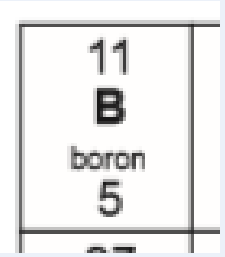
Mole Calculations



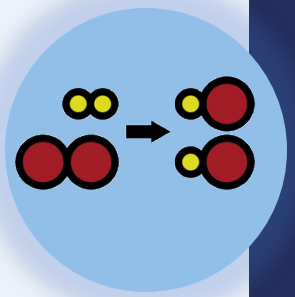
Answer the questions below.

1. State the relative atomic mass of boron.
   11
2. State how many particles are in one mole of a substance.
   6.02×10^{23}
3. State the mass in grams of boron that would contain this many particles.
   11 g
4. Calculate the M_r of copper carbonate ($CuCO_3$). Cu=63.5, C=12, O= 16
   63.5 + 12 + (3x16) = 123.5
5. Calculate the percentage by mass of oxygen in copper carbonate.

$$\% \text{ by mass} = \frac{\text{mass of element}}{\text{mass of compound}} \times 100$$

$$\% \text{ by mass} = \frac{3 \times 16}{123.5} \times 100$$

$$\% \text{ by mass} = 38.87\ \%$$



Do Now

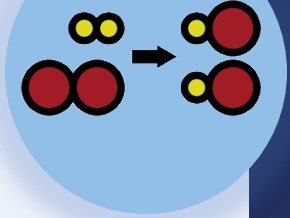
Mole Calculations

Do Now:

1. State the relative atomic mass of boron.
2. State how many particles are in one mole of a substance.
3. State the mass in grams of boron that would contain this many particles.
4. Calculate the M_r of copper carbonate ($CuCO_3$). Cu=63.5, C=12, O= 16
5. Calculate the percentage by mass of oxygen in copper carbonate.

Drill:

1. State Avogadro's number.
2. Calculate $3 \times 4.83 \times 10^{11}$. Write your answer in standard form.
3. Calculate $0.25 \times 4.83 \times 10^{11}$. Write your answer in standard form.



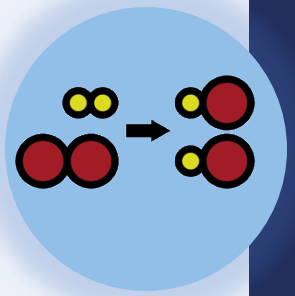
Do Now

Mole Calculations

Read Now:

In one mole of any substance there are 6.02 x10^{23} particles. This can be atoms, molecules or ions. For example, one mole of water contains 6.02 x10^{23} molecules of water and one mole of potassium contains 6.02 x10^{23} atoms of potassium. The relative atomic mass of an element tells you the mass of that element (in grams) that contains exactly this number of atoms. The relative atomic mass of Neon is 20, so 20 g of Neon contains one mole (6.02 x10^{23} atoms). The relative formula mass of a compound tells you the mass of the compound in grams that contains exactly this number of molecules or particles. The relative formula mass of sulfur dioxide (SO_2) is 64 (S=32, O=16), so 64 g of sulfur dioxide contains one more (6.02 x 10^{23}) molecules of sulfur dioxide.

1. State how many particles are in one mole of a substance.
2. Describe the relationship between relative atomic mass and the mass in grams that contains one mole of a substance.
3. Show how the relative formula mass of sulfur dioxide is 64.
4. Explain the difference between relative atomic mass and relative formula mass.

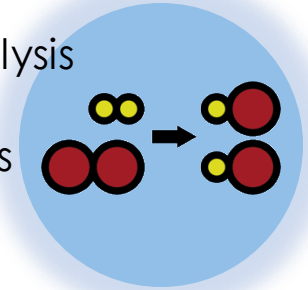


Do Now

(HT) Mole Calculations

C4.3.3

Science Mastery

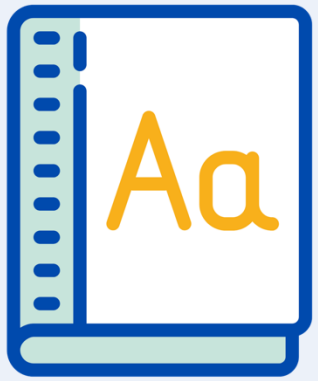


Lesson Objectives

Following this lesson, students will be able to:

- Recall the equation linking mass, M_r and number of moles.
- Convert amounts of substance in mol to their mass, given the M_r.
- Calculate the amount of substance in a given mass, in mol.

Key Words:



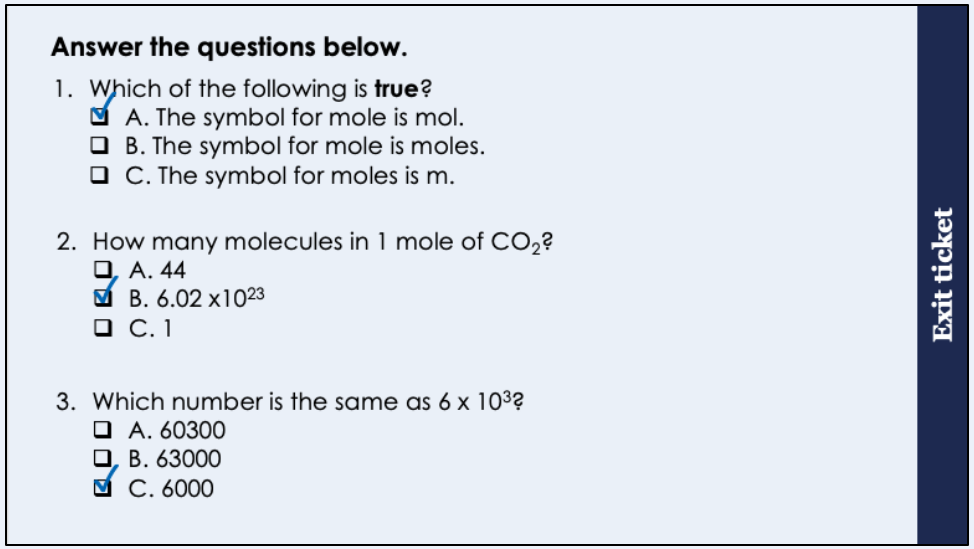
mole | **mass** | **amount**

relative formula mass | **Avogadro's number**

This is the fix-it portion of the lesson

The **fix-it** is an opportunity to respond to gaps in knowledge, especially those identified by the **pre-unit quiz**.

- The teacher should customise this slide as needed, to facilitate
  - **reteach**, **explanation, demonstration** or **modelling** of ideas and concepts that students have not yet grasped or have misunderstood.
  - **practise** answering specific questions or of key skills.
  - **redrafting** or **improving** previous work.



Answer the questions below.

1. Which of the following is **true**?
   - ☑ A. The symbol for mole is mol.
   - ☐ B. The symbol for mole is moles.
   - ☐ C. The symbol for moles is m.

2. How many molecules in 1 mole of CO_2?
   - ☐ A. 44
   - ☑ B. 6.02×10^{23}
   - ☐ C. 1

3. Which number is the same as 6×10^3?
   - ☐ A. 60300
   - ☐ B. 63000
   - ☑ C. 6000

Exit ticket

Fix-it

What is the relationship between moles, mass and M_r?

Take a look at the values in this table.

How did they calculate the mass?

Multiplied the number of moles by the M_r

1 mole of carbon dioxide (M_r = 44)	44 g
2 moles of carbon dioxide (M_r = 44)	88 g
0.5 moles of carbon dioxide (M_r = 44)	22 g
1 mole of water (M_r = 18)	18 g
0.25 mole of water (M_r = 18)	4.5 g
2 moles of X (M_r = 36.5)	73 g
0.5 moles of Y (M_r = 80)	40 g

What is the mathematical relationship between moles, mass and M_r?

Mass = number of moles x M_r

How can we use the equation to calculate the mass or number of moles?

$$\text{Number of moles} = \frac{\text{mass}}{M_r}$$

Remember: **amount of substance** is measured using the **mole**

What is the amount of substance in 64.0 g of O_2? (M_r = 32)

Number of moles = mass ÷ M_r

= 64.0 g ÷ 32

= 2 mol

Remember: the **symbol** for moles is **mol**

What is the mass (g) of 0.5 moles of $MgCO_3$? (M_r = 84)

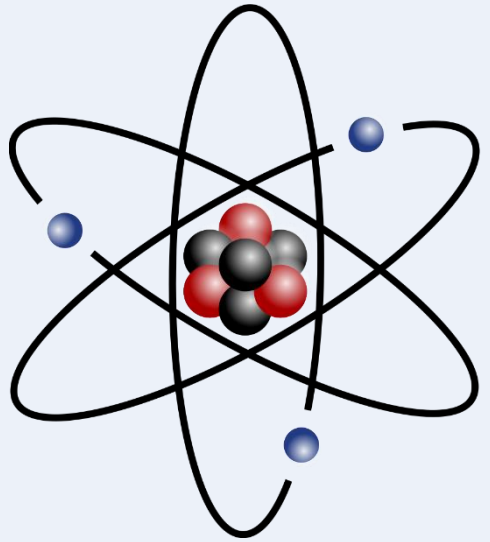
Mass = number of moles x M_r

= 0.5 mol x 84

= 42 g

Let's talk about moles.

Atoms of different **elements** have different **masses**. This is because they have different numbers of **protons** and **neutrons**.



Lead atoms are heavier than carbon atoms. **Why?**

Would 100 g of lead contain the same number of atoms as 100 g of carbon?

Imagine you measure out 100g of normal Mars bars and 100 g of mini Mars bars. Would 100g of normal Mars contain the same number of bars as 100g of mini Mars? **Why?**

Would 1 mol of lead contain the same number of atoms as 1 mol of carbon? Why?

12
C
carbon
6

207
Pb
lead
82

Talk Task

Describing Equations

Describe what happens in the following chemical equation using the idea of moles:

$$O_2 + 2H_2 \rightarrow 2H_2O$$

Talk Task

What is wrong with the following answers? Re-write them correctly. (Q5 has more than one issue).

16
O
oxygen
8

24
Mg
magnesium
6

7
Li
lithium
3

1. The student measured out the ~~amount~~ volume of HCl using a measuring cylinder.
2. The relative formula mass of MgO is 20.
   The relative formula mass of MgO is 40.
3. The symbol for the mole is m.
   The symbol for the mole is mol.
4. 2 moles of water molecules has a mass of 9 g (M_r = 18).
   0.5 mole of water has a mass of 9 g or 2 moles of water has a mass of 36g.
5. What is the amount of substance in 15 g of Li_2O?

   M_r of Li_2O = 7 + 16 = 23
   Number of moles = mass ÷ Mr
   = 15 g ÷ 23
   = 0.65 mole

   M_r of Li_2O = **(7 x 2)** + 16 = **30**
   Number of moles = mass ÷ Mr
   = 15 g ÷ **30**
   = **0.5 mol**

Check for understanding

Drill

1. State the unit for moles.
2. State the equation that links number of moles, mass and relative formula mass.
3. State the unit for mass.
4. Calculate the relative formula mass of sodium hydroxide (NaOH).
5. Calculate the number of moles in 120 g of sodium hydroxide.
6. Calculate the relative formula mass of magnesium chloride ($MgCl_2$).
7. Calculate the mass of 0.25 moles of magnesium chloride.

Check for understanding

Drill answers

1. mol
2. number of moles = mass/M_r
3. g
4. 23+16+1 = 40
5. number of moles = mass/M_r, so 120/40 = 3 mol
6. 24+(35.5 x 2) = 95
7. number of moles = mass/M_r so 0.25 = mass/95

mass = 23.75 g

Check for understanding

Answer the questions below.

1. What is the relative formula mass of NO_2? (A_r: N = 14; O = 16)
   - ☐ A. 30
   - ☐ B. 44
   - ☑ C. 46

2. What is the mass of 0.02 mol of Na_2CO_3? (M_r: 106)
   - ☑ A. 2.12 g
   - ☐ B. 21.2 g
   - ☐ C. 5 300 g

3. What is the amount of substance in 26.5 g of Na_2CO_3? (M_r: 106)
   - ☐ A. 4 mol
   - ☑ B. 0.25 mol
   - ☐ C. 2 809 mol

Exit ticket

Feedback

Lesson C4.3.3	
What was good about this lesson?	What can we do to improve this lesson?

Send us your feedback by clicking this link
or by emailing sciencemastery@arkonline.org
Thank you!