Gibb's Free Energy Worksheet

1. **Identify each of the variables in Gibb's Free Energy equation. What does each stand for?**

   ΔG = Gibbs - spontaneous/nonspontaneous
   ΔH = enthalpy - exo/endothermic
   ΔS = entropy - disorder

2. **How do you know if a reaction is exothermic or endothermic?**

Exo	Endo
$\Delta H = -$	$\Delta H = +$
Heat is product	Heat is reactant

3. **Is the following reaction exothermic or endothermic? How do you know?**
   $2Na + Cl_2 + 546\ J \rightarrow 2NaCl$

   Endothermic; heat is listed as a reactant

4. **Use the data below to determine if the following reactions are spontaneous/nonspontaneous, endothermic/exothermic, increase/decrease in entropy.**

   a. **$\Delta H = -11230$ J**
      $\Delta S = 345$ J/K
      $T = 313$ K

   $\Delta G = (-11230) - (345)(313)$
   $= -107985$ J

   ① Spontaneous ($\Delta G = -$)
   ② Exothermic ($\Delta H = -$)
   ③ ↑ in entropy ($\Delta S = +$)

   b. **$\Delta H = 5000$ J**
      $\Delta S = 192$ J/K
      $T = 298$ K

   $\Delta G = 5000 - (192)(298)$
   $= -52216$ J

   ① spontaneous ($\Delta G = -$)
   ② Endothermic ($\Delta H = +$)
   ③ ↑ in entropy ($\Delta S = +$)

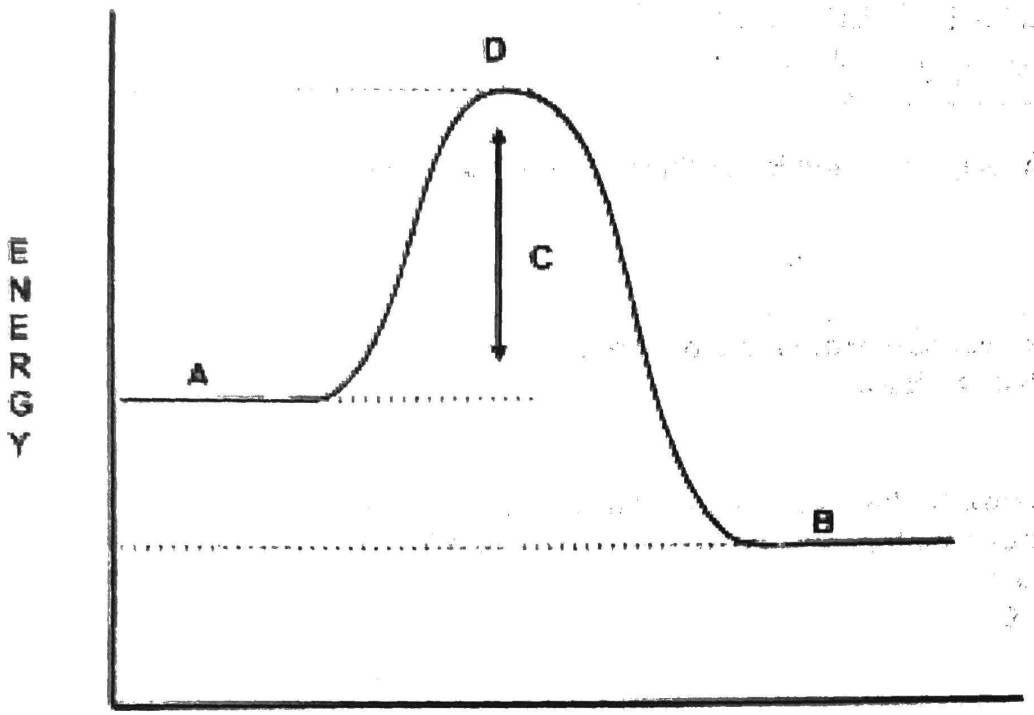
   c. **$\Delta H = 19400$ J**
      $\Delta S = -145$ J/K
      $T = 225$ K

   $\Delta G = 19400 - (-145)(225)$
   $= 52025$ J

   ① nonspontaneous ($\Delta G = +$)
   ② Endothermic ($\Delta H = +$)
   ③ ↓ in entropy ($\Delta S = -$)

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?

   Exo – products lower than reactants

2. Label the following letters:
   A. Reactants
   B. Products
   C. Activation Energy
   D. Activated Complex / Transition State

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

4. How does this apply to the collision theory?

   Reactants (A) collide and when they collide in the correct orientation they make an activated complex (D). If there is enough energy when they collide (C) they will form products (B).