1. In the presence of some metals. ethylene (C2H4) and hydrogen gas react to form ethane (C2H6) according to the following thermochemical equation:

C2H4(g) + H2(g)---> C2H6(g) triangle H°= -136.98 kJ
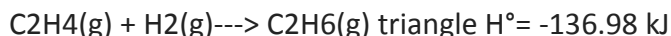
If the molar mass of ethylene is 28.05 g/mol. how much heat is liberated when 100.0 g of ethylene reacts?

Solution:

$$28.05 \ g \ - \ -136.98 \ kJ$$

$$100 \ g \ - \ x \ kJ$$

$$x = \frac{-136.98 \cdot 100}{28.05} = -495.47 \ kJ.$$

Answer: $-495.47 \ kJ$.

2. How much it was prior to convert 20.0 g of ice at -50.0°C to liquid water at 0.0°C?
The specific heat of ice is 2.06 J/(g•°C) and the heat of fusion of water is 334 J/g.

Solution:

$$Q = Q_1 + Q_2$$

$$Q_1 = 2.06 \ {}^J\!/_{g \ . \ °C} \cdot 20 \ g \ \cdot 50°C = 2.06 \ kJ$$

$$Q_2 = 334 \ {}^J\!/_g \cdot 20g = 6.68 \ kJ$$

$$Q = 2.06 + 6.68 = 8.74 \ kJ.$$

Answer: $8.74 \ kJ$.

3. Under certain conditions, nitrogen gas and oxygen gas react to form the toxic brown gas nitrogen dioxide: N2(g) + 2 O2(g) ---> 2 NO2(g). For this reaction, triangle H°= 66.2 kJ and triangle S°= -121.81 J/K; calculate triangle G° at standard conditions (298 K and 1 atm) and determined if a reaction is spontaneous, nonspontaneous, or an equilibrium at these conditions.
Solution:

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

$$\Delta G = 66200 - 298 \cdot (-121.81) = 102500 \ J = 102.5 \ kJ.$$

$$\Delta G > 0, so \ the \ reaction \ is \ nonspontaneous \ .$$

Answer: $102.5 \ kJ, the \ reaction \ is \ nonspontaneous$.