Answer on the question #60096, Chemistry / Physical Chemistry

Question:

19 Calculate the ΔH value of the reaction: $$HCl + NH_3 \rightarrow NH_4Cl$$ ΔH^o values for HCl, NH_{3} and $NH_{4}Cl$ are -92.30, -80.29 and -314.4 respectively

141.8

252.88

-486.99

-141.8

20 The specific heat of silver is 0.0565 $cal/g/^{o}C$. Assuming no loss of heat to the surroundings or to the container, calculate the final temperature when 100 g of silver at 40 ^{o}C is immersed in 60 g of water at 10 ^{o}C.

12.6 $^o C$

25 ^oC

16.2 ^oC

21.6 ^oC.

Answer:

19. Let's write reaction equation:

$$HCl + NH_3 \rightarrow NH_4Cl$$

The change in enthalpy for this reaction is:

$$\Delta H = \Delta H^0_{NH_4Cl} - \Delta H^0_{HCl} - \Delta H^0_{NH_3} = -314.4 + 92.30 + 80.29 = -141.81$$

20. In assumption that there is no loss of energy to the surroundings, we can write that the quantity of heat that silver lost and quantity of heat that water received are equal:

$$-Q_{Ag} = Q_{water}$$

The change of temperature and heat are strictly connected:

$$Q = cm(T_2 - T_1),$$

where c is the heat capacity of the substance, m is its mass, T_2 and T_1 are the final and initial temperatures, respectively.

Now, we can write the equation for heat transfer. Note that the final temperatures of water and silver are equal.

$$-c_{Ag}m_{Ag}(T_2 - T_{1,Ag}) = c_{water}m_{water}(T_2 - T_{1,water})$$

$$T_2 = \frac{-c_{Ag}m_{Ag}T_{1,Ag} - c_{water}m_{water}T_{1,water}}{-c_{Ag}m_{Ag} - c_{water}m_{water}}$$

$$T_2 = \frac{c_{Ag}m_{Ag}T_{1,Ag} + c_{water}m_{water}T_{1,water}}{c_{Ag}m_{Ag} + c_{water}m_{water}}$$

$$T_2 = \frac{0.0565\ (\mathrm{cal\ g^{-1}{}^\circ C^{-1}}) \cdot 100(\mathrm{g}) \cdot (40) + 1\ (\mathrm{cal\ g^{-1}{}^\circ C^{-1}}) \cdot 60(\mathrm{g}) \cdot (10)}{0.0565\ (\mathrm{cal\ g^{-1}{}^\circ C^{-1}}) \cdot 100(\mathrm{g}) + 1\ (\mathrm{cal\ g^{-1}{}^\circ C^{-1}}) \cdot 60(\mathrm{g})}$$

$$T_2 = 12.6\ ^\circ\mathrm{C}$$