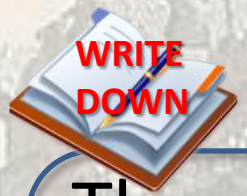
THE ACTIVATED COMPLEX

Transition State Theory

Chemical Change

- During a chemical reaction, atoms are rearranged to form new substances by breaking old bonds and forming new bonds.
- Bond breaking takes energy, while bond making releases energy.
- Even exothermic reactions, such as burning wood, need energy to get started.

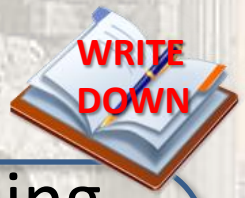


ACTIVATION ENERGY

- The energy needed to get a reaction started is called the **activation energy**.
- It comes from the collisions between the reacting particles.
- One explanation for the fact that even exothermic reactions require activation energy is that old bonds must be broken before new bonds form.

What the Evidence Shows

- Measurements show that the energy needed to break the bonds during a chemical reaction is greater than the activation energy.
- This means some other mechanism must be involved to enable old bonds to break and new bonds to form.
- An alternate explanation is that:

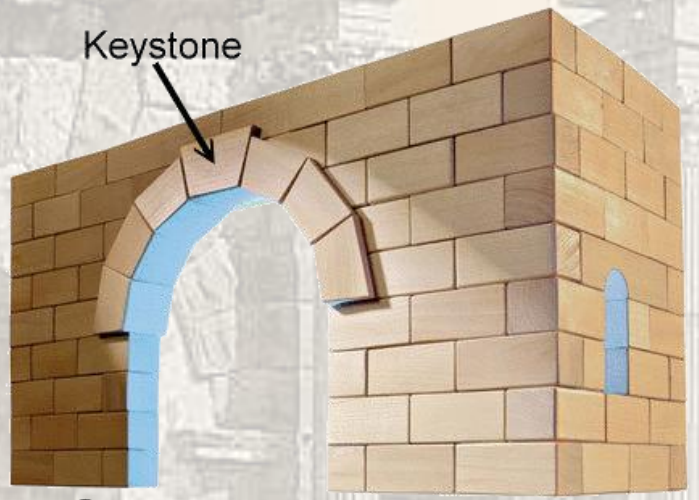


Instead of the energy from the collisions being used to break the bonds, it is used to form an unstable, high energy **activated complex**.

The Logic

Why does it make sense to form an activated complex that won't even be there when the reaction is done?

- Consider Roman Arches:
  - Once the keystone is in place, the arch is stable.
  - What keeps gravity from pulling the structure down before the keystone is in place?



While the structure is being built, a temporary scaffold of wood holds it up.

- An activated complex is similar to a scaffold because it is only temporary, but it enables the reaction to occur.

THE TRANSITION STATE

- The high energy activated complex is so unstable, it quickly falls apart to form the products.
- Because the activated complex lasts only a short time, it is also called a **transition state complex**.
- According to transition state theory, during a chemical reaction, intermediate products, known as the transition state complex, form that exist for only brief periods of time while the atoms rearrange themselves.

CONCLUSION

- Activation energy is used to form an activated complex instead of for breaking bonds.
- The old bonds break when the activated complex forms the products