Answer on Question #78391, Chemistry/ General Chemistry

How much energy in kilojoules is needed to heat 5.75 g of ice from -11.5 °C to 33.0 °C? The heat of fusion of water is 6.01 kJ/mol, and the molar heat capacity is 36.6 J/(mol•K) for ice and 75.4 J/(mol•K) for liquid water.

Solution

n(H2O) = m/M

M=Mr

Mr(H2O)= Ar(H)×2+Ar(O)= 1×2+16=18

n(H2O)= 5.75/18 = 0.32 (mol)

Q= Q1 + Q2 + Q3

Q1 – is the energy required to raise the temperature of 0.32 mol of ice from -11.5°C to 0°C. (We may use temperature in degrees of Celsius as difference of temperatures is the same both in K and in °C)

Q1=Cp×n×(T2-T1) = 36.6×0.32×(0-(-11.5))= 134.688 (J)

Q2 – is the energy required to melt 0.32 mol of ice at 0°C.

Q2 = n×ΔHf = 0.32×6010 = 1923.2 (J)

Q3 – is the energy required to raise the temperature of 0.32 mole of water from 0°C to 33°C.

Q3 = Cp×n×(T2-T1) = 75.4×0.32×(33.0-0) = 796.224 (J)

Q= Q1+Q2+Q3 = 134.688+1923.2+796.224 = 2854.112 (J) = 2.854 (kJ)

Answer: 2.854 kJ