

Physics 10154 - Quiz 12B

120 grams of steam at a temperature of 145 °C is inside a 3.5 kg Aluminum container that is also holding 242 grams of water. The Aluminum container and 342 grams of water are initially at a temperature of 18°C.

The specific heat of aluminum is 900 J/kg-C.

The specific heat of steam is 2010 J/kg-C.

The specific heat of water is 4186 J/kg-C.

The latent heat of vaporization for water is 2.26×10^6 J/kg.

Does all of the steam condense?

If yes, what is the final temperature of the system?

If no, how much steam condenses?

Condense all steam:

$$\Delta Q_s = (.120)(2010)(-45) - (.120)(2.26 \times 10^6)$$
$$= -282,054 \text{ J} \quad \leftarrow \text{smaller, so}$$

Heat Alum + water to 100 °C: all steam condenses

$$\Delta Q_{A+W} = (3.5)(900)(82) + (.342)(4186)(82)$$
$$= 375,692 \text{ J} \quad \leftarrow \text{all steam condenses}$$

$T_F < 100^\circ \text{C}$

$$\Delta Q_s + \Delta Q_{A+W} =$$

$$-282054 + (.120)(4186)(T_F - 100) + (3.5)(900)(T_F - 18)$$
$$+ (.342)(4186)(T_F - 18)$$

$$= -282054 + 502T_F - 50232 + 3150T_F - 56700 + 1432T_F - 25769 =$$

$$= 5084T_F - 414755 = 0$$

$$T_F = 82^\circ \text{C}$$