

Question:

A 3.530 g sample of an unknown hydrate of cobalt(II) bromide is heated until all the water of hydration is removed. The CoBr_2 that remains has a mass of 2.362 g. (Include units in your answer.)

- (a) How many moles of CoBr_2 are in the sample?
- (b) How many grams of water were lost in the dehydration?
- (c) How many moles of water were lost?
- (d) What is the value of "n" in the formula $\text{CoBr}_2 \cdot n \text{H}_2\text{O}$? (1, 2, 3, 4...)

Please provide solution.

Answer:

- (a) The amount of moles of CoBr_2 can be estimated from the mass of CoBr_2 remained:

$$n(\text{CoBr}_2) = \frac{m(\text{CoBr}_2)}{M(\text{CoBr}_2)} = \frac{2.362 \text{ g}}{218.73 \text{ g/mol}} = 0.01080 \text{ mol}$$

- (b) The change in mass of the sample is due to the released water vapor:

$$m(\text{H}_2\text{O}) = m_{\text{sample}} - m(\text{CoBr}_2) = 3.530 \text{ g} - 2.362 \text{ g} = 1.168 \text{ g}$$

- (c) The amount of moles of water lost in dehydration:

$$n(\text{H}_2\text{O}) = \frac{m(\text{H}_2\text{O})}{M(\text{H}_2\text{O})} = \frac{1.168 \text{ g}}{18.02 \text{ g/mol}} = 0.06482 \text{ mol}$$

- (d) The amount of moles of CoBr_2 relates to the amount of moles of water as $0.01080 : 0.06482 = 1 : 6.0002$, which means that $n = 6$.

The formula of hydrate is $\text{CoBr}_2 \cdot 6\text{H}_2\text{O}$.