13.49  a) termolecular  
  b) unimolecular  
  c) bimolecular  

13.50  no termolecular reactions because you need at least 1 reactant for a rxn to occur. Very rare that 3 reactants collide, considering the correct orientation, & sufficient nrg

13.51  a) unimolecular rate = $k \times [X]$  
  b) bimolecular rate = $k \times [X][Y]$  
  c) termolecular rate = $k \times [X][Y][Z]$  
  d) bimolecular rate = $k \times [X]^2$  
  e) termolecular rate = $k \times [X][Y]^2$

13.52  rate determining step = slowest step in the sequence of steps leading to product formation

Analog: Flow of traffic along a narrow road. Assuming the cars cannot pass one another on the road, the rate at which the cars travel is governed by the slowest-moving car

13.53  9 reactants would have to collide, w/ correct orientation & sufficient energy => highly unlikely
13.55  a) 2  b) 1st rxn is slow
2nd rxn is faster

13.56  a) \[ \text{rate} = k [X_2]^x [Y]^y [Z]^z \]
- \([X_2]\) doubles \& rate doubles
  \[ \therefore \text{rate} \propto [X_2] \text{ or } 1^{\text{st}} \text{ order} \]
- \([Y]\) triples \& rate triples
  \[ \therefore \text{rate} \propto [Y] \text{ or } 1^{\text{st}} \text{ order} \]
- \([Z]\) doubles \& rate is not effected
  \[ \therefore \text{rate} \text{ is indep. of } [Z] \text{ or } 0^{\text{th}} \text{ order} \]

\[ \text{rate} = k [X_2][Y] \]

b) implies that \(Z\) is not a term
in the rate law (does not
participate in the rate-determining
step of the rxn mechanism)

c) possible mechanism:

\[ \text{step 1: } X_2 + Y \rightarrow XY + X \text{ slow} \]
\[ X + Z \rightarrow XZ \text{ fast} \]

13.57
don't like, sorry
Mechanism I → NO

- why: rate-determining step (slow) would have a rate law of 
  rate = k [H₂][NO], which 
  doesn't match experimentally 
  determined rate law

Mechanism II → possible

- why: slow step (rate-determining step) has a mechanism that 
  matches the exp. determined 
  rate law

Mechanism III → possible

- why: rate law of rate-determining 
  step (slow) can be rearranged 
  to match exp. rate law.

rate law from RDS

rate = k₂ [N₂O₂][H₂]

* Use equil. of step 1 to substitute 
  rateᵣ = rateᵢ
  rateᵢ = k₁ [NO]² 
  rateᵣ = k₋₁ [N₂O₂]

k₁[NO]² = k₋₁ [N₂O₂]

k₋₁

[N₂O₂] = k₁ [NO]²

k₋₁
rate = \frac{k_2 K [NO]^2 [H_2]}{k_1}

rate = k [NO]^2 [H_2]

13.05
Overall rxn: look at 1st & 3rd box. \( B + B_3 \xrightarrow{A} 2B_2 \)
A is a catalyst (present in beg. & end., not consumed)

a)
Step 1: \( A + B_3 \rightarrow AB + B_2 \)
Step 2: \( AB + B \rightarrow A + B_2 \)
\( B + B_3 \rightarrow 2B_2 \)

b) Catalyst: A intermediate: AB

13.06
rate = k_2 [ES]
they want this in terms of [E] & [S]

rate_f = k_1 [E][S]
rate_r = k_1 [ES]
rate_f = rate_r

\( \frac{k_1 [E][S]}{k_1} = \frac{k_1 [ES]}{k_1} \)

[ES] = \frac{k_1 [E][S]}{k_1}

rate = \frac{k_2 k_1 [E][S]}{k_1}