

April 24, 2002

➤ **Exam #3**

✓ Graded exams? Not until Friday . . .

✓ **Labs**

ALL LABS DUE NO LATER THAN:

MIDNIGHT, MAY 1st

✓ **Final Exam**

• Friday, May 10th - start time change?

• Alternate *Earlier* day/time?

1

Not All Collisions Result in a Reaction

➤ **Must Be Above a Threshold Energy**

✓ Kinetic Energy of reactants must exceed the *Activation Energy* (E_a)

• For our example reaction: $E_a = 132 \text{ kJ/mol}$

✓ **E_a** is:

- Independent of temperature
- Independent of concentration
- Always a *positive* value

✓ Fraction of reactants with K.E. $> E_a$ is often small

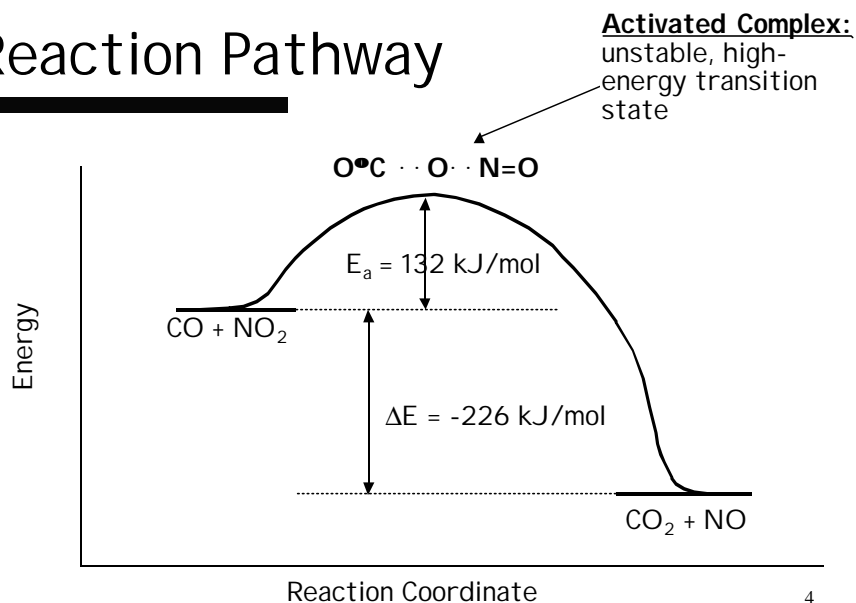
2

Sufficient Energy is Not Enough

- Colliding reactants must have *proper orientation* in order to react
 - ✓ Must be oriented so as to form an *activated complex* that will breakup into products
- ❖ Reaction Rate depends on:
 1. Collision Frequency
 2. Fraction of *activated* species
 3. Geometric Probability

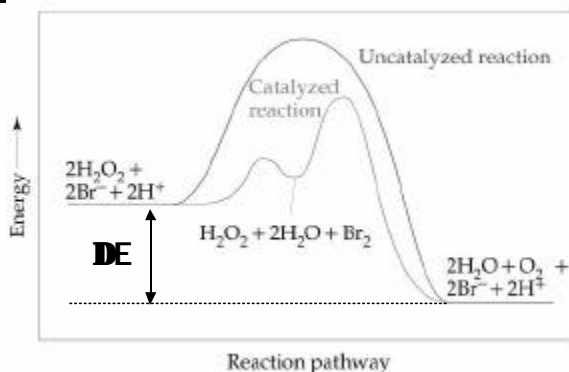
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Reaction Pathway



Catalysts

- Substances which *increase reaction rate* but are not changed/consumed by the reaction
- How? Provide a reaction pathway with a *lower E_a* :

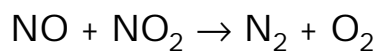


Note: ΔE is *unaffected* by the catalyst

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Catalysts: Example

■ Catalytic Converters

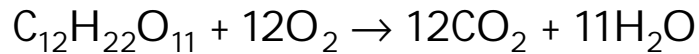


- ✓ Use Pt and Rh (deposited onto Al_2O_3 honeycomb) as catalysts
- ✓ *Heterogeneous Catalysis*
- ✓ Pb "poisons" catalyst (must use unleaded gasoline)

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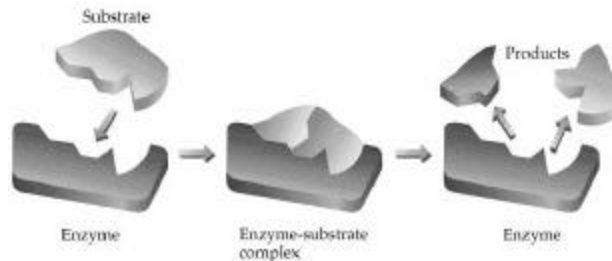
Catalysts: Another Example

➤ Combustion:



✓ Very slow reaction at body temperature (37 °C)

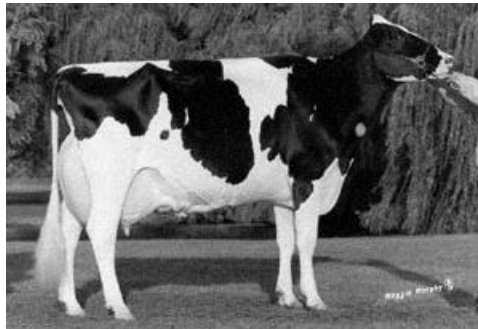
✓ Enzymes act as catalysts and speed up reaction:



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What's This?

- Jersey
- Guernsey
- Angus
- Brahman
- Texas Longhorn
- Brown Swiss
- Holstein

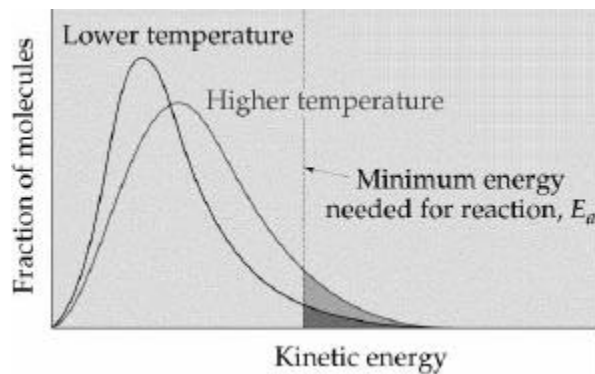


It's a "Cattle List"!

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Effect of Temperature

- Increasing temperature, increases fraction of reactants with $K.E. > E_a$



Rule of Thumb: Rxn rate *doubles* for every $10\text{ }^\circ\text{C}$ increase