

## Rate law and Rate constant

119. (a) For first order reactions rate is depend on the concentration of one reactant.

120. (b) Molecularity of a reaction never become zero or fraction.

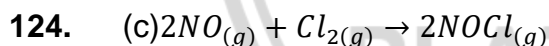
121. (d)  $t = \frac{2.303}{k} \log \frac{a}{a-x}$

$$t = \frac{2.303}{1.155 \times 10^{-3}} \log \frac{100}{100-50} = 600 \text{ sec}$$

122. (b) Rate =  $K[A]^{\frac{3}{2}}[B]^{-1}$

$$\therefore O.R. = \frac{3}{2} + (-1) = \frac{1}{2}$$

123.  $(dt_{\frac{1}{2}} \propto (CO)^0$  i.e. half life for 1<sup>st</sup> order is independent of initial concentration.



Rate =  $K[NO]^2[Cl_2]^1$ ,  $\therefore O.R. = 2 + 1 = 3$

125. (d)  $8 \times 10^{-5} = \frac{1}{t} \left[ \frac{1}{0.5} - \frac{1}{1} \right]$ ;  $8 \times 10^{-5} = \frac{1}{t} [2 - 1]$

$$t = \frac{1}{8 \times 10^{-5}} = 0.125 \times 10^5 = 1.25 \times 10^4 \text{ min.}$$

126. (b)  $r = k[\text{reactant}]^{-1} \therefore k = \frac{0.693 \times 10^{-2}}{1}$  also  $t_{\frac{1}{2}} = \frac{0.693}{k} = \frac{0.693}{0.693 \times 10^{-2}} = 100 \text{ min.}$

127. (d)  $t_{\frac{1}{2}} = \frac{1}{Ka}$  for second order reactions.



128. (d)  $k = \frac{2.303}{t} \log \left( \frac{a}{a-x} \right); k = \frac{2.303}{30} \log \left( \frac{100}{100-75} \right)$

$k = \frac{2.303}{t} \log \left( \frac{100}{100-93.75} \right)$  Put the value of  $K$  from above equation we get the value of  $t$  therefore  $\therefore t = 60 \text{ min.}$

129. (b)  $k = \frac{0.693}{45} \text{ min}^{-1} = \frac{2.303}{t_{99.9\%}} \log \frac{a}{a-0.999a}$  or

$t_{99.9\%} = \frac{2.303 \times 45}{0.693} \log 10^3 = 448 \text{ min} \approx 7.5 \text{ hrs}$

130. (a) Given  $A(a) = 2.00 \text{ m}$ ,  $t = 200 \text{ min}$  and  $a(a-x) = 0.15 \text{ m}$  we know

$k = \frac{2.303}{t} \log \frac{a}{a-x} = \frac{2.303}{200} \log \frac{2.00}{0.15}$   
 $= \frac{2.303}{200} \times (0.301 + 0.824) = 1.29 \times 10^{-2} \text{ min}^{-1}$

131. (a,c) The unit for zero order reaction is  $\text{mol litre}^{-1} \text{ time}^{-1}$

132. (c) It is a third order reaction because

$\text{Rate} = K[\text{NO}]^2[\text{O}_2]^1 \therefore O.R. = 2 + 1 = 3$

133. (d) Order of a reaction is decided by relative concentration of reactants.

134. (c) Unit of rate constant for second order reaction is  $\text{mol}^{-1} \text{ litre time}^{-1}$

135. (a)  $R = K[A]^2[B]$  order of reaction  $= 2 + 1 = 3$

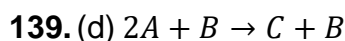
136. (a) Units of 1<sup>st</sup> rate constant order reaction are  $\text{sec}^{-1}$  and for zero order reaction, these are  $\text{mol litre}^{-1} \text{ sec}^{-1}$  i.e.  $\text{M sec}^{-1}$ .

137. (c) This reaction is bimolecular and first order of reaction.



138. (c)  $t_{\frac{1}{2}} = \frac{0.693}{k}$  Given  $t_{\frac{1}{2}} = 693 \text{ sec}$

$$693 = \frac{0.693}{k}, k = \frac{0.693}{693}; k = 10^{-3} = 0.001 \text{ sec}^{-1}.$$



$$\text{Rate} = k[A]^2[B]^1$$

$$\therefore O.R. = 2 + 1 = 3 \text{ and molecularity is } 3[2A + B].$$

140. (c) In photochemical reactions the rate of reaction is independent of the concentration of reacting species.

141. (c) We know that  $k = \frac{2.303}{t} \log \frac{a}{a-x} \cdot 10^{-3} = \frac{2.303}{t} \log \frac{a}{(a-\frac{2a}{3})}, 10^{-3} = \frac{2.303}{t} \log 3$

$$10^{-3} = \frac{2.303}{t} \times 0.4771, t = \frac{2.303 \times 0.4771}{10^{-3}} = 3300 \text{ sec}$$

142. (c)  $R = K(A)^2, R' = K(2A)^2, \therefore \frac{R'}{R} = 4$

$$R = K(A)^2, R' = K(3A)^2, \frac{R'}{R} = 9$$

143. **Order of reaction:**

- Can be integer or fractional (e.g., 0.5, 1.5 in complex reactions).

**Half-life ( $t_{1/2}$ ):**

- Can take any positive value, depends on rate constant and order.

**Molecularity:**

- Defined as the **number of reacting species in an elementary step**.
- Always a **whole number** (1, 2, 3).



- **Cannot be a fraction.**

**Rate constant (k):**

- Can have any positive value depending on units and reaction.

**Conclusion / Answer:** (c) Molecularity

