

According to **collision theory**, what are the requirements of an **effective collision**?

① Reactant particles must collide with proper orientation and sufficient kinetic energy in order for a rxn to occur

①

Define **activated complex**.

② activated complex - the complex formed during the collision when old bonds are being broken and new bonds are being formed.

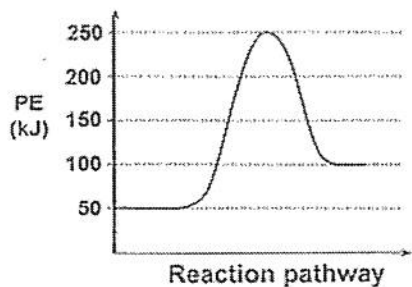
②

Define **activation energy**.

③ activation energy - the amount of energy required to form the activated complex so the reaction can begin.

③

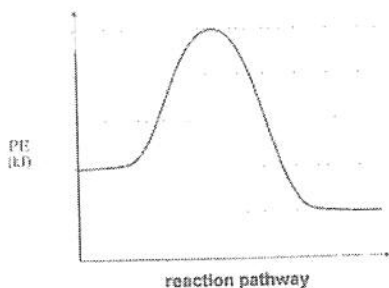
Classify the below PE diagram as endothermic or exothermic. Explain why.



④ This is an example of an endothermic PE diagram since the products have higher energy than the reactants.

④

Classify the below PE diagram as endothermic or exothermic. Explain why.



⑤ This is an example of an exothermic PE diagram b/c the products have less energy than the reactants.

⑤

Describe the effect of temperature on reaction rate. Explain why this relationship exists.

⑥ As temp \uparrow , rxn rate \uparrow b/c reactants collide more frequently, and with more kinetic energy.

⑥

Describe the effect of surface area on reaction rate. Explain why this relationship exists.

⑦ As surface area \uparrow , rxn rate \uparrow b/c there are more reactant particles exposed, so more frequent collisions.

⑦

Describe the effect of concentration on reaction rate. Explain why this relationship exists.

⑧ As concentration \uparrow , rxn rate \uparrow b/c there are more reactant particles available for effective collisions.

⑧

Describe the effect of nature of reactants on reaction rate. Explain why this relationship exists.

⑨ Dissolved (aq) ionic substances react fastest b/c they dissociate in water, so there are fewer bonds to break/rearrange.
 must be aq!

⑨

Describe the effect of pressure on reaction rate of a gas. Explain why this relationship exists.

⑩ As pressure of a gas \uparrow , rxn rate \uparrow b/c the particles are closer together, so collisions are more frequent.

⑪ Describe how a catalyst changes the rate of a chemical reaction.

⑪ A catalyst increases the rate of a reaction by providing an alternate rxn pathway w/ a lower activation energy.

⑫ Define the term "rate."

⑫ rate is change over time, or how fast something occurs.

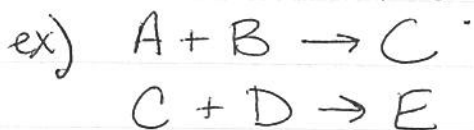
⑬ Fill in the following statement:

As reaction rate increases, the time it takes to complete a reaction _____.

decreases

What is a reaction mechanism?
Show an example.

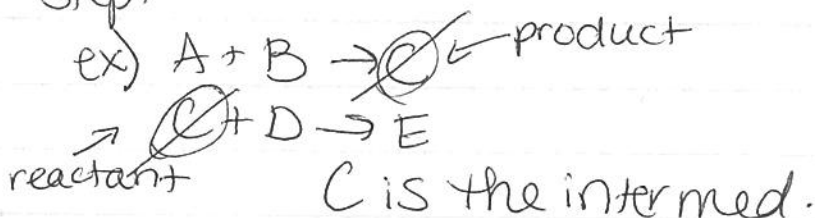
⑭ A reaction mechanism is the series of steps by which a reaction occurs.



⑭

Define "intermediate," and explain how an intermediate could be identified using a reaction mechanism.
Show an example.

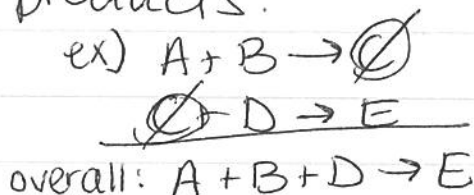
⑮ An intermediate is a substance that is produced in an earlier step of a mechanism, then used as a reactant in a later step.



⑮

How do you write the overall reaction when given the steps of a reaction mechanism?
Show an example.

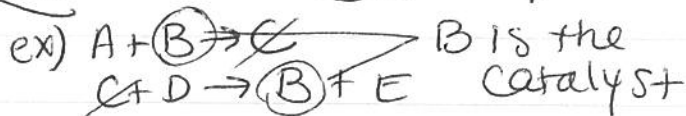
⑯ Cross out "like terms" (things that are same on reactants & products). Then combine remaining reactants & products.



⑯

How can a catalyst be identified using a reaction mechanism?
Show an example.

⑰ A catalyst is a substance that starts as a reactant in an earlier step, then is a product in a later step.



⑰

Define "rate determining step."

(18) The rate-determining step is the slowest step in a mechanism

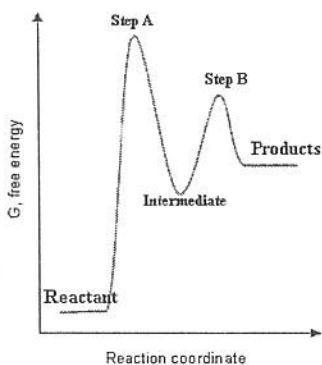
(18)

In order to increase the rate of a reaction, which step in the mechanism must be changed?

(19) The rate-determining step.

(19)

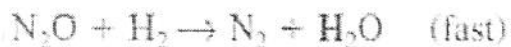
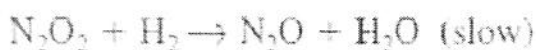
Using the PE diagram pictured, identify the rate-determining step of the reaction.



(20) Step A (has the highest activation energy)

(20)

A reaction follows the mechanism below:

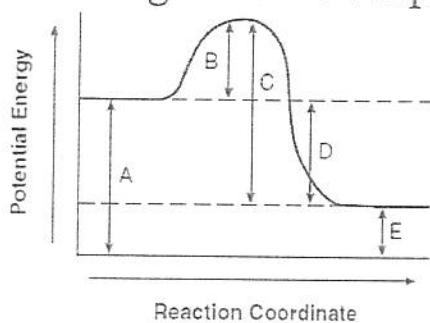


What effect would increasing the concentration of NO have on the reaction? Why?

(21) no effect, b/c NO is not in ~~the~~ the rate-determining step.

(21)

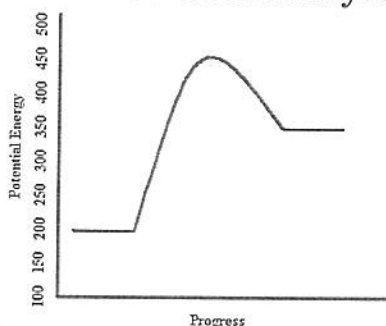
What would each lettered segment on the PE diagram below represent?



- 22 A = PE of reactants
B = activation energy of forward rxn
C = activation energy of reverse rxn
D = ΔH
E = PE of products

22

Show how the reaction pathway below would look different with the addition of a catalyst



23

23



24

$-\Delta H$

What is the sign of ΔH for an exothermic reaction?

24

25

$+\Delta H$

What is the sign of ΔH for an endothermic reaction?

25

What is the equation for internal energy?

(26) $\Delta U = q + w$

(26)

If heat is *released* by a system, what is the sign for q ?

(27) $q = -$

(27)

If heat is *absorbed* by a system, what is the sign for q ?

(28) $q = +$

(28)

If work is done *by* a system, what is the value of w ?

(29) $+ w$

(29)

If work is done *on* a system, what is the value of w ?

30) $+w$

30)

What is the equation for calculating enthalpy change (ΔH) for a reaction from heats of formations of reactants and products?

31)
$$\Delta H_{\text{rxn}} = \sum H_f^\circ \text{ products} - \sum H_f^\circ \text{ reactants}$$

*use Table A-4

31)

What is the H_f° (heat of formation) of a pure element? Why?

32) 0, b/c elements occur naturally. They don't need to be formed

32)

How do you write a *thermochemical equation* using the value of ΔH for a reaction?

33) Put the absolute value of ΔH into the reaction

- if $+\Delta H$, put on reactants side
- if $-\Delta H$, put on products side

33)

If a reaction listed on Table I was written in reverse, how would you manipulate the listed value for ΔH ?

34

34 flip the sign.

How would you manipulate ΔH for a reaction on Table I if quantities (moles) of reactant or product were changed (ex. Doubled or halved)?

35

35 double it or halve it
(whatever was done to the equation, do to value of ΔH)

Define *entropy*.

36

36 a measure of disorder/randomness of particles

List some factors that would increase the entropy of a system.

37

37

- \uparrow temp
- \uparrow # of particles
- $S \rightarrow l \rightarrow g$
less entropy most entropy
- dissolve / create a mixture.

What does a $+$ ΔS mean?
What does a $-$ ΔS mean?

38

If asked to calculate the entropy change for a system, which equation would you use?

39

38 $+\Delta S$ means disorder/entropy is increasing

$-\Delta S$ means disorder/entropy is decreasing

39
$$\Delta S_{\text{rxn}} = \sum \Delta S_{\text{products}} - \sum \Delta S_{\text{reactants}}$$

Define *spontaneous*.

40) spontaneous - occurs on its own, without external influence

41) Under which conditions of ΔH and ΔS is a reaction *always* spontaneous?

41) $-\Delta H$ and $+\Delta S$

42) What is the equation for calculating the free energy change, ΔG , of a system?

42) $\Delta G = \Delta H - (T \cdot \Delta S)$

*Note that temperature must be in K

43) What sign of ΔG indicates a spontaneous reaction?

43) $-\Delta G$ is always a spontaneous rxn

What sign of ΔG indicates a nonspontaneous reaction?

(44) $+G$ indicates a nonspontaneous reaction

(44)

Define the term *endergonic* and give the sign of ΔG that indicates an endergonic reaction.

(45) "endergonic" means that the reaction requires the addition of free energy. It is indicated by $+ \Delta G$.
(always nonspontaneous)

(45)

Define the term *exergonic* and give the sign of ΔG that indicates an exergonic reaction.

(46) "exergonic" means that the reaction releases free energy. It is indicated by $- \Delta G$.
(always spontaneous)

(46)

