

**Task:**

When a sample of copper oxide is heated in the presence of propane gas,  $C_3H_8$ , three products produce:  $CO_2$ ,  $H_2O$  and  $Cu$ . Using the results below identify the formula of the oxide as copper I oxide or copper II oxide.

Explain your answer by showing all calculations and discussing any laws necessary to support your answer.

Table looks like this:

Items: Masses:

Mass of empty test tube 20.15

Mass of test tube and copper(?) oxide 22.23

Mass of test tube and copper 21.76

**Solution:**

The chemical equation for this reaction is



$x = 1$  for copper (II) oxide

$x = 2$  for copper (I) oxide

From the data in the table we can find

Mass of copper(?) oxide	Mass of test tube and copper(?) oxide - Mass of empty tube $22.23 - 20.15 = 2.08$	2.08 g
Mass of copper	Mass of test tube and copper - Mass of empty test tube $21.76 - 20.15 = 1.61$	1.61 g

The amount of copper is

$$n(\text{mol}) = m(\text{g}) / MW(\text{g/mol})$$

$$n(\text{Cu}) = 1.61 / 63.5 = 2.53 \cdot 10^{-2} \text{ mol}$$

According to the chemical equation  $n(\text{Cu}_x\text{O}) = n(\text{Cu})/x$

$$n(\text{Cu}_x\text{O}) = 2.53 \cdot 10^{-2} / x \text{ (mol)}$$

From the other hand the amount of copper oxide is

$$n(\text{Cu}_x\text{O}) = m(\text{Cu}_x\text{O}) / MW(\text{Cu}_x\text{O}) = 2.08 / (63.5x + 16) \text{ mol}$$

We can write

$$n(\text{Cu})/x = m(\text{Cu}_x\text{O}) / MW(\text{Cu}_x\text{O})$$

$$2.53 \cdot 10^{-2} / x = 2.08 / (63.5x + 16)$$

$$2.53 \cdot 10^{-2} \cdot (63.5x + 16) = 2.08x$$

$$2.53 \cdot 10^{-2} \cdot 63.5x + 2.53 \cdot 10^{-2} \cdot 16 = 2.08x$$

$$1.6x + 0.40 = 2.08x$$

$$2.08x - 1.6x = 0.40$$

$$0.48x = 0.40$$

$$x = 0.83 \approx 1 \text{ (it's CuO)}$$

**Answer:** It was copper (II) oxide ( $\text{CuO}$ )