

1. $E_{a(\text{fwd})} = 60\text{kJ}$
2. $E_{a(\text{rev})} = 80\text{kJ}$
3. $\Delta H_{\text{fwd}} = -20\text{kJ}$
4. $\Delta H_{\text{rev}} = 20\text{kJ}$

Reaction Mechanisms

- most reactions do not occur in one step
 - > it is unlikely that several particles would collide simultaneously with sufficient energy and correct orientation
 - > reactions often occur as a result of several steps
 - > **ELEMENTARY PROCESSES** = collisions involving only 2 particles

Consider the following reaction:



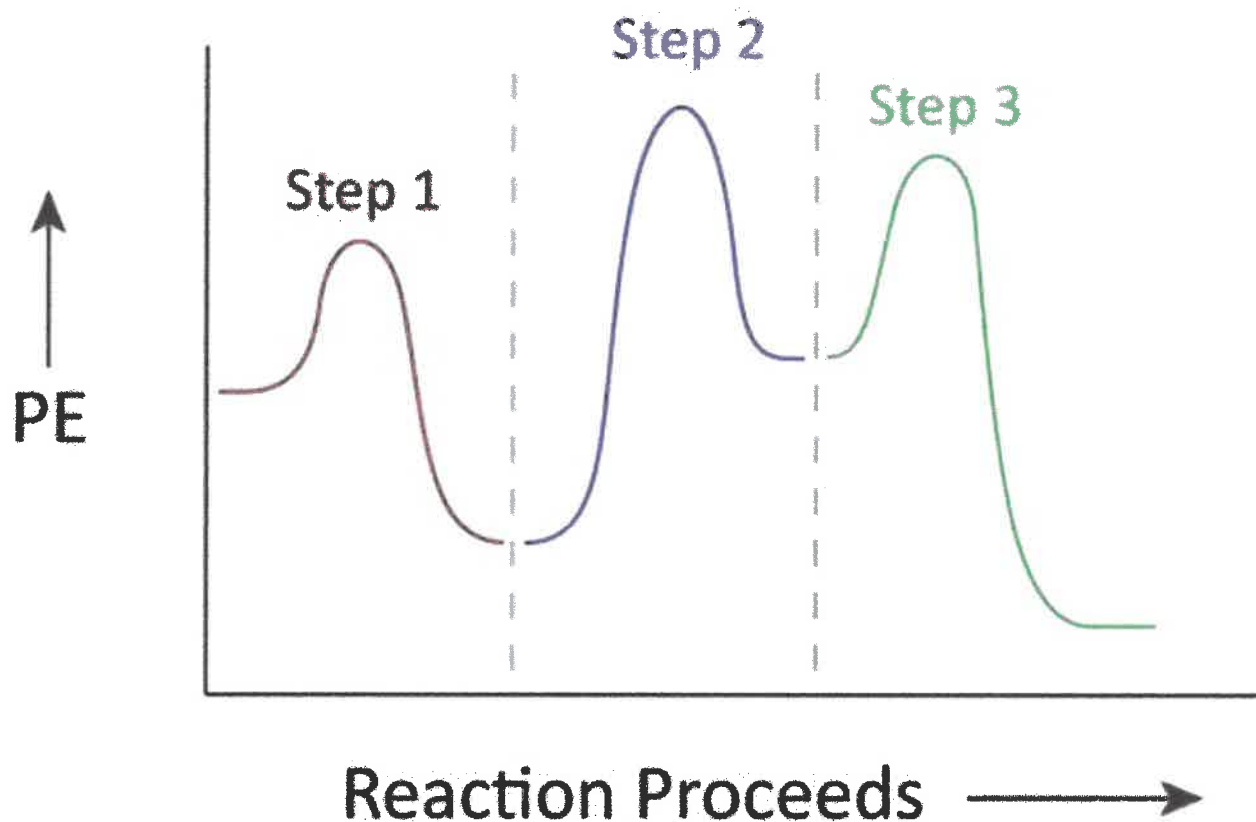
- it is unlikely 4 HBr molecules and 1 O₂ molecule will collide simultaneously to undergo a chemical change
- the reaction occurs in more than one step



- overall equation can be found by adding up all the chemical species on the left and the right and cancelling the similar species

REACTION MECHANISM = sequence of steps which makes up an overall reaction
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A PE diagram of a reaction mechanism:



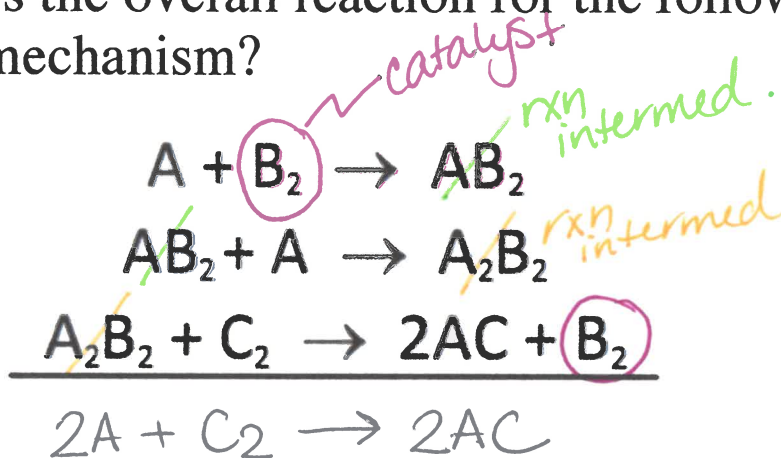
- each step will have its own peak
- overall activation energy is the difference between reactants and the highest peak
- activation energy for each step is PE difference between activated complex and the reactants involved in that step
- the step with the highest E_a is the rate determining step

RATE DETERMINING STEP = the slowest step in a reaction mechanism

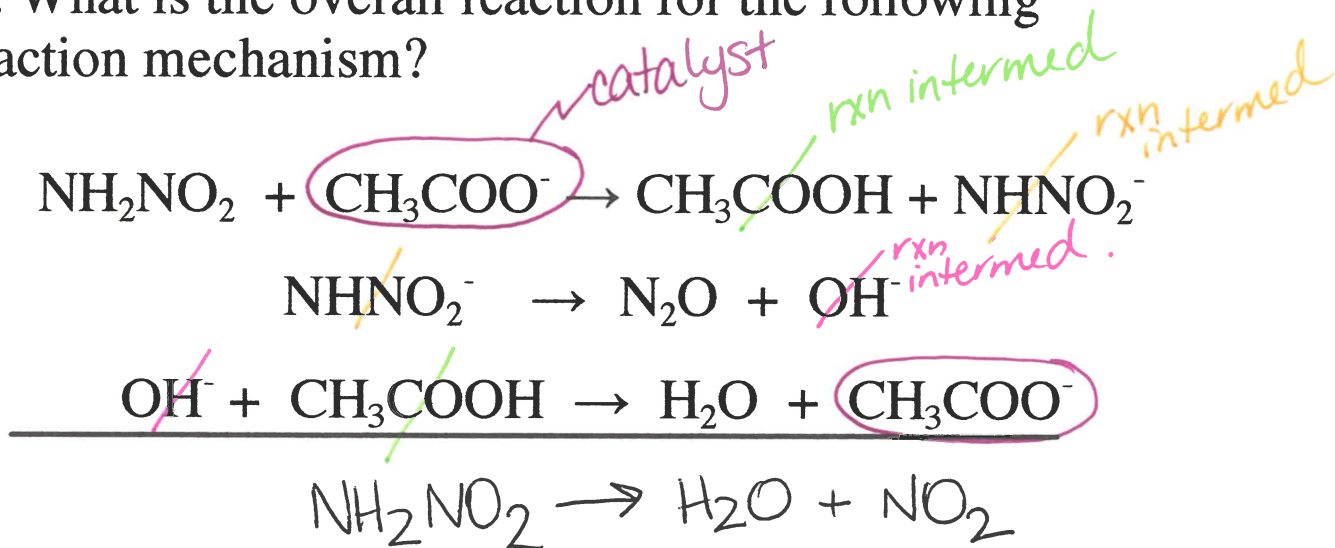
REACTION INTERMEDIATE = molecules which are produced in one step of a reaction mechanism and subsequently used up in another step

CATALYST = an active participant in a chemical reaction which is **regenerated** in a later step of the reaction mechanism

Q. What is the overall reaction for the following reaction mechanism?



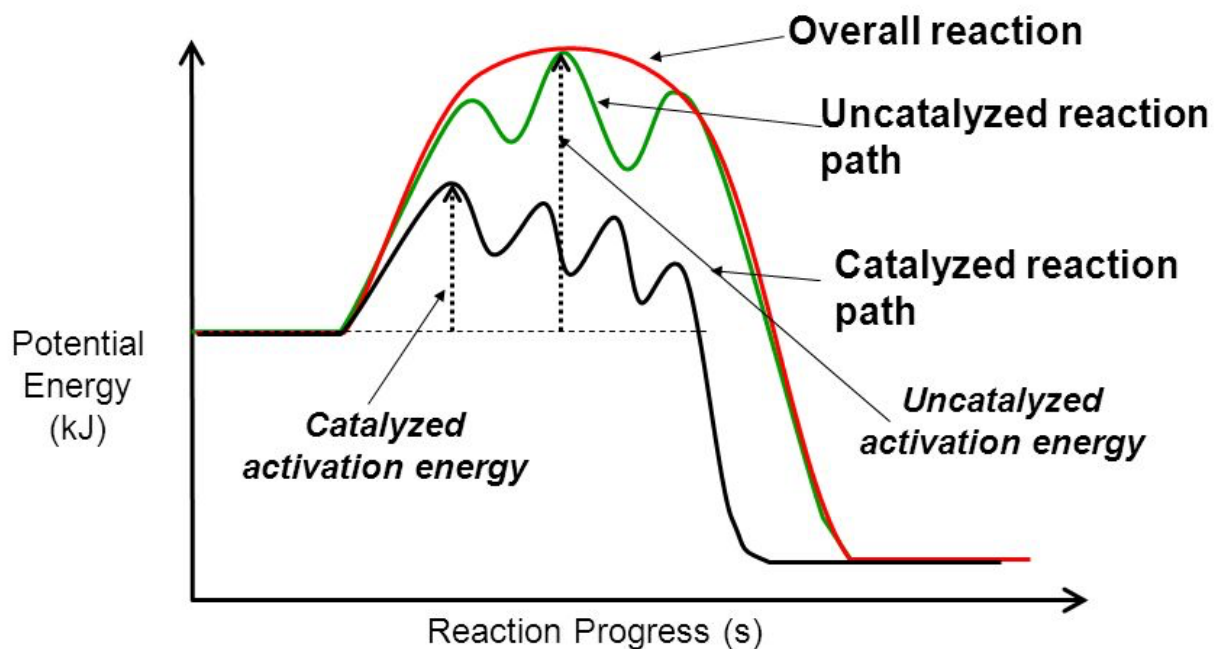
Q. What is the overall reaction for the following reaction mechanism?



How does a catalyst speed up a reaction?

- catalysts do not change the energy difference between reactants & products (ΔH)
- a catalyst lowers the E_a of a reaction; therefore, more molecules have enough E to react and reaction rate \uparrow
- a catalyst will $\downarrow E_a$ for both forward & reverse reaction

Catalysts work by providing an alternative mechanism having lower E_a .



Common catalysts:

- most biological reactions are initiated or aided by catalysts called **enzymes**
 - > enzymes are protein molecules which have a particular shape and composition to catalyze a specific reaction
 - > the molecule the enzyme acts on is called the **substrate**
 - ex. maltase, ethanol dehydrogenase
- **platinum** - common catalyst in industrial processes such as production of H_2SO_4
- catalytic converter in cars contains particles of platinum, palladium and rhodium which convert CO and unburned hydrocarbons to CO_2 and H_2O