

**QUESTION:**

How much steam is required to evaporate 627kg of water, when steam is saturated steam and 170C?

**SOLUTION:**

When steam is cooled down, it releases the heat

$$Q_{steam} = c_{steam} m_{steam} (T_{steam,initial} - T_0)$$

Here  $c_{steam}$  is specific heat of steam,  $T_0 = 373.15 \text{ K}$  ( $100 \text{ }^\circ\text{C}$ ).

When water absorbs this heat, its temperature decreases, and water boils.

The heat needed to evaporate water is

$$Q_{water} = c_{water} m_{water} (T_0 - T_{water,initial}) + L_{water} m_{water}$$

Here  $L_{water}$  is latent heat for evaporation of water. Let's assume, that the initial temperature of water is 293.15 K ( $20 \text{ }^\circ\text{C}$ ). Hence

$$Q_{steam} = Q_{water}$$

$$c_{steam} m_{steam} (T_{steam,initial} - T_0) = c_{water} m_{water} (T_0 - T_{water,initial}) + L_{water} m_{water}$$

$$m_{steam} = \frac{4180 \cdot 627 \cdot (373.15 - 293.15) + 2260 \cdot 10^3 \cdot 627}{2080 \cdot (443.15 - 373.15)}$$

$$m_{steam} = 11172 \text{ kg}$$

**ANSWER**

$$m_{steam} = 11172 \text{ kg}$$