Answer on Question #76246, Chemistry / General Chemistry

If 5.32 grams of H2O at 27.118°C is cooled to a final temperature of -35.641°C, how much energy was removed from this system?

Solution

$Q = Q_1 + Q_2 + Q_3$

1. Find Q_1 – heat that is removed when 5.32 g of water is cooled from 27.118°C to 0°C
   $Q_1 = cm(T_2-T_1)$, where c (for water) = 4184 J/kg·°C
   $Q_1 = 4184$ J/kg·°C $\cdot 5.32 \cdot 10^{-3}$ kg $\cdot (0-27.118)$°C = -603.616 J
2. Find Q_2 -the heat of phase change (freezing):
   $Q_2 = \lambda \cdot m$, where $\lambda = 334.7$ kJ/kg $= 334.7 \cdot 10^3$ J
   $Q_2 = -334.7 \cdot 10^3$ J/kg $\cdot 5.32 \cdot 10^{-3}$ kg = -1780.604 J
3. Find Q_3 – heat that is removed when 5.32 g of ice is cooled from 0°C to -35.641°C.
   $Q_3 = cm(T_2-T_1)$, where c (for ice) = 2092 J/kg·°C
   $Q_3 = 2092$ J/kg·°C $\cdot 5.32 \cdot 10^{-3}$ kg $\cdot (-35.641-0)$°C = -396.664 J
4. Find Q
   Q= -603.616 J -1780.604 J -396.664 J = -2780.884J
   Minus before value of Q means that the inner energy of the system is decreased. Then the value of energy that is removed is 2780.884J

Answer: 2780.884J