Chemistry 30
Unit 1: Energy Changes in Chemical Reactions
Assignment 2: Sections 2-1 to 2-3

24 max

1. What are STP and SATP? Give definitions and appropriate values.

STP – Standard Temperature and Pressure

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$T = 0°C \qquad P = 101.3$ **kPa**

(note – a recent update for notes. Thermodynamic STP is 25°C and 100 kPa)

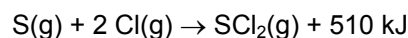**SATP – Standard Ambient Temperature and Pressure**
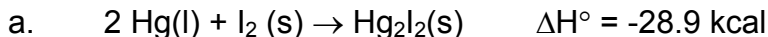
$T = 25°C \qquad P = 101.3$ **kPa**

2. Identify each of the following reactions as **endothermic** or **exothermic**. Also, write each one in an equivalent way.

For example: $S(g) + 2\ Cl(g) \rightarrow SCl_2(g) \Delta H° = -510$ kJ

Answer: Exothermic ($\Delta H°$ is negative). The reaction may also be written as:

$S(g) + 2\ Cl(g) \rightarrow SCl_2(g) + 510$ kJ

Notice the sign in front of 510 kJ – when the energy term is included in the equation, it always has a + sign in front.

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a. $2\ Hg(l) + I_2\ (s) \rightarrow Hg_2I_2(s) \qquad \Delta H° = -28.9$ kcal

2 marks each

$2\ Hg(l) + I_2\ (s) \rightarrow Hg_2I_2(s) + 28.9$ kcal $\qquad$ Exothermic

8

b. $N_2\ (g) +\ 3\ F_2\ (g) \rightarrow 2\ NF_3\ (g) + 27.2$ kcal

$N_2\ (g) +\ 3\ F_2\ (g) \rightarrow 2\ NF_3\ (g) \quad \Delta H° = 27.2$ kcal $\quad$ Exothermic

c. $NH_4NO_3(s) + 6.1$ kcal $\rightarrow NH_4^+\ (aq) + NO_3^-\ (aq)$

$NH_4NO_3(s) \rightarrow NH_4^+\ (aq) + NO_3^-\ (aq) \quad \Delta H° = + 6.1$ kcal $\quad$ Endothermic

d. $Na(s) \rightarrow Na\ (g) \qquad \Delta H° = 25.98$ kcal

$Na(s) + 25.98$ kcal $\rightarrow Na\ (g) \qquad\qquad$ Endothermic

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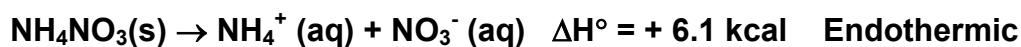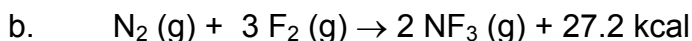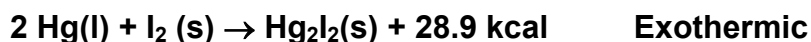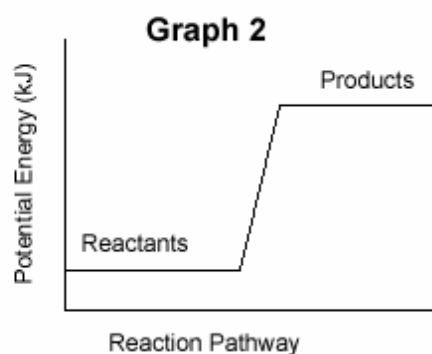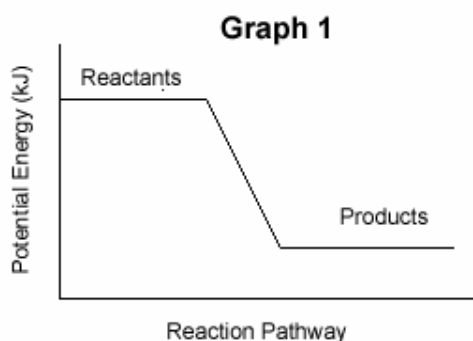
3. Consider the following two potential energy graphs:

A. Identify the following graphs as representing **endothermic** or **exothermic** reactions:

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Graph 1

Reactants

Products

Reaction Pathway

Potential Energy (kJ)

Graph 2

Products

Reactants

Reaction Pathway

Potential Energy (kJ)

EXOTHERMIC   **ENDOTHERMIC**

B. Which graph above will have a value for ΔH that is **negative**?
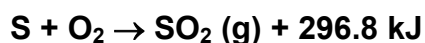
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GRAPH 1

4. Using a table of thermochemical data, write heats of formation reactions for the following compounds. Include the energy term as part of the equation.

Example: Write the heat of formation reaction for KOH, including the energy term as part of the equation.

Answer: $K + \frac{1}{2} O_2 + \frac{1}{2} H_2 \rightarrow KOH + 428.8$ kJ

IMPORTANT: Be sure to memorize the seven diatomic molecules: H_2, N_2, O_2, F_2, Cl_2, Br_2, I_2

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a. $SO_2(g)$

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$S + O_2 \rightarrow SO_2 (g) + 296.8$ kJ

b. $C_3H_8 (g)$

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$3 C + 4 H_2 \rightarrow C_3H_8 (g) + 103.8$ kJ

c. N_2O (g)

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$$N_2 + ½ O_2 + 82.1 \text{ kJ} \rightarrow NO_2(g)$$

d. Na_2CO_3 (s)

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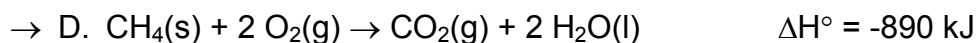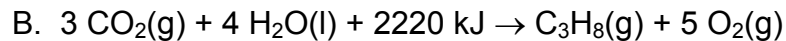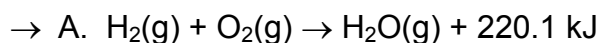$$2 \text{ Na} + C + \frac{3}{2}O_2 \rightarrow Na_2CO_3 + 1130.7 \text{ kJ}$$
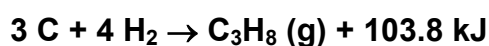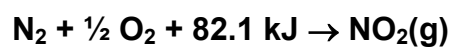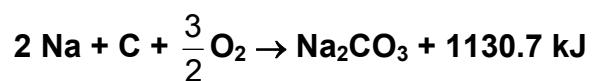
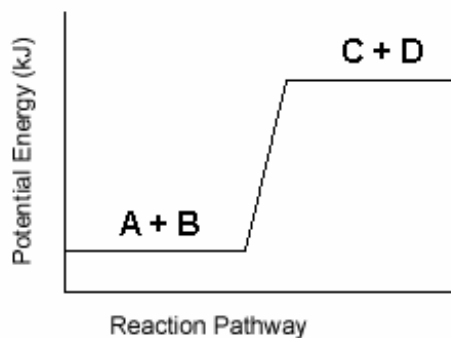5. On the basis on energy changes, select the three reactions from the list below that are most likely to occur spontaneously:

The exothermic reactions are the most likely to be spontaneous – A, D, and F

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→ A. $H_2(g) + O_2(g) \rightarrow H_2O(g) + 220.1 \text{ kJ}$

B. $3 CO_2(g) + 4 H_2O(l) + 2220 \text{ kJ} \rightarrow C_3H_8(g) + 5 O_2(g)$

C. $2 HCl(g) \rightarrow H_2(g) + Cl_2(g)$ $\qquad\qquad\qquad \Delta H° = +185 \text{ kJ}$

→ D. $CH_4(s) + 2 O_2(g) \rightarrow CO_2(g) + 2 H_2O(l)$ $\qquad \Delta H° = -890 \text{ kJ}$

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E.

→ F.