GIBBS FREE ENERGY

Name _____

For a reaction to be spontaneous, the sign of ΔG (Gibbs Free Energy) must be negative. The mathematical formula for this value is:

$$\Delta G = \Delta H - T\Delta S$$

where ΔH = change in enthalpy or heat of reaction
T = temperature in Kelvin
ΔS = change in entropy or randomness

Complete the table for the sign of ΔG; +, – or undetermined. When conditions allow for an undetermined sign of ΔG, temperature will decide spontaneity.

ΔH	ΔS	ΔG
–	+	
+	–	
–	–	
+	+	

Answer the questions below.

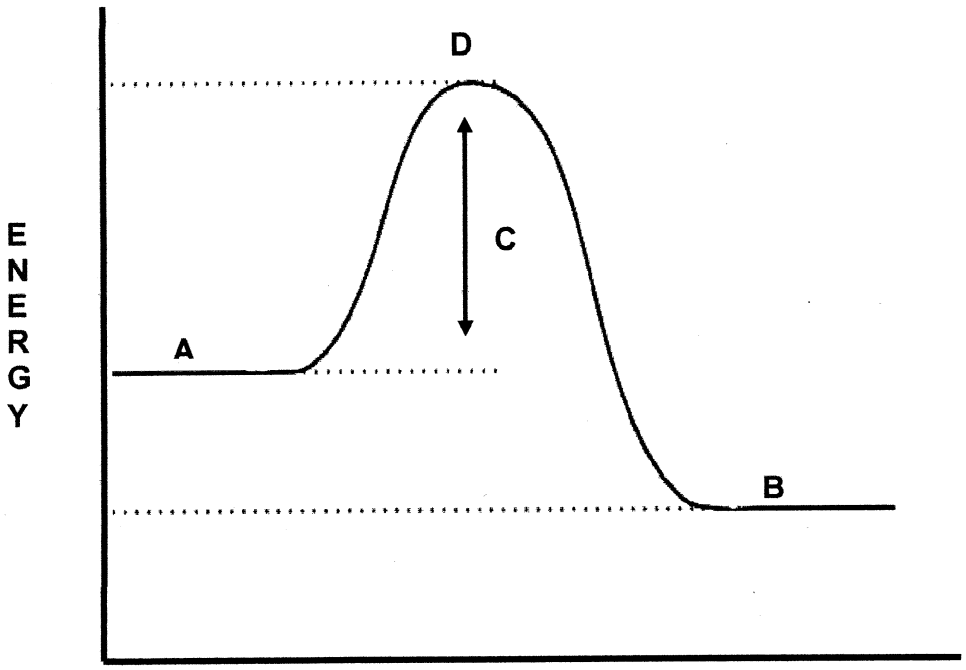
1. The conditions in which ΔG is always negative is when ΔH is _____ and ΔS is _____.
2. The conditions in which ΔG is always positive is when ΔH is _____ and ΔS is _____.
3. When the situation is indeterminate, a low temperature favors the (entropy / enthalpy) factor, and a high temperature favors the (entropy / enthalpy) factor.

Answer Problems 4-6 with always, sometimes or never.

4. The reaction: $Na(OH)_s \rightarrow Na+(aq) + OH^-(aq)$ + energy will _____ be spontaneous.
5. The reaction: energy + $2H_2(g) + O_2(g) \rightarrow 2H_2O$ (l) will _____ be spontaneous.
6. The reaction: energy + $H_2O(s) \rightarrow H_2O(l)$ will _____ be spontaneous.
7. What is the value of ΔG if ΔH = -32.0 kJ, ΔS = +25.0 kJ/K and T = 293 K? _____
8. Is the reaction in Problem 7 spontaneous? _____
9. What is the value of ΔG if ΔH = +12.0 kJ, ΔS = -5.00 kJ/K and T = 290. K? _____
10. Is the reaction in Problem 9 spontaneous? _____

Potential Energy Diagram

Use the graph below to answer the questions at the bottom.



1. Does this graph show an exothermic or endothermic reaction? How do you know?

2. Label the following letters:
   A. _____
   B. _____
   C. _____
   D. _____

3. If a catalyst was added, what letter on the graph would change? How would it change?

4. How does this apply to the collision theory?