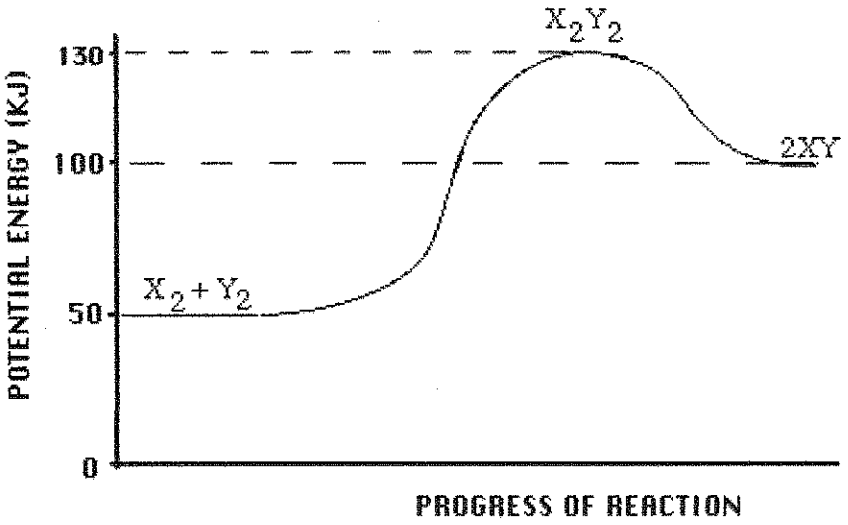
Chemistry 12
Worksheet 1-2 - Potential Energy Diagrams

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



1. Is the overall reaction as shown **exothermic** or **endothermic**?

2. What is the **activation energy** for the forward reaction?

3. What is the **activation energy** for the reverse reaction?

4. What is the **enthalpy change of reaction** (H) for the *forward* reaction?

5. What is the **H** for the *reverse* reaction?

6. Is the ***reverse*** reaction **exothermic** or **endothermic**?

7. Which species forms the ***activated complex***?

8. Which species or set of species has the *highest* **potential energy**?

9. Which species or set of species has the *highest* **kinetic energy**?

10. Which species or set of species has the ***weakest*** **bonds**?

11. Which species or set of species has the ***strongest*** **bonds**?

12. What is **H** for the reaction: $\mathbf{X_2Y_2 \rightarrow X_2 + Y_2}$?

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

_____ Explain. _____

_____

14. Which species or set of species has the ***lowest*** **kinetic energy**?

15. Show the **ΔH**, 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 ___, while the ***Kinetic*** Energy goes _____.

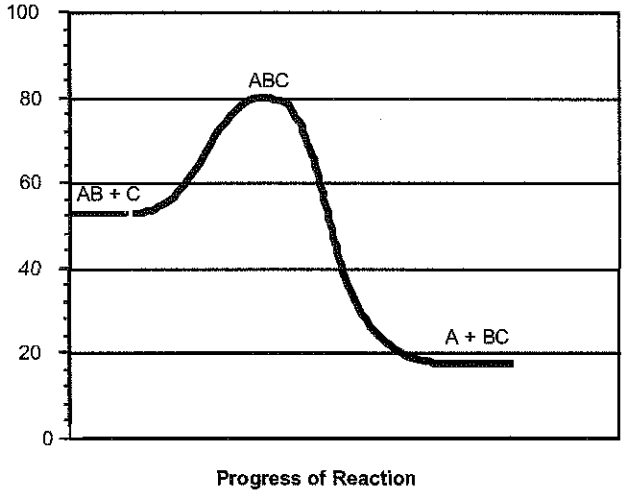
17. As particles of newly formed products move away from one another, the ***Potential*** Energy goes _____, while the ***Kinetic*** Energy goes _____

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

19. State the meaning of ***Activated Complex***. _____

_____

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



a) Determine the ***Activation Energy*** for the *forward* reaction... _____kJ

b) Determine the ***Activation Energy*** for the *reverse* reaction.... _____kJ

c) What is the ***Enthalpy Change*** (ΔH) for the *forward* reaction?.. _____kJ

d) What is the ***Enthalpy Change*** (ΔH) for the *reverse* reaction?.. _____kJ

e) The *forward* reaction is _____thermic.

f) The *reverse* reaction is _____thermic.

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

h) Which bond is *stronger*, A--B or B--C?_____. Give a reason for your answer. _____

_____

i) Particles from which species or set of species is moving the *fastest*? _____

State how you arrived at your answer. _____

_____

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

State how you arrived at your answer. _____

_____

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? _____

_____

21. State the meaning of ***Activation Energy***. _____

_____

_____

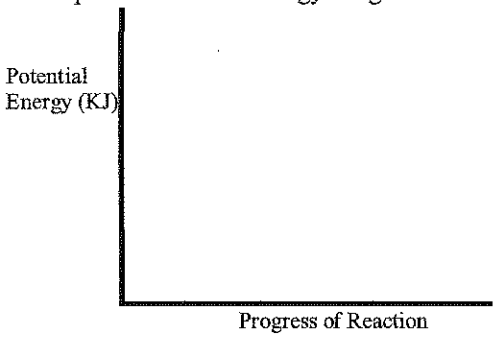
22. What two requirements must be met before a collision between two reactant particles is ***effective***?
1. _____
2. _____

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

_____

_____

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.



Key

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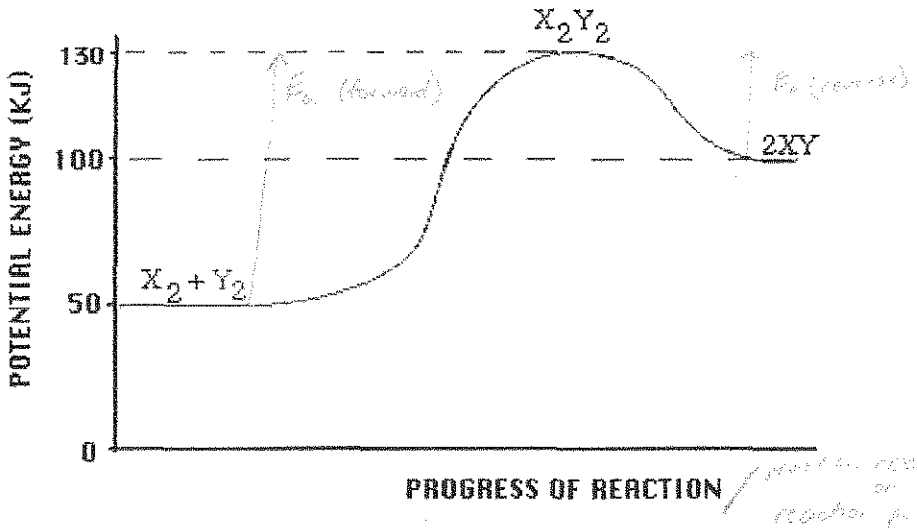
USE THE POTENTIAL ENERGY DIAGRAM TO ANSWER THE QUESTIONS BELOW:



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

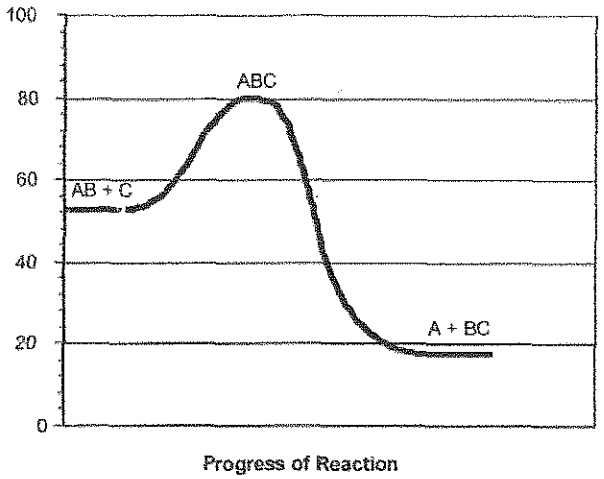
16. As reactant particles approach each other before a collision, the ***Potential*** Energy goes up, while the ***Kinetic*** Energy goes down.

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***. - (temporary) arrangement 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 takes 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 possess in order to form the activated complex (have a successful collision)

the energy required to form a 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.