

Answer on Question #67810 - Chemistry - General Chemistry

Question: Given: 17 L of steam cools from 100.0 celcius to -10.0 celcius.

$$SH_{\text{fusion}} = 300 \text{ J/g}$$

$$SH_{\text{ice}} = 2.0 \text{ J/g K}$$

$$SH_{\text{water}} = 4.0 \text{ J/g K}$$

$$SH_{\text{vaporization}} = 2300 \text{ J/g}$$

SH stands for standard heat

Question: 17 L of steam at 100.0 degrees celcius is _____ g water? So how many grams of water?

Solution

We can find the mass of given volume gas at any temperature from the ideal gas law equation:

$$p * V = n * R * T.$$

Because $n = m/M$, where m – mass, M – molar mass, we can derive the equation

$$p * V = \frac{m * R * T}{M}$$

And finally

$$m = \frac{p * V * M}{R * T}$$

We have to express the temperature in kelvins ($100^{\circ}\text{C} = 373.15 \text{ K}$). As nothing is mentioned about the pressure, we assume that the pressure is 1 atm (101.313 kPa for the equation). R is the gas constant (8.314 J/mol*K), molar mass of water is 18 g/mol. So the mass of water will be

$$m(\text{H}_2\text{O}) = \frac{101.313 * 17 * 18}{8.314 * 373.15} = 9.993 \text{ g.}$$

Answer: $m(\text{H}_2\text{O}) = 9.993 \text{ g.}$

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