When it comes to equilibrium, I can… (ANSWERS)

1. effective collision – a collision between two reactants that have the proper orientation and sufficient energy to overcome the activation energy barrier

   collision theory – substances must sustain effective collisions in order for chemical reactions to occur

2. As the temperature increases, the reaction rate for most chemical reactions increases, because there are more effective collisions between particles.

   In the reaction: $2Mg_{(S)} + O_{2(G)} \rightarrow 2MgO_{(S)}$ The temperature of 95°C is the highest temperature, and the most and the strongest collisions between particles, and will cause the higher rate of reaction.

3. As the surface area increases, the reaction rate increases because there are more effective collisions between particles. At STP, which 4.0 g sample of Zn(s) will react most quickly with dilute hydrochloric acid? When the zinc is: a powder because there will be MORE particles and therefore more collisions, and therefore a higher reaction rate.

4. As the concentration increases, the reaction rate increases because there are more effective collisions between particles. At 20°C, a reaction between powdered $Zn_{(S)}$ and $HCl_{(AQ)}$ will occur most quickly if the concentration of the $HCl_{(AQ)}$ is 2.8 M, because at this HIGHEST concentration, there will be more particles and therefore more collisions. Anything that increases the rate of collisions will increase the rate of reaction.

5. I can state the unit used to measure energy: Energy is measure in kilo-Joules/mole kJ/mole

6. Given the following chemical equation: $I + I \rightarrow I_2 + 146.3\ kJ$ This reaction is exothermic because the energy of reaction is written as a product, energy is released. The ΔH is a negative number.

7. Of these four reactions, only D is endothermic. Looking on table I, that reaction has a +ΔH, the others all have -ΔH (which makes them exothermic)

8. potential energy diagram – a graph showing the changes in potential energy over the course of a chemical reaction.

reaction coordinate – shown on the X-axis of a PE diagram, it indicates the reaction pathway or TIME.

PE reactants – potential energy of the reactants (the starting PE) in kJ/mole

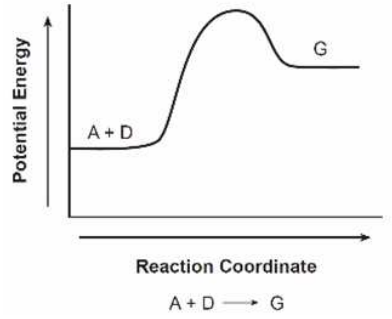
PE products – potential energy of the products (the ending PE) in kJ/mole

Heat of reaction (ΔH) – potential energy of the products minus the potential energy of the reactants

Activation Energy (AE) – the amount of energy that must be added to the reactants to overcome the energy barrier so the reaction will happen

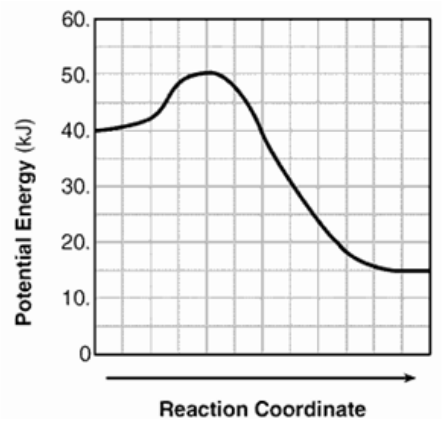
Catalyst – a substance that speeds up the rate of a chemical reaction by lowering the AE, or by creating an alternate pathway. Both will require less energy, letting reaction to occur faster, without changing the outcome of the reaction, or the products, in anyway. Only the reaction rate increases.

Entropy – a measure of the system's disorder

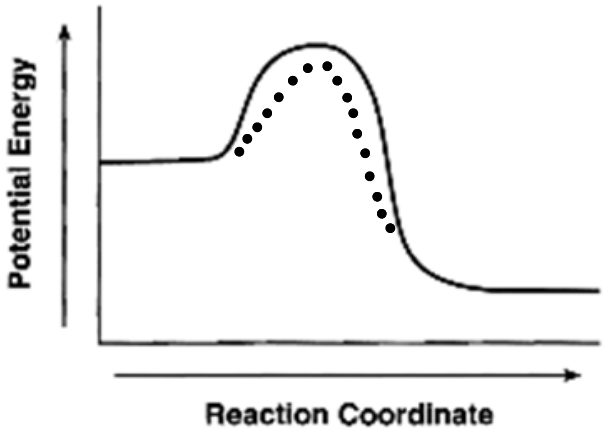


9. This PE diagram at right is ENDOTHERMIC. It is because the PE of the products is greater than the PE of the reactants. This makes ΔH positive.

10. ▪ PE of the reactants is 40 kJ/mole
    ▪ PE of the products is 15 kJ/mole
    ▪ ΔH is 25 kJ/mole (the difference in PE from start → end
    ▪ Activation energy (AE) is 10 kJ/mole, the energy required to get from the starting point to the top of the curve



11. Catalyst affect is shown by the DOTS in the diagram below.



The catalyst changes the path, or lowers the AE, but does not change anything else, including the ΔH of the reaction. The reactants and products are STILL the reactants and products, they have PE that is unchanged.

12. I can rank the three phases of matter from least entropy to most entropy.
    Least entropy solids < liquids < gases Most entropy

14. In nature most systems in nature tend to undergo reactions that have a <u>increase</u> in entropy and a <u>decrease</u> in energy.

15A . Which reaction results in an decrease in entropy? B. $H_2O_{(L)} \rightarrow H_2O_{(S)}$

15B. Which equation shows an increase in entropy? B. $CO_{2(L)} \rightarrow CO_{2(G)}$

16. <u>forward reaction</u> – the chemical reaction read from left to right

    <u>reverse reaction</u> – the chemical reaction read from right to left

    <u>reversible reaction</u> – a chemical reaction that can proceed from both left to right and right to left

    <u>closed system</u> – a system in which reactants and products are trapped and may not enter or leave

17. I can state 2 conditions that apply to all systems at equilibrium. In a system at dynamic equilibrium the <u>rate of the forward reaction is equal to the rate of the reverse reaction.</u> And, the <u>mass</u> of the reactants and the <u>mass</u> of the products will remain <u>constant</u>.

18. In terms of saturation, a solution that is at equilibrium must be saturated. The solution is holding as much solute as it can (at that temperature) but more is always dissolving into solution at the same rate as it is precipitating out of solution.

19. LeChatleier's Principle is: A system at equilibrium tends to stay at equilibrium; and, whenever a chemical stress is added to this equilibrium, the system shifts to form a new dynamic equilibrium.

20. $2SO_{2(G)} + O_{2(G)} <-----> 2SO_{3(G)} + 392kJ$

Change	**Direction of Shift**
Increase concentration of SO_2	Shift forward
Increase concentration of SO_3	Shift reverse
Increase temperature	Shift reverse
Increase pressure	Shift forward
Add a catalyst	There is no change in dynamic equilibrium, the system just gets to equilibrium faster

5. I can state the unit used to measure energy. Energy is measure in _____

6. Based on the location of the energy term in a balanced thermochemical equation, I can determine if the reaction is exothermic or endothermic.
   Given the following chemical equation: $I + I \rightarrow I_2 + 146.3\ kJ$

   This reaction is exothermic or endothermic? Justify your answer.

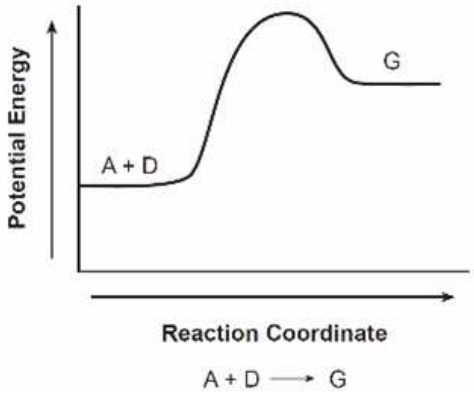
7. I can use Table I to determine if a reaction is exothermic or endothermic.
   (the boxed question is from an old regents exam)

Which balanced equation represents an endothermic reaction?

A) $C(s) + O_2(g) \rightarrow CO_2(g)$
B) $CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(\ell)$
C) $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$
D) $N_2(g) + O_2(g) \rightarrow 2NO(g)$

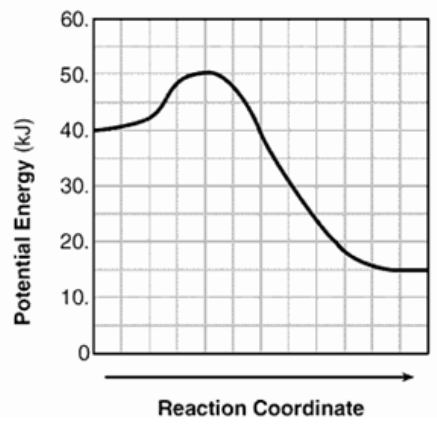
8. I can define potential energy diagram, reaction coordinate, PE reactants, PE products, heat of reaction (ΔH), activation energy (AE), catalyst affect, and entropy.

9. Given a potential energy diagram, I can determine if the reaction is exothermic or endothermic.



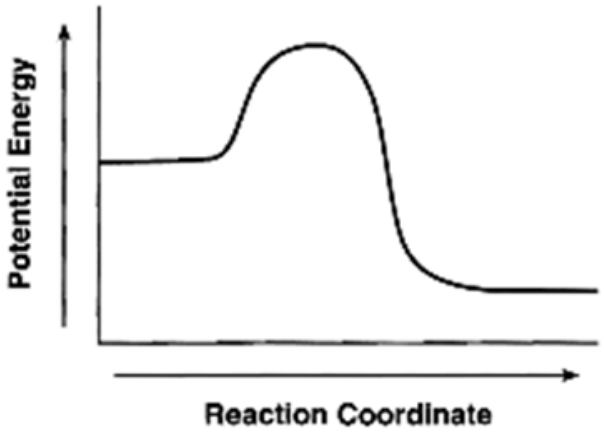
10. Given a potential energy diagram, I can determine the
    PE of the reactants
    PE of the products
    ΔH
    Activation energy (AE)

    All with proper units.



11. Given a potential energy diagram for an uncatalyzed reaction diagram, I can how the diagram will change when a catalyst is been added.

Draw a dotted line on this potential energy diagram indicating how it will change if a catalyst is added.



12. I can rank the three phases of matter from least entropy to most entropy.

Least entropy Most entropy

_____ < _____ < _____

13. skip this one, of course!

14. I can state the trends in nature for entropy and energy. In nature most systems in nature tend to undergo reactions that have an increase/a decrease (circle one) in entropy, and an increase/a decrease (circle one) in energy.