rate determining elementary step.

– End of DPP-4 –

Keep experimenting, keep learning! – Weird Chemist