Key

Chemistry Pretest
Chapters 10 & 11

1. What mass of water could be heated from 18.0 °C to 87.6 °C by 36.5 kJ of energy? $q = mC\Delta T$ $\quad m = \frac{q}{C\Delta T}$

$$m = \frac{36.5\text{ kJ}}{(4.18\text{ kJ/kg K})(59.4\text{ K})} = 0.147\text{ kg} = \boxed{147\text{ g } H_2O}$$

2. Use the following information to find the amount of energy released when 20.0 grams of element X is cooled from 196 °C to 87.6 °C.

Boiling point = 160 °C	Melting point = 85.0 °C	H_{vap} = 1160 J/g
H_{fus} = 300 J/g	C_{solid} = 1.7 J/g °C	C_{liquid} = 4.6 J/g °C
C_{gas} = 1.2 J/g °C		

$q = mC\Delta T$
$q = m\Delta H_{vap}$

196 °C − 160 °C = gas cooling — q_1 $\Delta T = -36$
160 °C − 87.6 °C = liquid cooling — q_2 $\Delta T = -72.4$
20 g condensing. — q_3 ΔT = no temp

$q_1 = (20.0\text{ g})(1.2\text{ J/g°C})(-36\text{°C}) = -864\text{ J}$
$q_2 = (20.0\text{ g})(4.6\text{ J/g°C})(-72.4\text{°C}) = -6660.8\text{ J}$
$q_3 = (20.0\text{ g})(-1160\text{ J/g}) = -23{,}200\text{ J}$

Total $q = -30724.8\text{ J}$ $= \boxed{-30.7\text{ kJ}}$

3. 10.0 grams of a liquid at its boiling point absorbed 375 kJ of energy which vaporized some of the gas. If the mass of the liquid remaining after the energy was absorbed is 5.70 grams, calculate the heat of vaporization of the liquid.

$q = m\Delta H_{vap} \Rightarrow \Delta H_{vap} = \frac{q}{m}$ $\quad M_{vaporized} = 10 - 5.7 = 4.3\text{ g}$

$$\Delta H_{vap} = \frac{375\text{ kJ}}{4.3\text{ g}} = \boxed{87.2\text{ kJ/g} = \Delta H_{vap}}$$

challenge

4. A 27.2 gram sample of Millerium (named after some fabulous chemistry teacher) is placed in a 200.0 mL sample of water. The water temperature is changed from 12.0 °C to 25.0 °C. If the heat capacity of Mi is 0.588 Cal/g °C, what was the original temperature of the Mi?

$q_{Mi} = -q_{H_2O}$ $\quad (M_{Mi})(C_{Mi})(\Delta T_{Mi}) = -(M_{H_2O})(C_{H_2O})(\Delta T_{H_2O})$

$\Delta T_{Mi} = \frac{-(M_{H_2O})(C_{H_2O})(\Delta T_{H_2O})}{(M_{Mi})(C_{Mi})}$

$0.588\text{ Cal/g°C}\left(\frac{4.18\text{ J}}{1\text{ Cal}}\right) = 2.46\text{ J/g°C}$

$\Delta T_{Mi} = \frac{-(200\text{ g})(4.18\text{ J/gK})(13\text{ K})}{(27.2\text{ g})(2.46\text{ J/gK})} = -162.42\text{ K}$

$\Delta T = T_f - T_i \quad T_i = T_f - \Delta T \quad T_i = 25 - (-162.42) = \boxed{187.4\text{ °C}}$

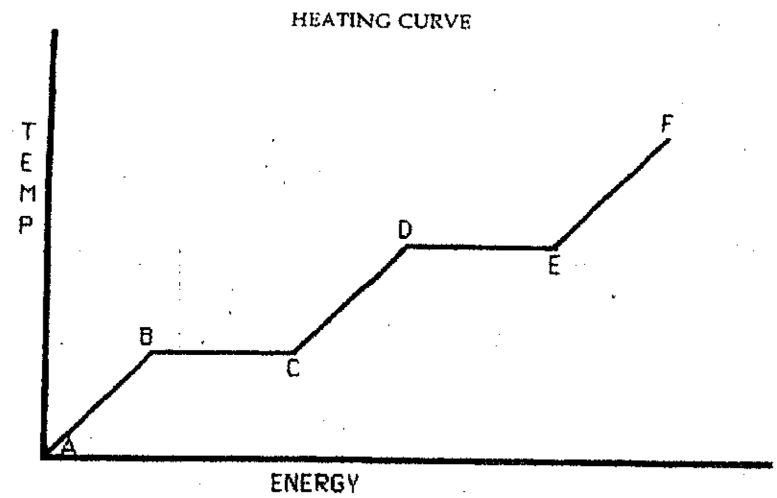
5. How much heat energy is required to convert 25.0 grams of water at 60.0 °C to a gas at 100 °C? ΔH_v = 2300 J/g $\quad \Delta H_f$ = 340 J/g
C_{solid} = 2.04 J/g°C $\quad C_{liquid}$ = 4.18 J/g°C $\quad C_{gas}$ = 2.00 J/g°C

60.0 °C − 100 °C = heating liquid $\quad q_1 = mC_l\Delta T$
liquid − gas = vaporizing $\quad q_2 = m\Delta H_{vap}$

$q_1 = (25\text{ g})(4.18\text{ J/gK})(40\text{ K}) = 4{,}180\text{ J} = \boxed{4.18\text{ kJ}}$ $\quad q_2 = (25\text{ g})(2300\text{ J/g}) = 57500\text{ J}$ ~~5.75 kJ~~ $\boxed{57.5\text{ kJ}}$

$\boxed{q_{total} = 9.93\text{ kJ}}$

Key



Answer the following questions using the heating curve provided. There may be more than one answer per question!

10. Between what two points would you find both a liquid and a gas? D - E

11. What section or sections would you find a phase change taking place? B-C, D-E

12. Between what two points would you find translational motion? E-F

13. At what point would you find a liquid at its freezing point? C

14. Water boils at 100 °C at normal atmospheric pressure which is about 101.3 kPa at sea level. What would you expect boiling temperature of water to be in Denver, Colorado, a city with an elevation of 5280 ft? What about in Death Valley, CA which is located well below sea level?

Co - less pressure   Death Valley - more pressure

↑P pushes molecules together

CO = lower BP b/c its easier to pull molecules away from eachother.
DV - higher BP b/c opposite.

15. Use the following data, obtained from a calorimeter lab, to calculate the heat capacity of the metal.

$q_{metal} = -q_{H_2O}$

Variable	Trial 1
Mass of metal	106.7 g
T_i of water	17.7 °C
T_f of water $= T_f$ metal	29.4 °C
T_i of metal	78.9 °C
Volume of water	250 mL

$\Delta T_{H_2O} = 29.4 - 17.7 = 11.7 K$

$\Delta H_{metal} = 29.4 - 78.9 = -49.5 K$

$$(M_{metal})(C_{metal})(\Delta T_{metal}) = -(M_{H_2O})(C_{H_2O})(\Delta T_{H_2O})$$

$$C_{metal} = \frac{-(M_{H_2O})(C_{H_2O})(\Delta T_{H_2O})}{(M_{metal})(\Delta T_{metal})} \Rightarrow \frac{-(250g)(4.18 J/gK)(11.7K)}{(106.7g)(-49.5K)}$$

$$C_{metal} = 2.31 \ J/gK$$

Name Key Class ______ Date ______

18—POTENTIAL ENERGY DIAGRAMS FOR REACTIONS

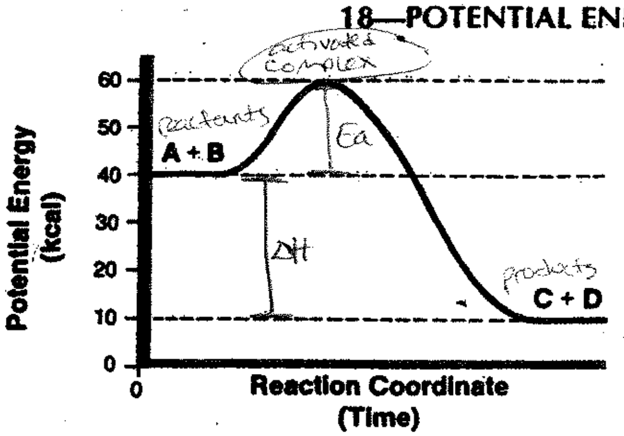


Fig. 1 Potential energy diagram for the reaction $A + B \rightarrow C + D$.

Questions 1-5: These questions refer to the potential energy diagram in Fig. 1.

1. Is the reaction exothermic or endothermic? 1. exo
2. What is the value of ΔH? 2. 30 kcal
3. What is the value of the activation energy of the reaction? 3. 20 kcal
4. What is the potential energy of the products? 4. 10 kcal
5. What is the potential energy of the activated complex? 5. 60 kcal

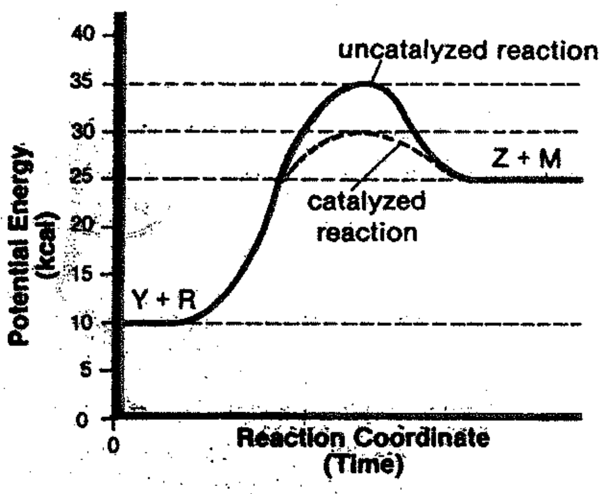


Fig. 2 Potential energy diagram for the reaction $Y + R \rightarrow Z + M$.

Questions 6-10: These questions refer to the potential energy diagram in Fig. 2.

6. Is the reaction exothermic or endothermic? 6. endo
7. What is the value of the activation energy of the uncatalyzed reaction? 7. 25 kcal
8. What is the value of the activation energy of the catalyzed reaction? 8. 20 kcal
9. What is the potential energy of the activated complex of the catalyzed reaction? 9. 30 kcal
10. How does ΔH for the catalyzed reaction compare to ΔH for the uncatalyzed reaction? (same, greater, less) 10. same

Questions 11-19: These questions refer to the potential energy diagram in Fig. 3. For each question, give the letter of the arrow that represents the energy described.

11. potential energy of the activated complex for the uncatalyzed reaction 11. H

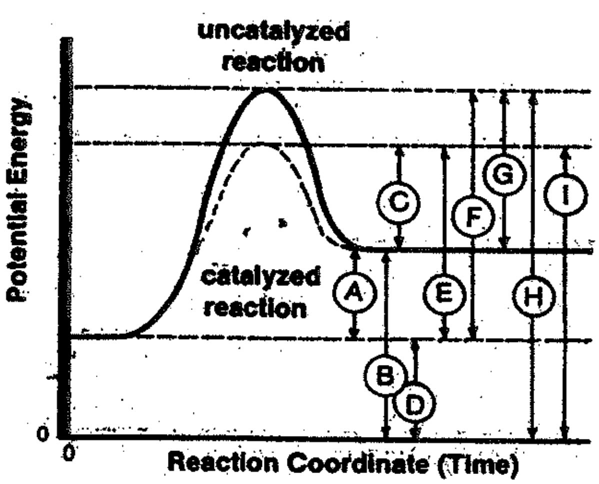


Fig. 3

12. activation energy of the forward catalyzed reaction 12. E
13. potential energy of the products of the forward reaction 13. B
14. activation energy of the uncatalyzed reverse reaction 14. G
15. potential energy of the activated complex for the catalyzed reaction 15. I
16. activation energy of the uncatalyzed forward reaction 16. F
17. heat of reaction 17. A
18. activation energy of the catalyzed reverse reaction 18. C
19. potential energy of the reactants for the forward reaction 19. D