What is a Rate Law?

Worksheet

Rate law expresses how reaction rate depends on reactant concentration. The rate constant k is specific to temperature. The reaction order m (for [A]) and n (for [B]) are found by fitting experimental data - they do NOT equal stoichiometric coefficients.

rate = k[A]^m [B]^n

Questions

1. For rate = k[A][B], the order in [A] is:
A) 0
B) 1
C) 2
D) 3

2. If a reaction is first-order in A and the rate law is rate = k[A], doubling [A] results in:
A) Rate unchanged
B) Rate halved
C) Rate doubled
D) Rate quadrupled

3. For rate = k[X], if [X] is doubled, rate increases by factor of:
A) 2
B) 4
C) 8
D) 16

4. Rate constant k has units that depend on:
A) Temperature only
B) Overall reaction order
C) Stoichiometry
D) Pressure

5. For the reaction 2A + B products, the rate law is found to be: rate = k[A][B]. Find the rate if k = 0.5 Ms, [A] = 0.2 M, [B] = 0.1 M.

6. Reactant concentration is doubled. If reaction is first-order in [A], what happens to rate?

7. For a second-order reaction in [A], if [A] is tripled, how does rate change?

8. Define: What is a rate law?

9. Define: Are rate law exponents the same as stoichiometric coefficients?

10. Define: What is a rate constant k?

Answer Key

1. C) 2 - The exponent of [A] is 2, so the order in [A] is 2 (second-order).
2. C) Rate doubled - First-order: rate [A]. Double [A] double rate.
3. C) 8 - rate = k[X]. If [X] 2[X]: rate = k(2[X]) = 8k[X]. Factor is 8.
4. B) Overall reaction order - Units of k = (concentration)^(1overall order) (time)^(1). Order determines k's units.
5. rate = k[A][B] rate = (0.5)(0.2)(0.1) rate = (0.5)(0.2)(0.01) rate = 0.001 M/s = 1.0 10 M/s
6. First-order: rate = k[A] = k[A] If [A] doubles: new rate = k(2[A]) = 2k[A] Rate also doubles (2)
7. Second-order: rate = k[A] If [A] triples: new rate = k(3[A]) = 9k[A] Rate increases nine-fold (9)
8. A mathematical expression relating reaction rate to reactant concentrations: rate = k[A]^m[B]^n.
9. No - exponents are determined experimentally; coefficients come from the balanced equation.
10. A proportionality constant specific to a reaction and temperature; units depend on overall order.