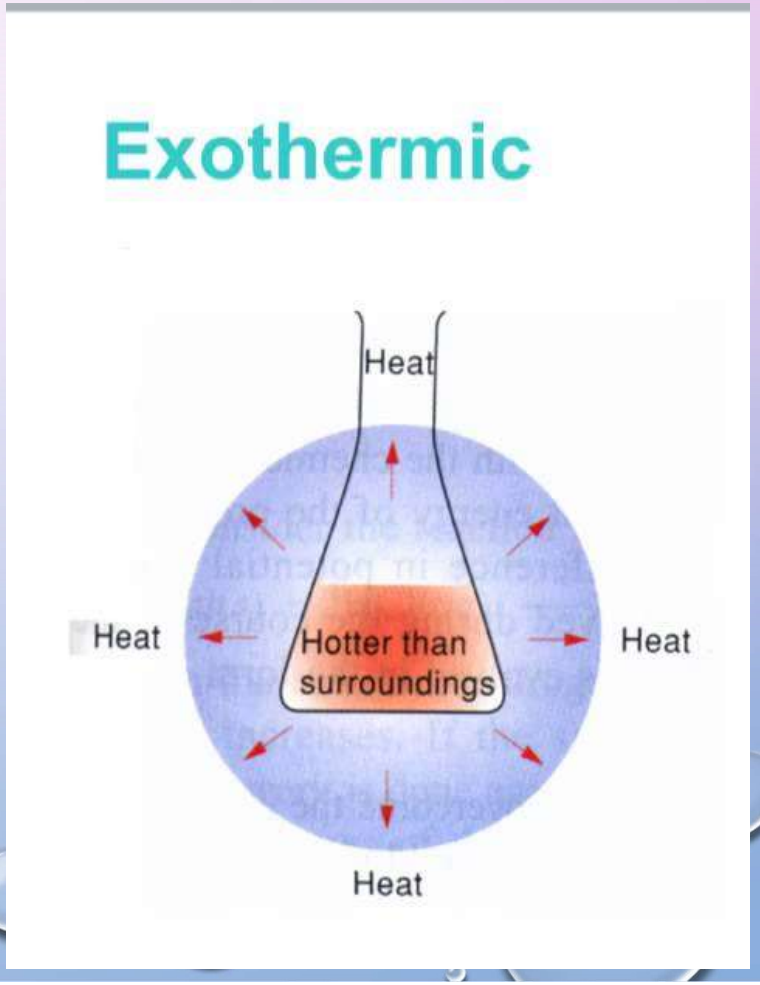
EXOTHERMIC & ENDOTHERMIC REACTIONS: ENERGY DIAGRAMS

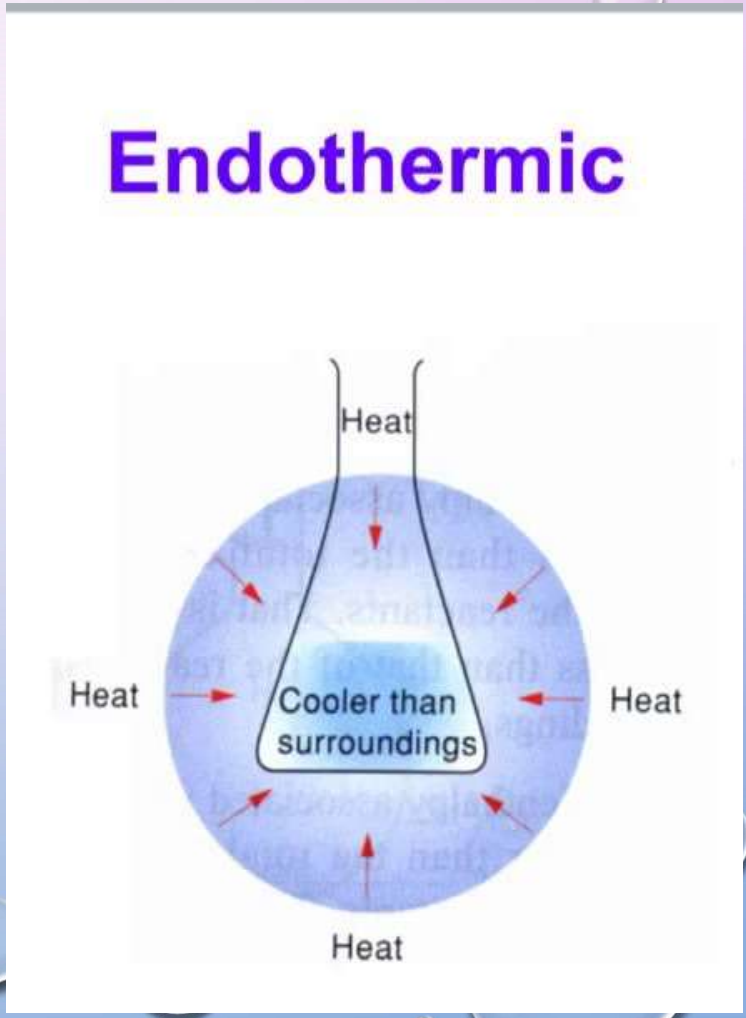
EXOTHERMIC

- EXOTHERMIC – THE SYSTEM LOSES HEAT AS THE SURROUNDINGS WARM UP
- WILL FEEL WARM/HOT!
  - HEAT ENERGY IS BEING RELEASED FROM THE SYSTEM TO THE SURROUNDINGS
- -ΔH = **NEGATIVE**



ENDOTHERMIC

- ENDOTHERMIC – SYSTEM GAINS HEAT AND THE SURROUNDINGS COOL DOWN
- WILL FEEL COOL/COLD
  - HEAT IS BEING ABSORBED BY THE SYSTEM FROM THE SURROUNDINGS
- ΔH = POSITIVE



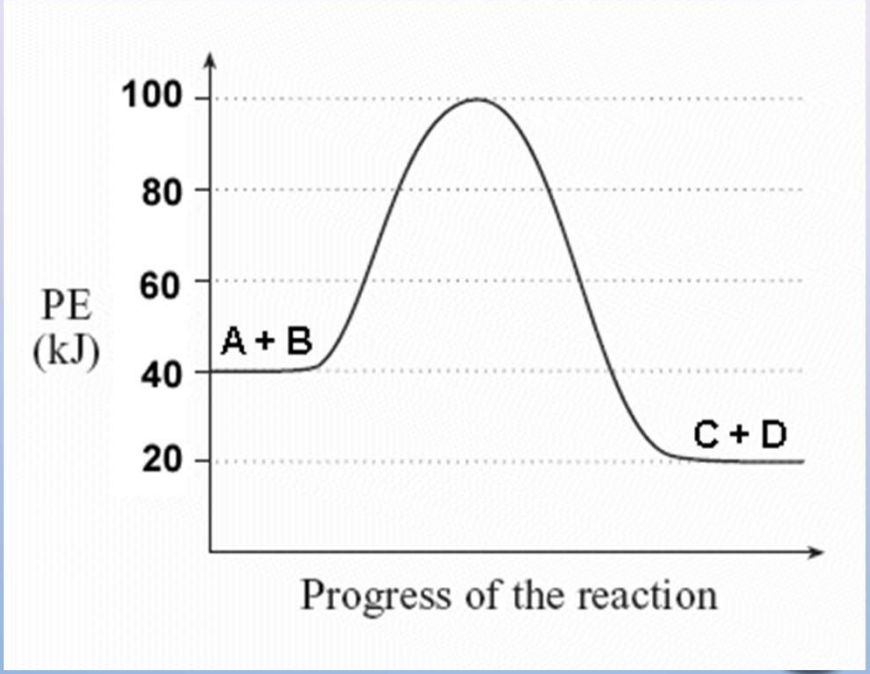
REACTIONS

- $CAO + H_2O \rightarrow CA(OH)_2 +$ **65.2 KJ**
- $\Delta H = -65.2KJ$
- ENERGY IS A PRODUCT, SO THE REACTION IS EXOTHERMIC AND ΔH IS NEGATIVE!

- $2NAHCO_3 +$ **129KJ** $\rightarrow NA_2CO_3 + H_2O + CO_2$
- $\Delta H = 129KJ$
- ENERGY IS A REACTANT, SO THE REACTION IS ENDOTHERMIC AND ΔH IS POSITIVE!

EQUATIONS & ENERGY DIAGRAMS

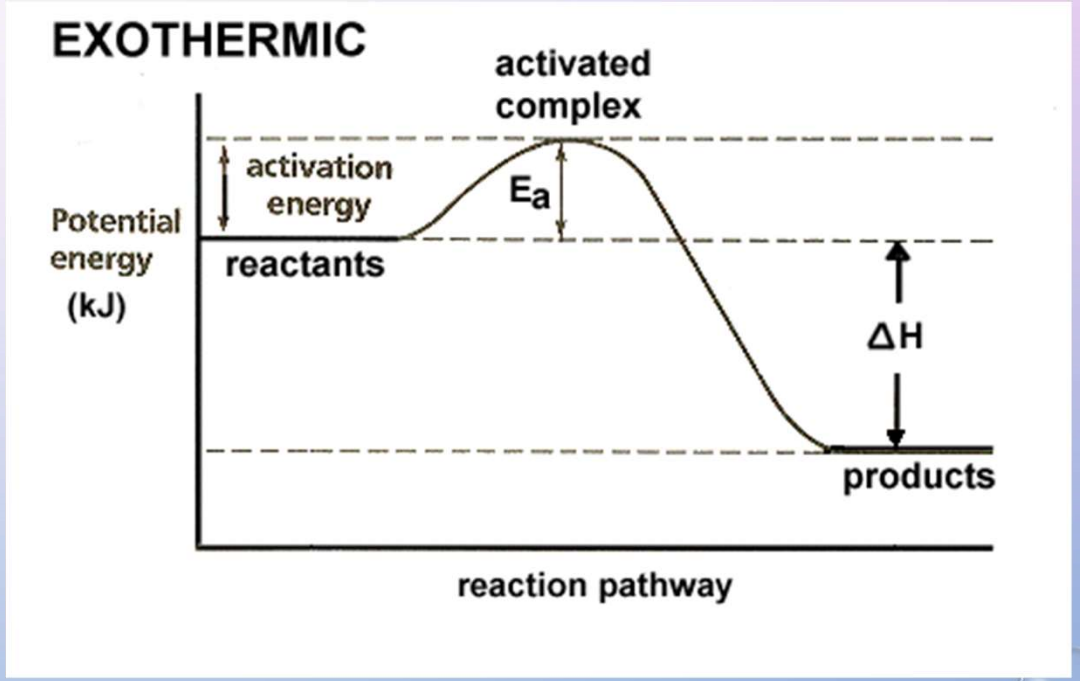
- WE CAN USE AN ENERGY DIAGRAM FOR A VISUAL REPRESENTATION OF THE ENERGY WITHIN A REACTION.



ENERGY DIAGRAM

- Y-AXIS = POTENTIAL ENERGY
- X-AXIS = REACTION PATHWAY (TIME)

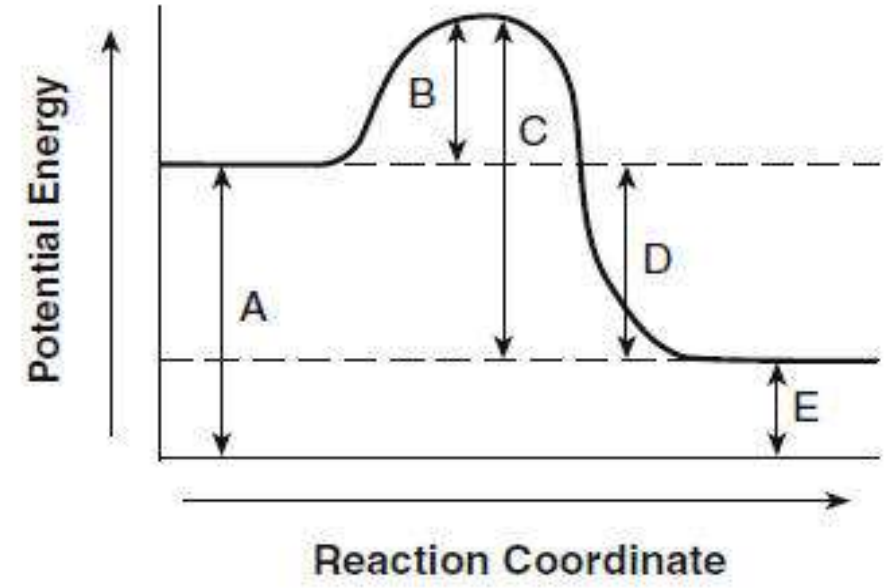
- REACTANTS ON LEFT
- PRODUCTS ON RIGHT
- IF REACTION IS REVERSIBLE:
  - REVERSE REACTION:
    - REACTANTS ON RIGHT
    - PRODUCTS ON LEFT



- ACTIVATED COMPLEX IS AN INTERMEDIATE COMPOUND WITH HIGHER ENERGY THAN BOTH REACTANTS AND PRODUCTS

ENERGY DIAGRAM

- A = POTENTIAL ENERGY OF REACTANTS
- B = ACTIVATION ENERGY
  - ENERGY REQUIRED TO START THE REACTION
- C = ACTIVATION ENERGY (REVERSE REACTION)
- D = ΔH
  - ENERGY OF THE REACTION
- E = POTENTIAL ENERGY OF PRODUCTS

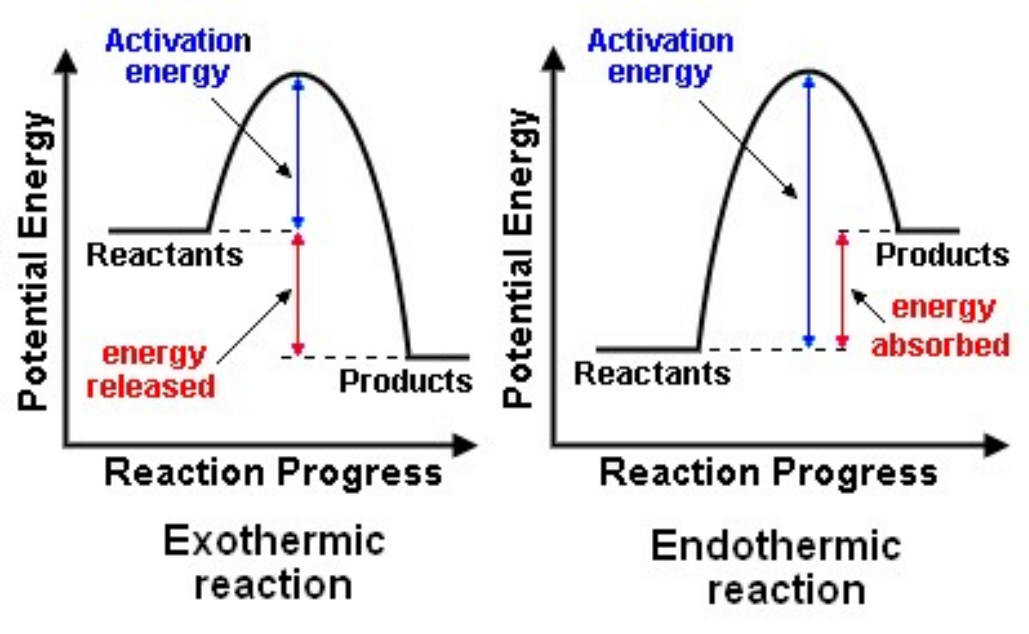


$$CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(\ell) + 890.4\ kJ$$

ENERGY DIAGRAM

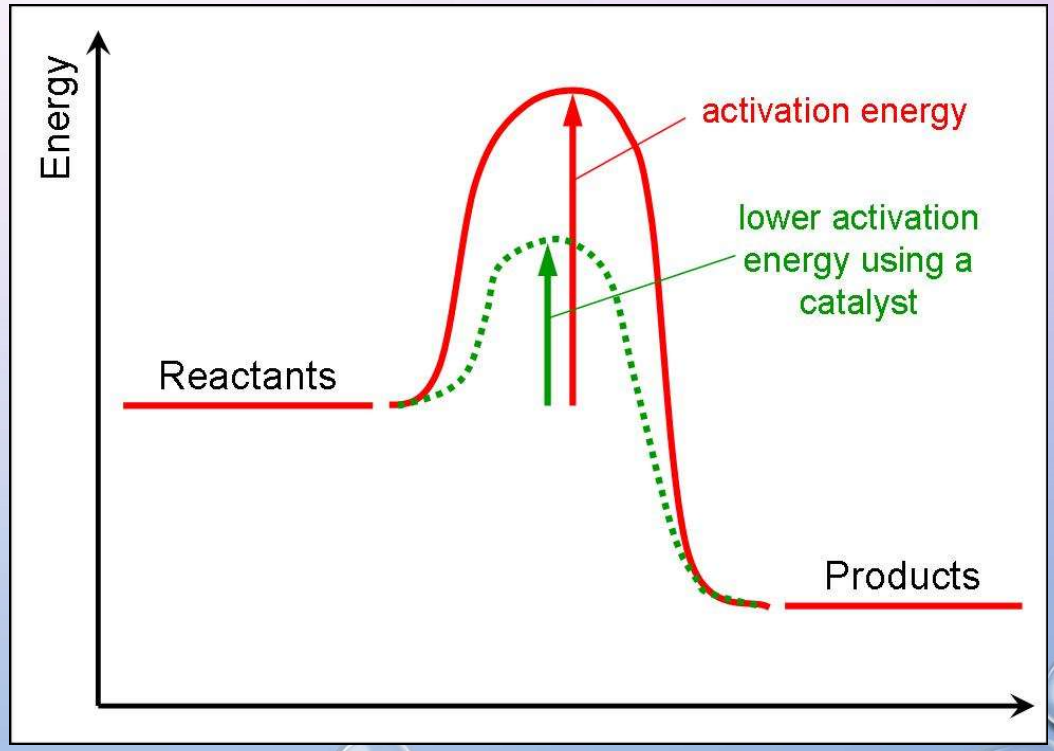
- $\Delta H = H_{PRODUCTS} - H_{REACTANTS}$

- IF ENERGY OF REACTANTS IS HIGHER THAN PRODUCTS
  - EXOTHERMIC REACTION
  - ΔH = **NEGATIVE**
- IF ENERGY OF REACTANTS IS LOWER THAN PRODUCTS
  - ENDOTHERMIC REACTION
  - ΔH = **POSITIVE**



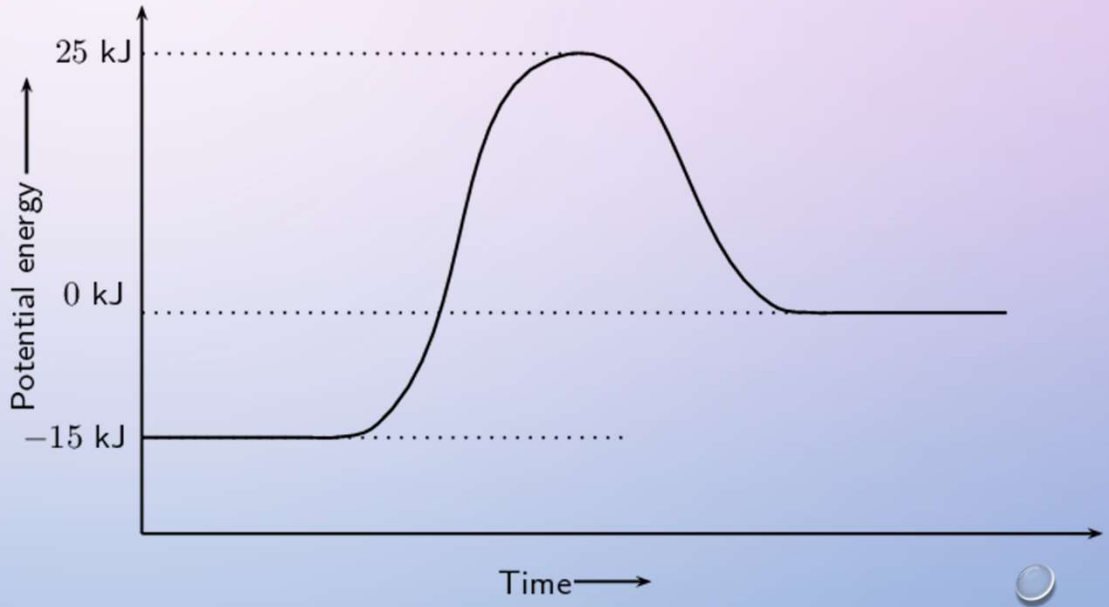
ACTIVATION ENERGY

- CATALYST – LOWERS THE ACTIVATION ENERGY OF A REACTION
  - SPEEDS UP THE REACTION BECAUSE LESS ENERGY IS NEEDED TO GET THE REACTION STARTED



ENERGY DIAGRAM

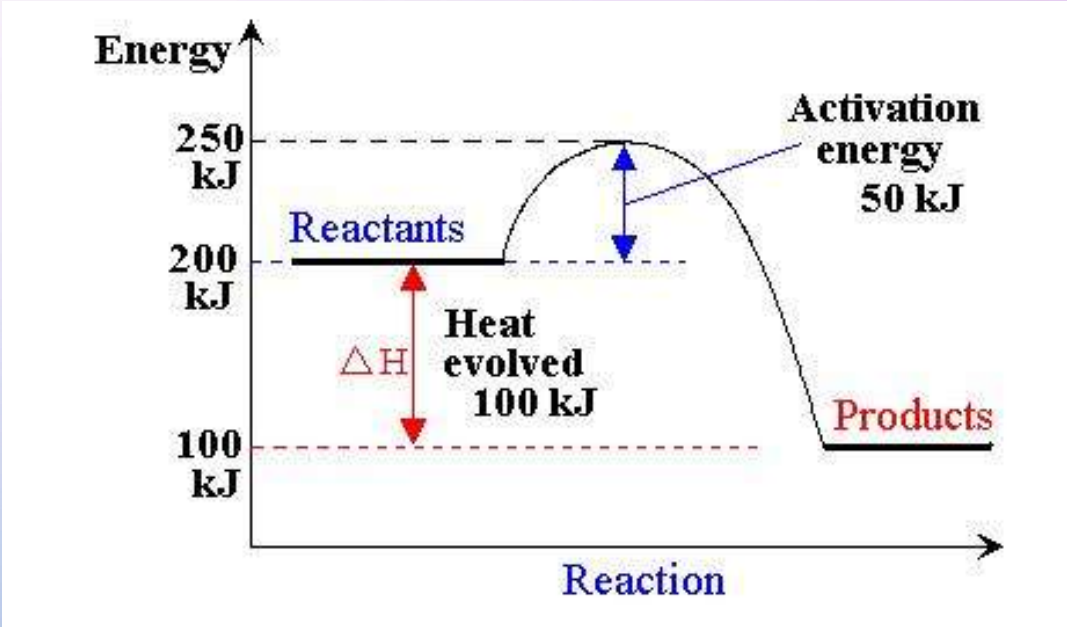
- EXOTHERMIC OR ENDOTHERMIC?
  - ENDOTHERMIC
- ACTIVATION ENERGY OF FORWARD REACTION?
  - 40KJ
- ACTIVATION ENERGY OF REVERSE REACTION?
  - 25KJ
- ΔH FORWARD REACTION?
  - 15KJ
- ΔH REVERSE REACTION?
  - -15KJ



- NOTICE THAT IN AN ENDOTHERMIC REACTION:
  - THE ACTIVATION ENERGY OF THE REVERSE REACTION IS LESS THAN THAT OF THE FORWARD REACTION
  - THE CHANGE IN INTERNAL ENERGY OF FORWARD REACTION IS GREATER THAN ZERO

ENERGY DIAGRAM

- EXOTHERMIC OR ENDOTHERMIC?
  - EXOTHERMIC
- ACTIVATION ENERGY OF FORWARD REACTION?
  - 50KJ
- ACTIVATION ENERGY OF REVERSE REACTION?
  - 150KJ
- ΔH FORWARD REACTION?
  - -100KJ
- ΔH REVERSE REACTION?
  - 100KJ



- NOTICE THAT IN AN EXOTHERMIC REACTION:
  - THE ACTIVATION ENERGY OF THE REVERSE REACTION IS GREATER THAN THAT OF THE FORWARD REACTION
  - THE CHANGE IN INTERNAL ENERGY OF THE FORWARD REACTION IS LESS THAN ZERO