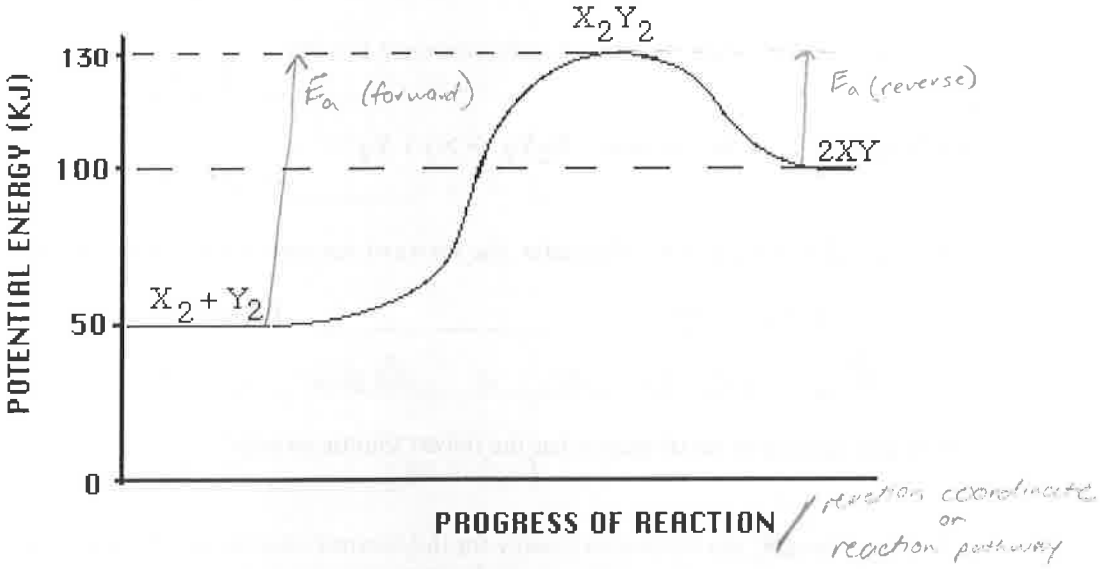
Key

Chemistry 12
Worksheet 1-2 - Potential Energy Diagrams

USE THE **POTENTIAL ENERGY DIAGRAM** TO ANSWER THE QUESTIONS BELOW:



1. Is the overall reaction as shown **exothermic** or **endothermic**? endothermic
2. What is the **activation energy** for the forward reaction? + 80 KJ
3. What is the **activation energy** for the reverse reaction? + 30 KJ
4. What is the **enthalpy change of reaction** (ΔH) for the *forward* reaction? +50
5. What is the Δ **H** for the *reverse* reaction? -50
6. Is the *reverse* reaction **exothermic** or **endothermic**? exothermic
7. Which species forms the ***activated complex***? X_2Y_2
8. Which species or set of species has the *highest* **potential energy**? X_2Y_2

9. Which species or set of species has the *highest* **kinetic energy**? (lowest PE) $X_2 + Y_2$

10. Which species or set of species has the ***weakest*** **bonds**? (highest PE) X_2Y_2

11. Which species or set of species has the ***strongest*** **bonds**? (lowest PE) $X_2 + Y_2$

12. What is ΔH for the reaction: $X_2Y_2 \rightarrow X_2 + Y_2$? -80 kJ

13. Which do you think would be *faster*, the **forward** reaction or the **reverse** reaction?

reverse Explain. smaller E_a leads to a faster reaction

14. Which species or set of species has the ***lowest*** **kinetic energy**? (highest PE) X_2Y_2

15. Show the ~~ΔH~~ E_a, the Activation Energy for the *forward* reaction and the Activation Energy for the *reverse* reaction on the graph above.

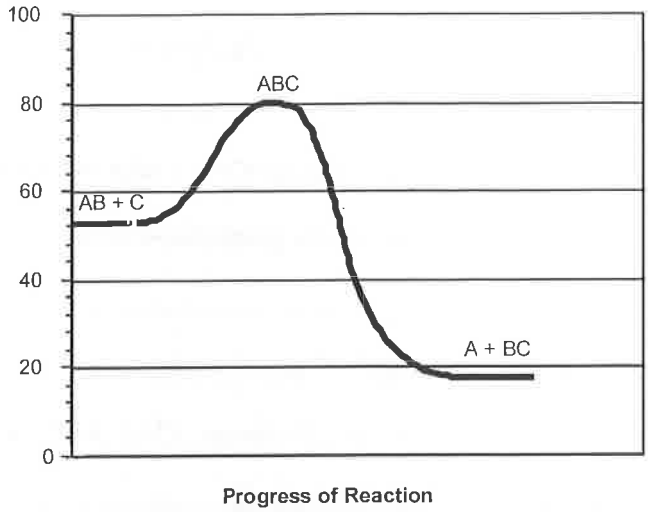
16. As reactant particles approach each other before a collision, the ***Potential*** Energy goes up, while the ***Kinetic*** Energy goes down.

17. As particles of newly formed products move away from one another, the ***Potential*** Energy goes down, while the ***Kinetic*** Energy goes up

18. As *reactant* molecules approach each other, they exert repulsive forces on each other. Thus, as they move together, their speed decreases and their *Potential Energy* increases

19. State the meaning of ***Activated Complex***. - arrangement (temporary) of atoms at the top of the potential energy "hill" or barrier - transition state between reactants and products

20. Use the following ***Potential Energy Diagram*** to answer the questions below:



a) Determine the ***Activation Energy*** for the *forward* reaction... 80 - 52 + 28 kJ

b) Determine the ***Activation Energy*** for the *reverse* reaction.... 80 - 16 + 64 kJ

c) What is the ***Enthalpy Change*** (ΔH) for the *forward* reaction?.. 16 - 52 - 36 kJ

d) What is the ***Enthalpy Change*** (ΔH) for the *reverse* reaction?.. 52 - 16 + 36 kJ

e) The *forward* reaction is EXO thermic.

f) The *reverse* reaction is endo thermic.

g) Which species or set of species forms the ***Activated Complex***? ABC

h) Which bond is *stronger*, A--B or B--C? B-C. Give a reason for your answer. lower PE (more stable); It take more energy (64 kJ) to break B-C than to break A-B (28 kJ)

i) Particles from which species or set of species is moving the *fastest*? A + BC

State how you arrived at your answer. lowest PE = highest KE

j) Particles from which species or set of species is moving *most slowly*? ABC

State how you arrived at your answer. highest PE = lowest KE

k) The compound "AB" is a gas and the element "C" is a solid. What effect would grinding "C" into a fine powder have on the graph shown here? none

21. State the meaning of ***Activation Energy***. minimum KE reactant molecules must posses in order to form the activated complex (have a successful collision)

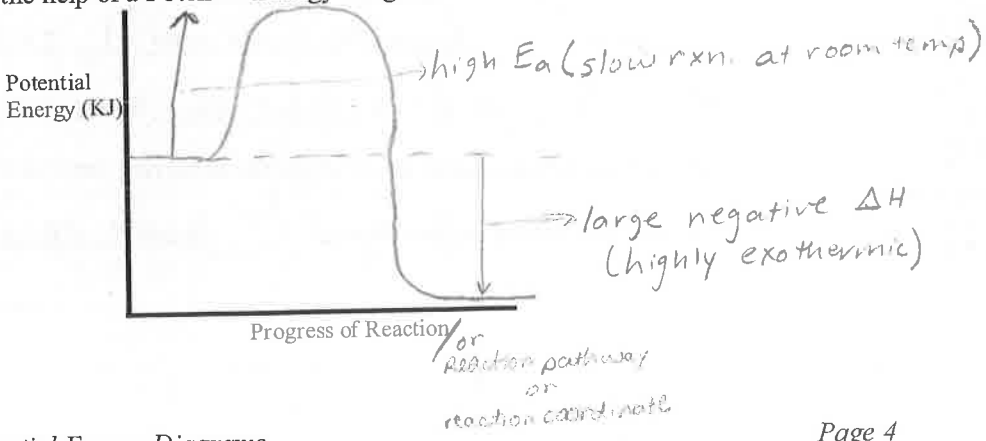
~~the~~ energy required to form the transition state in a chemical reaction

22. What two requirements must be met before a collision between two reactant particles is ***effective***?
    1. sufficient energy ($\geq E_a$) to form activated complex
    2. favorable collision geometry (alignment)

23. Describe what happens to two reactant particles which collide with *less* energy than the ***Activation Energy***.

bounce off each other unchanged

24. Burning coal (Carbon) is a highly *exothermic* reaction. However coal, in contact with air at room temperature has such a *slow* reaction that it is not noticeable. Explain these two facts with the help of a Potential Energy Diagram.



Name Key Date _____ Period _____

Energy Ws #1: Reaction Rates

1. Chemical reactions occur when reactants collide. For what reasons may a collision fail to produce a chemical reaction?
   1) not traveling fast enough (not enough KE)
   2) not positioned correctly (wrong alignment)

2. If every collision between reactants lead to a reaction, what determines the rate at which the reaction occurs?
   activation energy
   (or energy need to form intermediates in the reaction)

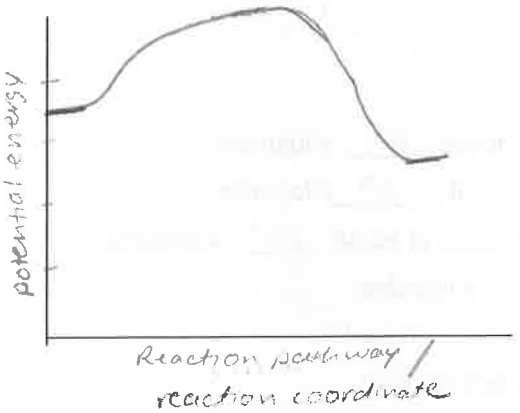
3. What is the activation energy of a reaction, and how is this energy related to the activated complex of the reaction?
   E_a is the highest energy needed for reactants to be converted to products. The temporary atom arrangement when the highest energy is reached is the activated complex.

4. What happens when a catalyst is used in a reaction?
   lowers the activation energy

5. Name 4 things that will speed up or slow down a chemical reaction.
   1) increased surface area
   2) higher temp
   3) higher concentration
   4) use of catalyst

   1) decreased surface area (big chunks)
   2) lower temps
   3) lower concentration
   4) lack of catalyst

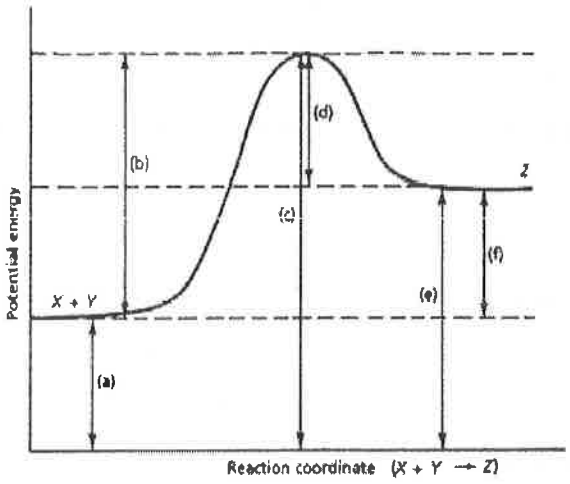
6. Draw an energy diagram for a reaction. (label the axis)
   Potential energy of reactants = 350 KJ/mole
   Activation energy = 100 KJ/mole
   Potential energy of products = 250 KJ/mole



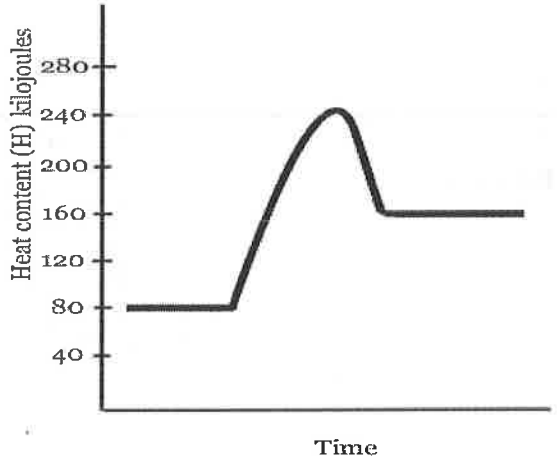
7. Is the reaction in # 6 exothermic or endothermic? Explain.
   exothermic -- products have lower energy than reactants, energy is released

8. How could you lower the activation energy for the reaction in #6?
   add a catalyst

Potential Energy Diagram Worksheet



1. Which of the letters a–f in the diagram represents the potential energy of the products? e
2. Which letter indicates the potential energy of the activated complex? c
3. Which letter indicates the potential energy of the reactants? a
4. Which letter indicates the activation energy? b
5. Which letter indicates the heat of reaction? f
6. Is the reaction exothermic or endothermic? endo
7. Which letter indicates the activation energy of the reverse reaction? d
8. Which letter indicates the heat of reaction of the reverse reaction? f
9. Is the reverse reaction exothermic or endothermic? exo



1. The heat content of the reactants of the forward reaction is about 80 kilojoules.
2. The heat content of the products of the forward reaction is about 160 kilojoules.
3. The heat content of the activated complex of the forward reaction is about 240 kilojoules.
4. The activation energy of the forward reaction is about 160 kilojoules.
5. The heat of reaction (ΔH) of the forward reaction is about +80 kilojoules.
6. The forward reaction is endothermic (endothermic or exothermic).
7. The heat content of the reactants of the reverse reaction is about 160 kilojoules.
8. The heat content of the products of the reverse reaction is about 80 kilojoules.
9. The heat content of the activated complex of the reverse reaction is about 240. kilojoules.
10. The activation energy of the reverse reaction is about 80 kilojoules.
11. The heat of reaction (ΔH) of the reverse reaction is about −80 kilojoules.
12. The reverse reaction is exothermic (endothermic or exothermic).