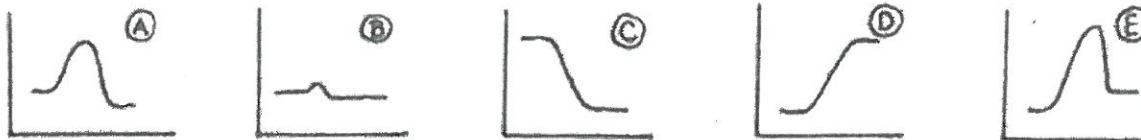


### Homework #3 – Enthalpy Diagrams and Reaction Rates

Questions 1-4 refer to the enthalpy diagrams shown. In each instance, choose the diagram which best fits the described process.



1. The dilution of sulfuric acid by water is spontaneous, rapid reaction that is accompanied by the evolution of large amounts of heat. **A**

2. Ammonia,  $\text{NH}_3$  may be made by the combination of nitrogen and hydrogen according to the following equation:



**E**

The use of catalysts, temperature of  $500^\circ\text{C}$  and pressure of 250 atm are necessary to get a yield of about 30% ammonia.

3. Carbon (graphite) may be converted to carbon (diamond) under extremely high temperature and high pressure.  $\Delta H = 37.5 \text{ cal/g}$ . **D OR E**

4. Ammonium chloride dissolves readily and spontaneously in water. When this process occurs, the reaction vessel becomes cold. **E**

Match the statements with the correct term(s).

- |   |                      |
|---|----------------------|
| 5. The minimum energy necessary to start a chemical reaction <b>A</b>   | A. Activation energy |
| 6. A substance added to a chemical reaction to alter the reaction rate but is not consumed in the over all reaction. <b>C</b> | B. Activated complex |
| 7. A biological catalyst <b>H</b>   | C. Catalyst          |
| 8. A system that releases heat <b>J</b>   | D. Combustion        |
| 9. Process of liquid changing to a gas <b>I</b>   | E. Condensation      |
| 10. Process of solid changing to a gas <b>M</b>   | F. Endothermic       |
| 11. The total energy contained within a molecule <b>G</b>   | G. Enthalpy          |
| 12. A system that absorbs heat <b>F</b>   | H. Enzyme            |
| 13. An intermediate molecule which forms before the final product and only lasts for a short period of time <b>B</b>          | I. Evaporation       |
|   | J. Exothermic        |
|   | K. Initiation step   |
|   | L. Melting           |
|   | M. Sublimation       |

14. What is the latent heat of fusion for water?

$$334 \frac{\text{J}}{\text{g}}$$

15. What is the latent heat of vaporization for water?

$$2230 \frac{\text{J}}{\text{g}}$$

16. When a substance melts, the temperature remains constant, even though you are adding heat to it. Where does the heat go?  
 THE HEAT GOES INTO CHANGING THE SOLID TO A LIQUID (i.e. THE HEAT MAKES THE SOLID PARTICLES MOVE FASTER, BECOMING A LIQUID)
17. Define exothermic and endothermic.  
 EXOTHERMIC = HEAT RELEASING  
 ENDOTHERMIC = HEAT ABSORBING
18. For each of the following processes, state whether they are endothermic or exothermic.
- Wood burning in a fire place **EXO**
  - Solidification of wax **EXO**
  - $\text{H}_2\text{O}(l) + 9.7 \text{ kcal} \rightarrow \text{H}_2\text{O}(g)$  **ENDO**
  - A piece of iron changing temperature from  $80^\circ\text{C}$  to  $20^\circ\text{C}$  **EXO?**
  - Water vapor condensing in the atmosphere (rain) **EXO**
  - Burning gasoline in your car **EXO**
  - $\text{H}_2\text{O}(l) \rightarrow \text{H}_2\text{O}(s) + 1.44 \text{ kcal}$  **EXO**

Draw the enthalpy diagrams for the following processes.

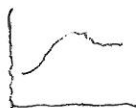
19. Ice melts absorbing 1.44 kcal/mol of heat.



20. Ethanol burns and produces 330 kcal/mol.



21. Water vaporizes absorbing 9.7 kcal/mol.



22. A 20-gram block of copper is heated from  $10^\circ\text{C}$  to  $75^\circ\text{C}$ . (hint: first calculate the heat necessary for this process...see HW 5-1)

$$Q = m c \Delta T = (20g) \times (0.385 \text{ J/g}^\circ\text{C}) \times (65^\circ\text{C}) = 500.5 \text{ J}$$



Extra Credit: 15 grams of ethanol at  $25^\circ\text{C}$  is heated to its boiling point ( $78.3^\circ\text{C}$ ) and then vaporized ( $H_v = 204.3 \text{ cal/g}$ ). Draw the enthalpy diagram for this process.