

**Shedding Light on Atoms Episode 3: The Discovery of Atoms** Name: \_\_\_\_\_

**Part A** 1. Two examples of elements are \_\_\_\_\_ and \_\_\_\_\_, and two examples of compounds are \_\_\_\_\_ and \_\_\_\_\_.

**Part B** 2. Describe what happens when copper (Cu) is heated.

\_\_\_\_\_

\_\_\_\_\_

3. Write a word equation and a balanced symbol equation for the reaction that takes place when copper is heated.

(Word Equation) \_\_\_\_\_

(Symbol Equation) \_\_\_\_\_

4. Write a word equation and a balanced symbol equation for the reaction that takes place when copper oxide is heated with carbon powder.

(Word Equation) \_\_\_\_\_

(Symbol Equation) \_\_\_\_\_

5. What is a blast furnace?

\_\_\_\_\_

\_\_\_\_\_

NOTE: Every single piece of copper and steel (which is about 99% iron) that you have ever seen or touched in your life has come out of a blast furnace in which chemical reactions like the one in Q4 take place!

**Part C** 6. Lavoisier's list of elements included things like copper, iron and zinc. What was his reason for declaring these things to be elements?

\_\_\_\_\_

\_\_\_\_\_

7. Why did Lavoisier mistakenly include things like barium oxide and magnesium oxide on his list of elements?

\_\_\_\_\_

\_\_\_\_\_

8. What is fire?

\_\_\_\_\_

\_\_\_\_\_

**Part D** 9. The Law of Conservation of Mass states that \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

10. Fill in the gaps:

1.0 gram of magnesium + \_\_\_\_\_ grams of oxygen  $\rightarrow$  1.66 grams of magnesium oxide

50 g zinc + 12.24 g oxygen  $\rightarrow$  \_\_\_\_\_ g zinc oxide

11. Why is the ash left over after a fire much lighter than the wood you started with?

\_\_\_\_\_

\_\_\_\_\_

**Part E** 12. We often think of air as something that just floats around. But what are the particles that make up the air really doing?

\_\_\_\_\_

\_\_\_\_\_

13. You boil a small amount of water in a can for a few minutes and then you place a lid on the can. Why does the can crush as it cools down?

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Part F

14. When magnesium chemically reacts with oxygen, magnesium oxide forms. In terms of weight, magnesium makes up \_\_\_\_\_% of the magnesium oxide while oxygen makes up \_\_\_\_\_%.

15. In the early 1800s, Dalton not only figured out that atoms existed, he also figured out that the atoms which make up all the different elements all have different weights. He didn't know how heavy each atom actually was, but he was able to roughly calculate how heavy the different types of atoms were compared to each other. Fill in the table of relative atomic weights below.

Atom	Relative Atomic Weight (according to Dalton)	Relative Atomic Weight (actual)
Hydrogen, H	1	1
Carbon, C		
Nitrogen, N		
Oxygen, O		
Sulphur, S		
Copper, Cu		

16. How heavy are carbon atoms compared to hydrogen atoms?

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17. How heavy are oxygen atoms compared to hydrogen atoms?

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18. How heavy are sulphur atoms compared to **oxygen** atoms?

(Here we have used the "ph" spelling of sulphur, which Dalton used. The "f" spelling of sulfur came later, but has probably become more common. Both spellings are acceptable.)

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19. Why did Dalton assign hydrogen atoms a weight of 1?

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20.  Hydrogen,  carbon,  nitrogen,  oxygen,  phosphorus,  sulphur

Use Dalton's atomic symbols to draw the following compounds:

(a) water (b) nitrogen dioxide, NO<sub>2</sub> (c) nitric acid, HNO<sub>3</sub> (d) carbon disulphide, CS<sub>2</sub> (e) carbonyl sulphide, OCS

### Skill-Building Exercises: Data Analysis

21. If exactly 100 grams of copper chemically reacts with exactly 25.2 grams of oxygen, 125.2 grams of copper oxide (CuO) will be formed. Calculate the percentages by weight of copper and oxygen in copper oxide.

(a) % by weight of copper in CuO (b) % by weight of oxygen in CuO

(c) Based on the information above, approximately how heavy are copper atoms compared to oxygen atoms?

22. Under certain circumstance, exactly 12 grams of carbon will react with 16 grams of oxygen to produce carbon monoxide, CO. How many grams of oxygen will you need to produce carbon dioxide, CO<sub>2</sub>, if you start with 12 grams of carbon?