



An Introduction to Mole Concept









The Chemistry of Baking a Cake





Food for thought…

- **How do you bake a delicious cake?**

- **There are certain rules to follow.**

- **Certain ingredients must be mixed together.**

- **The recipe tells you the amount of each ingredient that you need.**

- To bake a cake of a certain size, you need a specific amount of each ingredient.

2 × 

Butter

2 ×  **+ 1 ×** 

Butter Eggs

2 ×

Butter

+ 1 ×

Eggs

+ 2 ×

Milk

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2 × 

Butter

+ 1 × 

Eggs

+ 2 × 

Milk

+ 4 × 

Flour

2 × 

Butter

+ 1 × 

Eggs

+ 2 × 

Milk

+ 4 × 

Flour

+ 1 × 

Sugar

2 ×  Butter

+ 1 ×  Eggs

+ 2 ×  Milk

+ 4 ×  Flour

+ 1 ×  Sugar

→ 2 ×  Cake

2 × 
Butter

1 × 
Eggs

2 × 
Milk

4 × 
Flour

1 × 
Sugar

- Assuming that all of the other ingredients are available in excess...

...how much cake can be made with 2 × eggs?

2 ×  Cake

2 ×

Butter

1 ×

Eggs

2 ×

Milk

4 ×

Flour

1 ×

Sugar

- Assuming that all of the other ingredients are available in excess...

...how much cake can be made with 2 × eggs?

2 ×

Cake

Answer

4

2 ×  Butter

1 ×  Eggs

2 ×  Milk

4 ×  Flour

1 ×  Sugar

- Assuming that all of the other ingredients are available in excess...

...how much cake can be made with 2 × flour?

2 ×  Cake

2 ×  Butter

1 ×  Eggs

2 ×  Milk

4 ×  Flour

1 ×  Sugar

- Assuming that all of the other ingredients are available in excess...

...how much cake can be made with 2 × flour?

2 ×  Cake

Answer 1

2 ×

Butter

1 ×

Eggs

2 ×

Milk

4 ×

Flour

1 ×

Sugar

- Assuming that all of the other ingredients are available in excess...

...how much cake can be made with 3 × milk?

2 ×

Cake

2 ×

Butter

1 ×

Eggs

2 ×

Milk

4 ×

Flour

1 ×

Sugar

- Assuming that all of the other ingredients are available in excess...

...how much cake can be made with 3 × milk?

2 ×

Cake

Answer

3

2 ×

Butter

1 ×

Eggs

2 ×

Milk

4 ×

Flour

1 ×

Sugar

- How much sugar do you need to make 6 × cake?

2 ×

Cake

2 ×

Butter

1 ×

Eggs

2 ×

Milk

4 ×

Flour

1 ×

Sugar

- How much sugar do you need to make 6 × cake?

2 ×

Cake

Answer

3

2 ×

Butter

1 ×

Eggs

2 ×

Milk

4 ×

Flour

1 ×

Sugar

- How much butter do you need to mix with 2 × flour?

2 ×

Cake

2 × 
Butter

1 × 
Eggs

2 × 
Milk

4 × 
Flour

1 × 
Sugar

- How much butter do you need to mix with 2 × flour?

2 ×  Cake

Answer

1

2 ×  Butter

1 ×  Eggs

2 ×  Milk

4 ×  Flour

1 ×  Sugar

- You have 8 × butter, 4 × eggs, 6 × milk, 14 × flour and 4 × sugar. What is the maximum amount of cake that you can bake? Why?

2 ×  Cake

2 ×

Butter

1 ×

Eggs

2 ×

Milk

4 ×

Flour

1 ×

Sugar

- You have 8 × butter, 4 × eggs, 6 × milk, 14 × flour and 4 × sugar. What is the maximum amount of cake that you can bake? Why?

2 ×

Cake

Answer

6

Milk is Limiting

2 ×

Butter

1 ×

Eggs

2 ×

Milk

4 ×

Flour

1 ×

Sugar

- You burn the cake! Of the 240 g cake that you have baked, 60 g is a burnt, black mass! What percentage of your cake can you still eat?

2 ×

Cake

2 × 
Butter

1 × 
Eggs

2 × 
Milk

4 × 
Flour

1 × 
Sugar

- You burn the cake! Of the 240 g cake that you have baked, 60 g is a burnt, black mass! What percentage of your cake can you still eat?

2 ×  Cake

Answer

75%

Percentage Yield

Mole Concept

- Generalisations and Enduring Understandings

1. Matter is *conserved* during a chemical reaction.

2. The *changes* that take place during a chemical reaction can be *predicted* – the *products* of a chemical reaction can be *predicted*.

Mole Concept

- Generalisations and Enduring Understandings

Why? How?

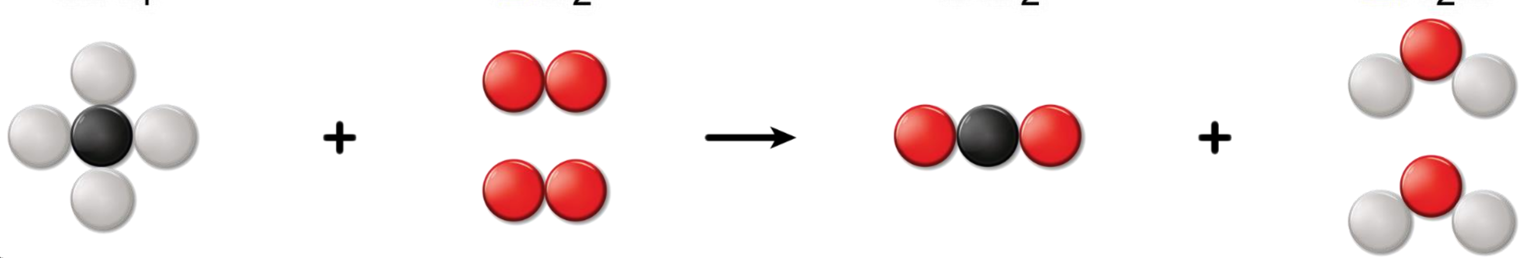
Mole Concept

- Generalisations and Enduring Understandings

1. During a chemical reaction, exactly the same particles present at the *start* of the reaction are present at the *end* of the reaction, but they are bonded / arranged in *different ways*.

2. Chemical reactions are *systems* that *follow specific rules*.

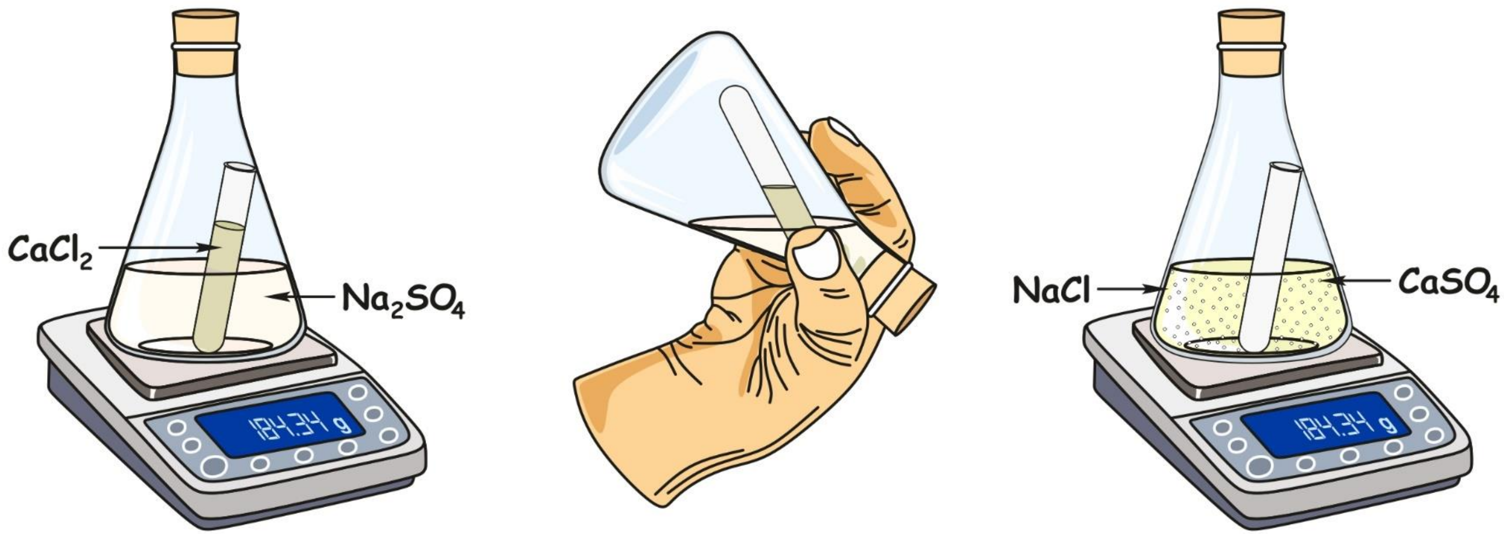
$$CH_4 + 2O_2 \longrightarrow CO_2 + 2H_2O$$



Mole Concept

Law of Conservation of Mass

Regardless of how substances within a closed system are changed, the total mass remains the same.



$$CaCl_2 + Na_2SO_4 \longrightarrow CaSO_4 + NaCl$$

Reactants = 184.34 g

Products = 184.34 g

Reactants Mass (g) = Products Mass (g)

$CaCl_2$	Calcium Chloride Solution
Na_2SO_4	Sodium Sulfate Solution
$CaSO_4$	Calcium Sulfate White Precipitate
NaCl	Sodium Chloride Solution

Mole Concept

- Generalisations and Enduring Understandings

So what?

Mole Concept

- Generalisations and Enduring Understandings

1. Chemical reactions can be *analysed mathematically*.

2. Constructing *mathematical models* of chemical reactions allows the amount (concentration, mass, volume) of a chemical to be *calculated* / *predicted*.

Mole Concept

- Generalisations and Enduring Understandings

Systems in which ......?...... can be.......?.......can be analysed and ....?....... ......?....... .

Mole Concept

- Generalisations and Enduring Understandings

Systems in which changes can be ……?…….can be analysed and ……?……. ……?……. .

Mole Concept

- Generalisations and Enduring Understandings

Systems in which changes can be predicted can be analysed and ......?....... ......?....... .

Mole Concept

- Generalisations and Enduring Understandings

Systems in which changes can be predicted can be analysed and modelled mathematically.

- To bake a cake of a certain size, you need a specific amount of each ingredient.

- The recipe tells you the amount of each ingredient that you need.

Mole Concept

Apart from the kitchen, where else is it important for substances to be combined together in the correct quantities?

Mole Concept

Mole Concept

- Chemicals must be combined together in the correct quantities prior to a *chemical reaction*.
- The *coefficients* given in the balanced chemical equation state the *ratios* in which the reagents must be combined.

Mole Concept

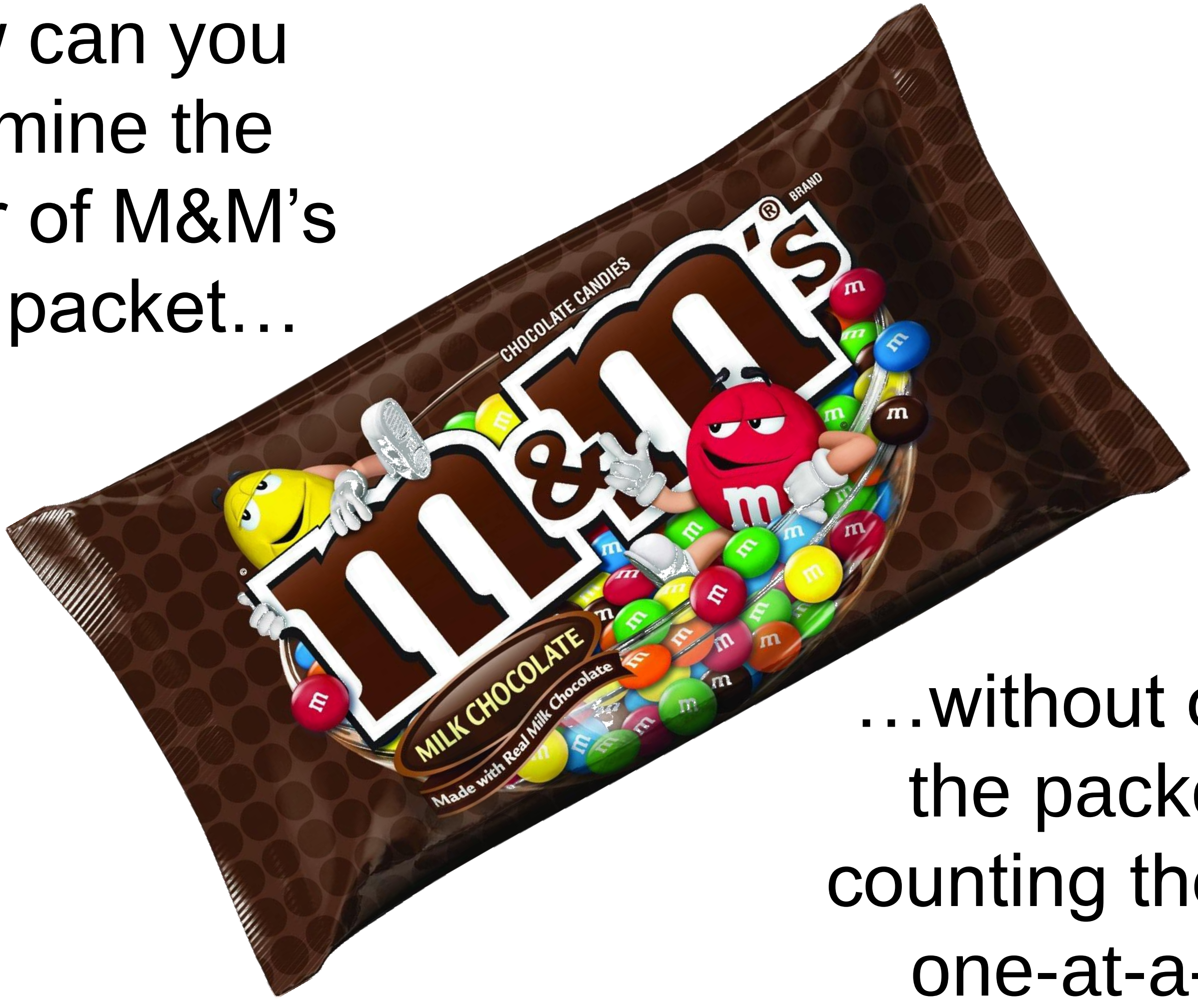
But how can I *count* out the correct number of atoms, ions and molecules? They are too small to be counted out by hand!

Mole Concept

- What different ways can you think of to determine the number of grains of rice in this bag?

Mole Concept

- How can you determine the number of M&M's in this packet…



…without opening the packet and counting the M&M's one-at-a-time?

Mole Concept

- If the packet of M&M’s weighs 47.3 g, and a single M&M weighs 0.860 g, then there are…

Mole Concept

- If the packet of M&M's weighs 47.3 g, and a single M&M weighs 0.860 g, then there are…

  47.3 ÷ 0.860 = 55.0

  M&M's in a single packet.

Mole Concept

- Now imagine that you needed 150 M&M's. You could count them out one-at-a-time, or…

Mole Concept

- Now imagine that you needed 150 M&M's. You could count them out one-at-a-time, or…

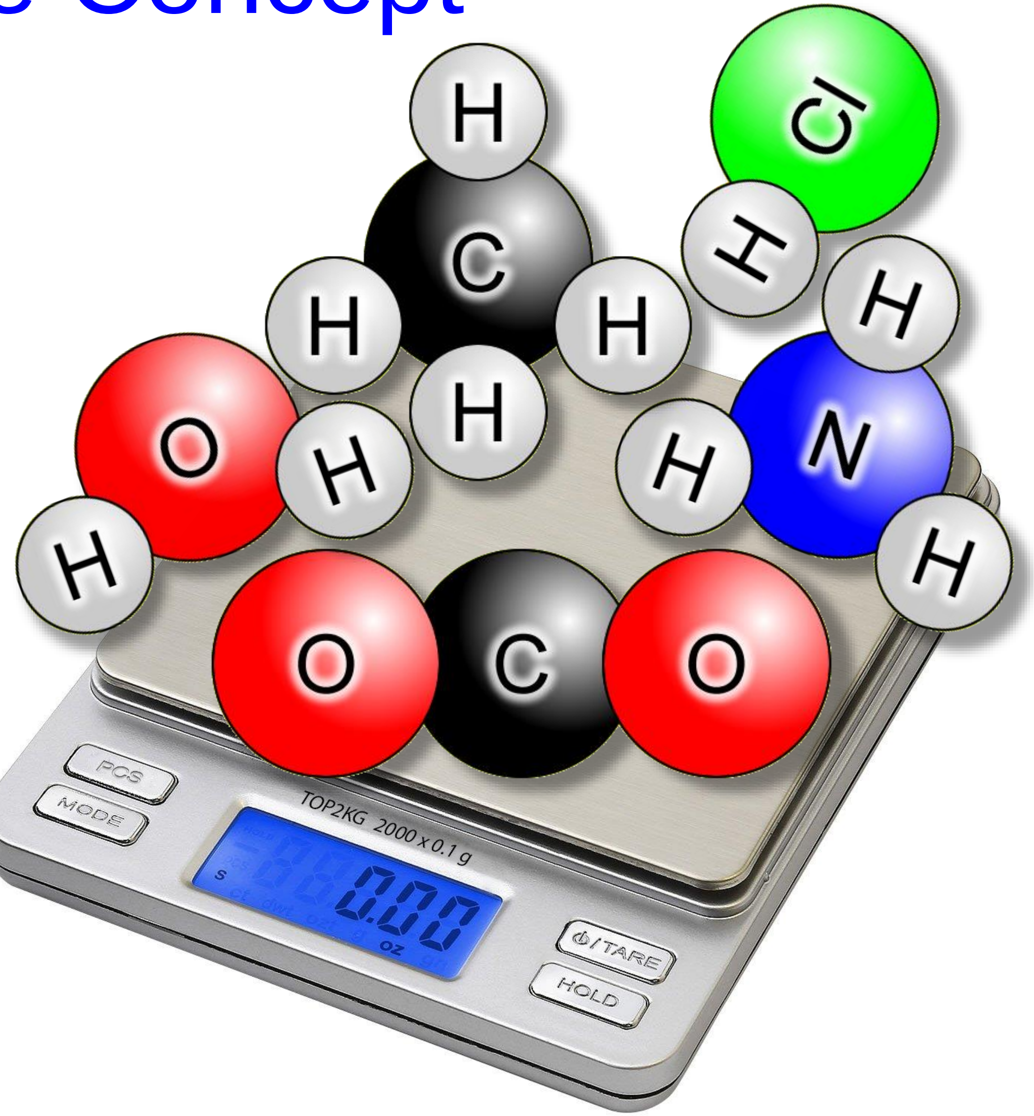
…you could simply *weigh* them out:

$150 \times 0.860 = 129$ g

of M&M's

Mole Concept

- Atoms, ions and molecules are too small to count individually.
- *Chemicals* can also be *counted* by *weighing* them on a balance.



Mole Concept

But atoms, ions and molecules are very *small*, so when I weigh them out, won’t the number of particles be very *large*?

Mole Concept

- What name is given to each one of the following numbers?

100? ____________

1000? _____________

1000 000? ___________

600 000 000 000 000 000 000 000 (or 6×10^{23})?

____

Mole Concept

- What name is given to each one of the following numbers?

100? One hundred

1000? One thousand

1000 000? One million

600 000 000 000 000 000 000 000 (or 6×10^{23})? One mole*

*The word "*mole*" is derived from the Latin "*moles*" meaning "*heap*" or "*pile*".

The mole is an *SI unit*. It is used in Chemistry to represent the amount of a substance, *e.g.* 1 mole of sulfur contains 6×10^{23} atoms of sulfur.

Mole Concept

- Amedeo Avogadro, 1776 – 1856.

- The number of particles in 1 mole of a chemical, 6.022×10^{23}, is known a *Avogadro's Constant* (N_A).
- Avogadro did not derive the quantity of 6.022×10^{23} himself. It is named after Avogadro in recognition of his contribution to science.

Mole Concept

- Amedeo Avogadro, 1776 – 1856.

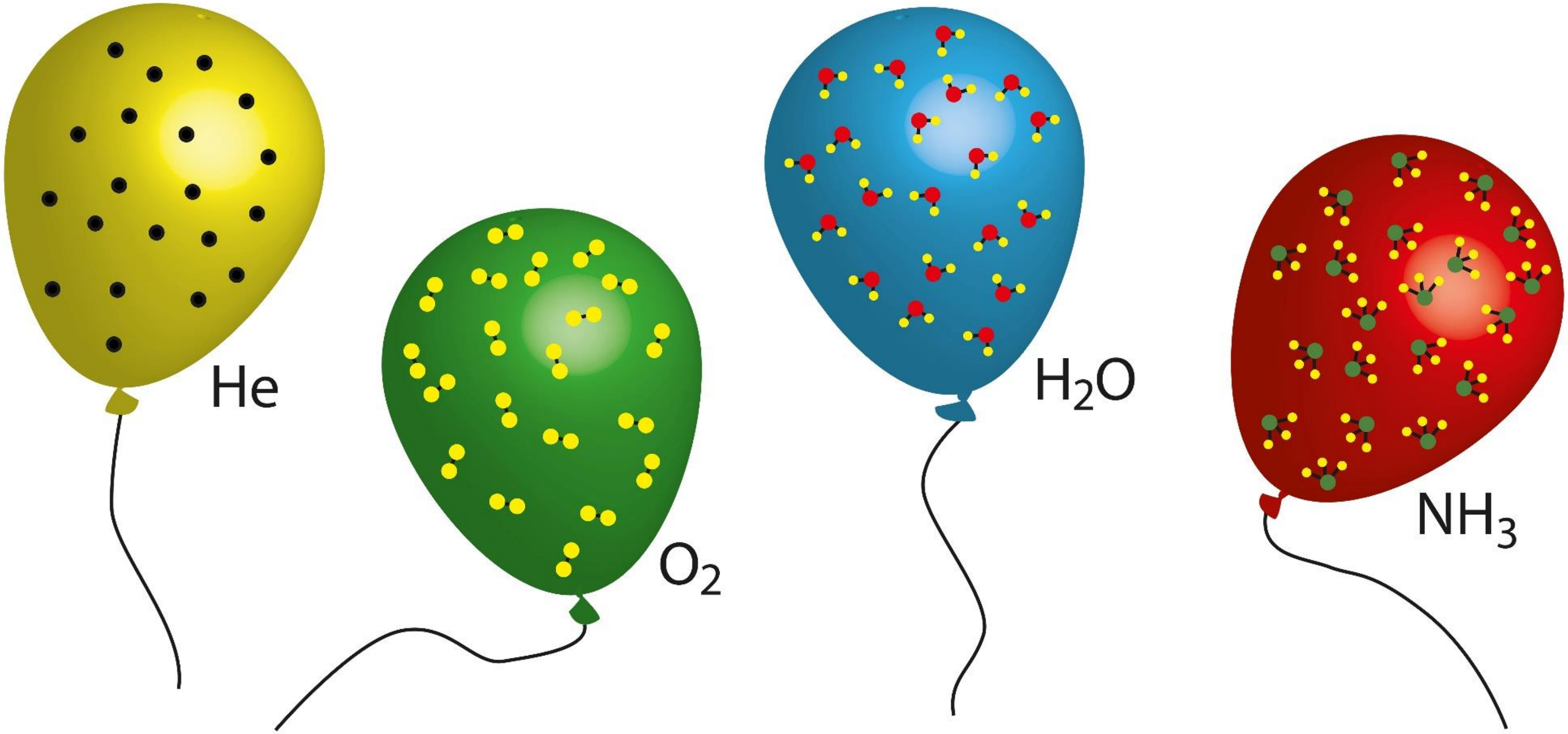
- *Avogadro's Law* states that *equal volumes of gases*, at the same temperature and pressure, contain the *same number of molecules*.

- Although equal volumes of gases contain the same number of molecules, they have *different masses*.

→ *Molecules* of different gases therefore have *different masses*.

→ This contributed to the idea of *relative molecular mass*.

Mole Concept



• *Avogadro's Law* states that *equal volumes of gases*, at the same temperature and pressure, contain the *same number of molecules*.

Mole Concept

1 mole (6×10^{23} particles) of an *element* can be measured by weighing out the element's *relative atomic mass* (A_r) in *grams*!

- Don't confuse the element's *relative atomic mass* with the element's *atomic number* !

Mole Concept

1 mole (6 × 10^{23} particles) of a *compound* can be measured by weighing out the compound's *relative molecular mass* (M_r) in *grams*!

Mole Concept

Mole Concept

- How big is a chemical mole?
- Putting the chemical mole into context using the concepts of *models* and *scale*.
- If Singapore was covered by 1 mole of M&M's, how high would the pile of M&M's be in km?

Mole Concept

- Question: If Singapore was covered by 1 mole of M&M's, how high would the pile of M&M's be in km?

- 88 M&M's occupy 100 cm^3.

What volume do 6×10^{23} M&M's occupy in cm^3, m^3, km^3?

Mole Concept

- Question: If Singapore was covered by 1 mole of M&M's, how high would the pile of M&M's be in km?

- 88 M&M's occupy 100 cm^3.

What volume do 6×10^{23} M&M's occupy in cm^3, m^3, km^3?

$\rightarrow$ 1 M&M occupies a volume of $100 \div 88 = 1.34\ cm^3$

$\rightarrow$ 6×10^{23} M&M's occupy a volume of $1.34 \times (6 \times 10^{23})$
$= 8.04 \times 10^{23}\ cm^3$

- Convert volume in cm^3 to volume in m^3:

$\rightarrow$ $8.04 \times 10^{23}\ cm^3 \div (100 \times 100 \times 100) = 8.04 \times 10^{17}\ m^3$

- Convert volume in m^3 to volume in km^3:

$\rightarrow$ $8.04 \times 10^{17}\ m^3 \div (1000 \times 1000 \times 1000) = 8.04 \times 10^{8}\ km^3$

Mole Concept

- Question: If Singapore was covered by 1 mole of M&M's, how high would the pile of M&M's be in km?

- Singapore has a land area of 719 km^2. What is the height of 8.04×10^8 km^3 of M&M's spread over this area?

Mole Concept

- Question: If Singapore was covered by 1 mole of M&M's, how high would the pile of M&M's be in km?

- Singapore has a land area of 719 km^2. What is the height of 8.04×10^8 km^3 of M&M's spread over this area?

$\rightarrow (8.04 \times 10^8) \div 719 = 1\ 120\ 000$ km

- The distance from the Earth to the Moon is 384 400 km. How many times taller is the pile of M&M's covering Singapore?

$\rightarrow 1\ 120\ 000 \div 384\ 400 = 2.91$

- The pile of M&M's covering Singapore would be almost three times taller than the distance from the Earth to the Moon!

Mole Concept

- How big is a chemical mole?
- Putting the chemical mole into context using the concepts of *models* and *scale*.
- How many years would it take to eat 1 mole of M&M's if you were to eat 10 M&M's a second, every second?

Mole Concept

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Mole Concept

- Question: How many years would it take to eat 1 mole of M&M's if you were to eat 10 M&M's a second, every second?
  - How many M&M's would you eat in 1 minute?

    $\rightarrow 10 \times 60 = 600$
  - How many M&M's would you eat in 1 hour?

    $\rightarrow 600 \times 60 = 36\,000$
  - How many M&M's would you eat in 1 day?

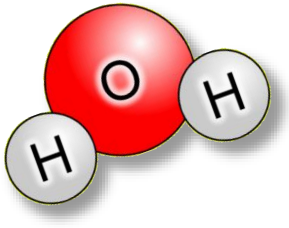
    $\rightarrow 36000 \times 24 = 864\,000$
  - How many M&M's would you eat in 1 year?

    $\rightarrow 864\,000 \times 365 = 315\,360\,000$ or 3.15×10^8
- How many years would it take to eat 1 mole of M&M's?

  $\rightarrow (6 \times 10^{23}) \div (3.15 \times 10^8) = 1\,900\,000\,000\,000\,000$ years or 1.90×10^{15} years. The known universe is only calculated to be 1.38×10^{10} years old!

Mole Concept

- Question: How long would it take to drink 1 mole of water (H_2O)?



Mole Concept

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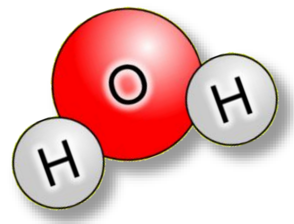


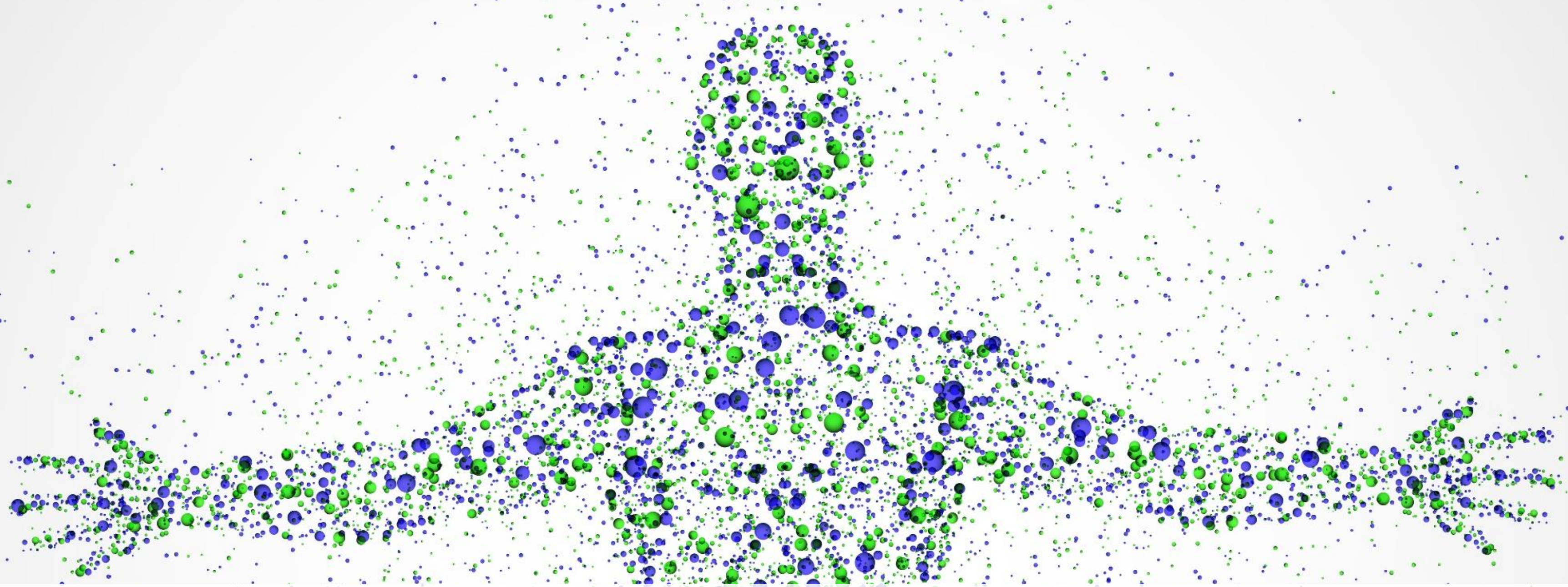
→ 1 mole of water has a mass of $^{1}H + {}^{1}H + {}^{16}O = 1 + 1 + 16 = 18.0$ g

→ Water has a density of 1 g per cm^3 therefore 18.0 g of water occupy 18.0 cm^3

→ It would take just a *few seconds* to drink 1 mole (6×10^{23} molecules) of water!

Water molecules are very small!

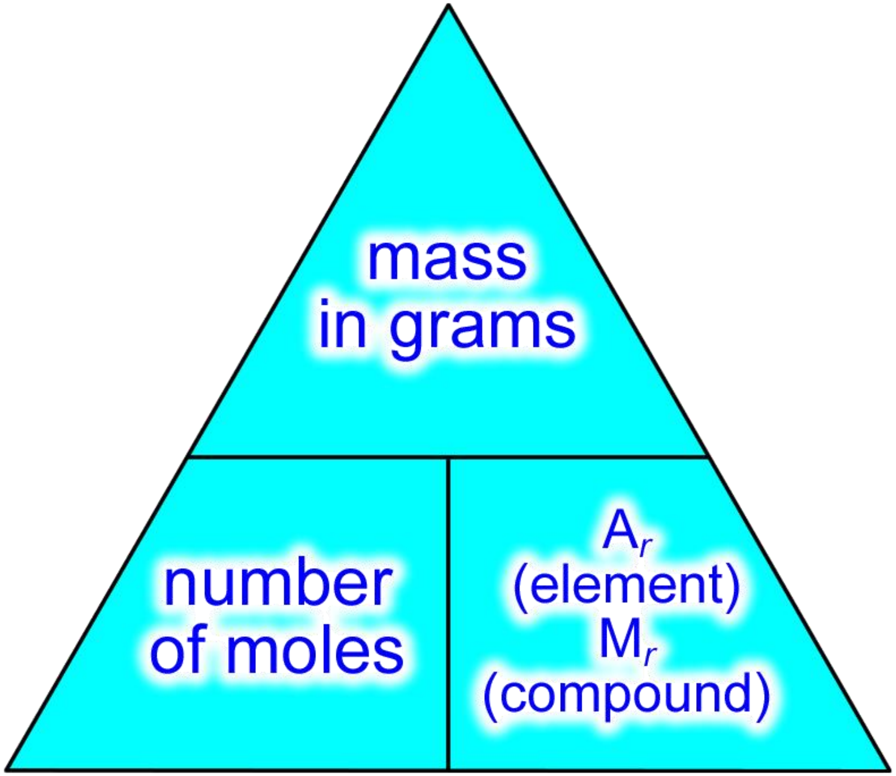
Mole Concept



- Link to Biology: How many atoms does your body contain?

http://www.bbc.com/earth/story/the-making-of-me-and-you

Mole Concept



- moles = mass in grams ÷ A_r or M_r
- mass in grams = moles × A_r or M_r
- A_r or M_r = mass in grams ÷ moles

Mole Concept

- moles = mass in grams ÷ A_r or M_r
- moles of magnesium in 12.0 g of magnesium?

= 12.0 ÷ 24 = 0.500 mol (3 s.f.)

= 3×10^{23} atoms of magnesium

- moles of CO_2 in 132 g of CO_2?

= 132 ÷ (12 + 16 + 16) = 3.00 mol (3 s.f.)

= 1.8×10^{24} molecules of carbon dioxide

Mole Concept

- mass in grams = moles × A_r or M_r
- mass in grams of 5.00 moles of sodium?

= 5.00 × 23 = 115 g (3 s.f.)

- mass in grams of 2.50 moles of Al_2O_3?

= 2.50 × ((2 × 27) + (3 × 16)) = 255 g (3 s.f.)

Mole Concept

- Imagine that a business document needs to be translated from French to Italian.
- One translator speaks French and Mandarin.
- The other translator speaks Italian and Mandarin.
- How can the document be translated?

Mole Concept

- Imagine that a business document needs to be translated from French to Italian.
- One translator speaks French and Mandarin.
- The other translator speaks Italian and Mandarin.
- How can the document be translated?

Step 1: Translate the document from French into Mandarin.

Step 2: Translate the document from Mandarin into Italian.

- Mandarin is the common language that allow the translation to take place.

Mole Concept

- In a similar way, the *mole* is the *common language* that allows a *translation* to take place between the chemicals in a *balanced chemical equation*.

X moles of Chemical A $\rightarrow$ Y moles of Chemical B

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Step 1)

Convert:

- Mass in grams,
- Volume of gas,
- Concentration of solution,

into *moles*.

Mole Concept

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Step 2)

- Look at the *mole ratio* between the two chemicals.

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Step 1)

Convert:

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- Volume of gas,
- Concentration of solution,

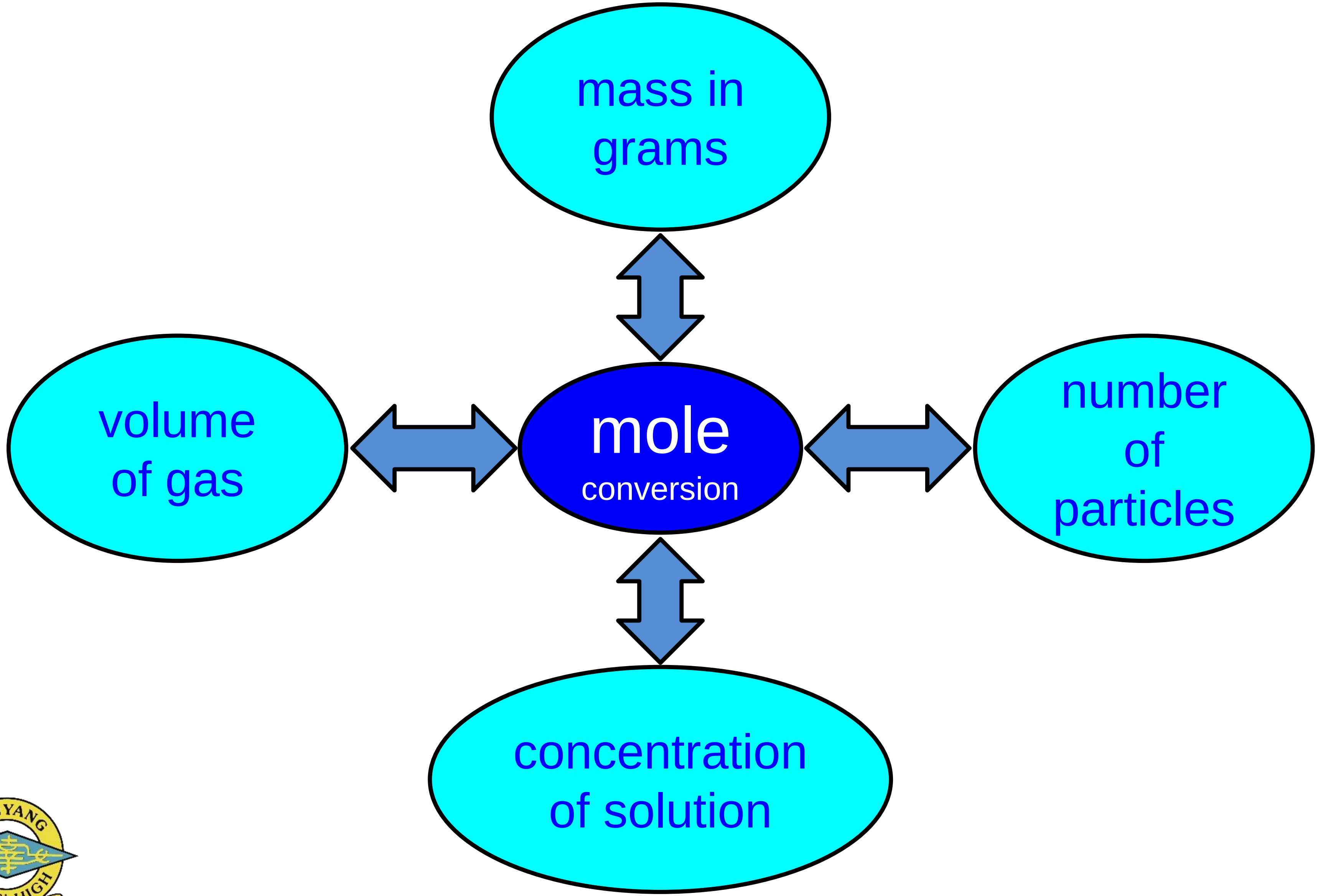
into *moles*.

Step 3)

Convert *moles* into:

- Mass in grams,
- Volume of gas,
- Concentration of solution.

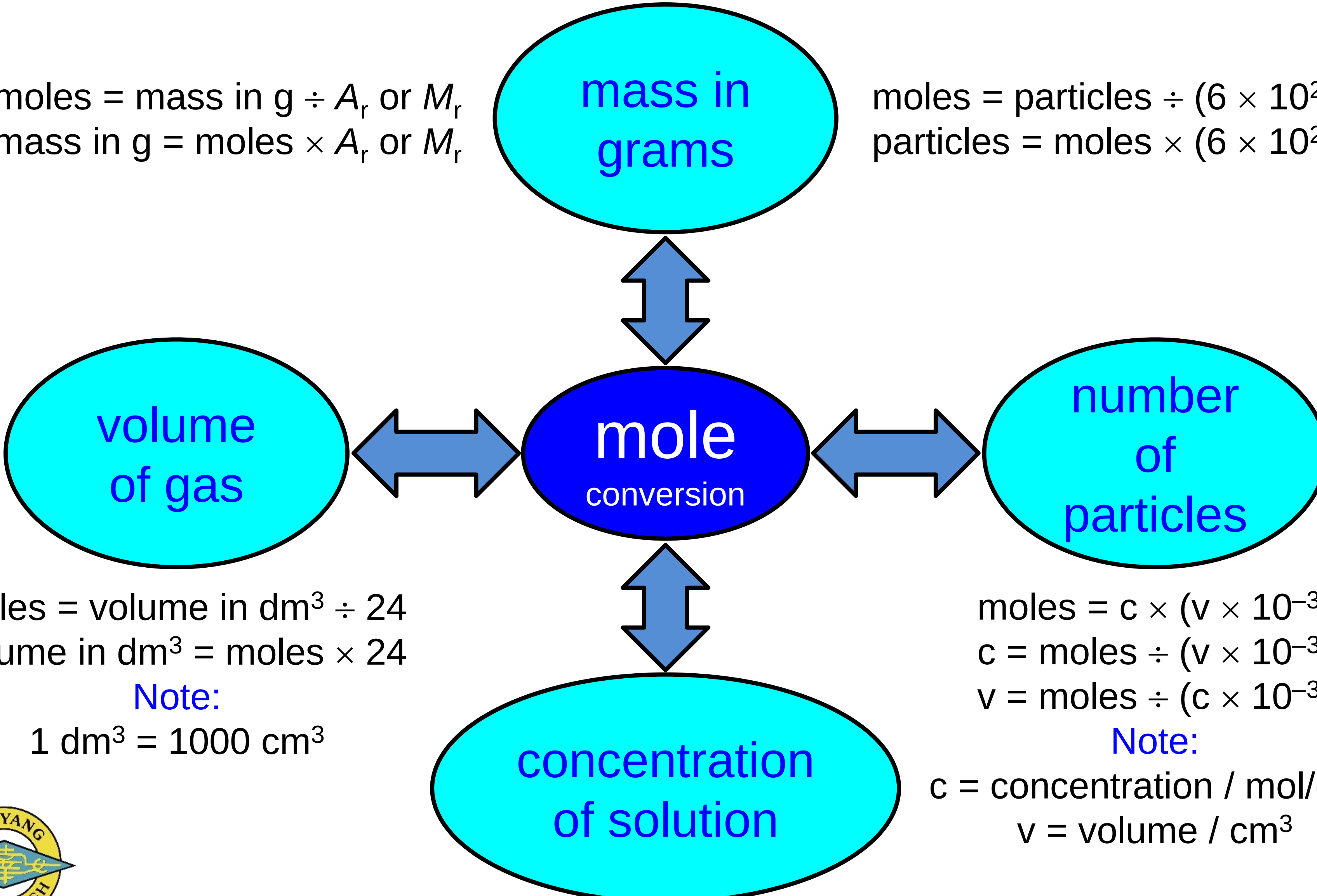
Mole Concept



Mole Concept

moles = mass in g ÷ A_r or M_r
mass in g = moles × A_r or M_r

moles = particles ÷ (6 × 10^{23})
particles = moles × (6 × 10^{23})



moles = volume in dm^3 ÷ 24
volume in dm^3 = moles × 24
Note:
1 dm^3 = 1000 cm^3

moles = c × (v × 10^{-3})
c = moles ÷ (v × 10^{-3})
v = moles ÷ (c × 10^{-3})
Note:
c = concentration / mol/dm^3
v = volume / cm^3

Mole Concept

Apply what you have learned in the kitchen to the following example in the laboratory...

$$4Al_{(s)} + 3O_{2(g)} \rightarrow 2Al_2O_{3(s)}$$

Mole Concept

The number in front of a formula tells you the number of *moles* of that chemical that are involved in the chemical reaction.

$$4Al_{(s)} + 3O_{2(g)} \rightarrow 2Al_2O_{3(s)}$$

Mole Concept

Thus, **4** moles of aluminium react with **3** moles of oxygen to form **2** moles of aluminium oxide.

$$4Al_{(s)} + 3O_{2(g)} \rightarrow 2Al_2O_{3(s)}$$

4 moles of Al, with a mass of $4 \times 27 = 108$ g
react with 3 moles of O_2, with a mass of $3 \times (2 \times 16) = 96.0$ g
to produce 2 moles of Al_2O_3, with a mass of $((4 \times 27) + (6 \times 10)) = 204$ g

108 g + 96.0 g = 204 g
mass is conserved during the reaction

Question 1.

$$2Na_{(s)} + Cl_{2(g)} \rightarrow 2NaCl_{(s)}$$

- What mass of sodium chloride will be formed when **69.0 g** of **sodium** reacts completely with chlorine?

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- First, calculate the number of moles of sodium that are used:
  moles = mass in grams ÷ A_r = 69.0 ÷ 23.0 = **3.00 mol**

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- Next, calculate the moles of sodium chloride produced by 3.00 mol of sodium:
  From the balanced chemical equation…
  3.00 mol Na forms ($^2/_2 \times 3.00$) mol NaC*l* = **3.00 mol**

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From the balanced chemical equation…

3.00 mol Na forms ($^2/_2$ × 3.00) mol $NaCl$ = **3.00 mol**

- Finally, calculate the mass in grams of 3.00 mol of sodium chloride:

mass in grams = moles × M_r = 3.00 × (23.0 + 35.5) = **175.5 g**

= **176 g** (to 3 s.f.)

NANYANG GIRLS' HIGH

Question 2.

$$4Al_{(s)} + 3O_{2(g)} \rightarrow 2Al_2O_{3(s)}$$

- What mass of aluminium oxide will be formed when **162 g** of **aluminium** reacts completely with oxygen?

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  moles = mass in grams ÷ A_r = 162 ÷ 27.0 = **6.00 mol**

NANYANG GIRLS' HIGH

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- First, calculate the number of moles of aluminium that are used:
  moles = mass in grams ÷ A_r = 162 ÷ 27.0 = **6.00 mol**

- Next, calculate the moles of aluminium oxide produced by 6.00 mol of aluminium:
  From the balanced chemical equation…
  6.00 mol Al forms ($^2/_4 \times 6.00$) mol Al_2O_3 = **3.00 mol**

Question 2.

$$4Al_{(s)} + 3O_{2(g)} \rightarrow 2Al_2O_{3(s)}$$

- What mass of aluminium oxide will be formed when **162 g** of **aluminium** reacts completely with oxygen?

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  moles = mass in grams ÷ A_r = 162 ÷ 27.0 = **6.00 mol**

- Next, calculate the moles of aluminium oxide produced by 6.00 mol of aluminium:
  From the balanced chemical equation…
  6.00 mol Al forms ($^2/_4 \times 6.00$) mol Al_2O_3 = **3.00 mol**

- Finally, calculate the mass in grams of 3 moles of aluminium oxide:
  mass in grams = moles × M_r
  = 3 × ((2 × 27.0) + (3 × 16.0)) = **306 g**

Question 3.

$$CaCO_{3(s)} \rightarrow CaO_{(s)} + CO_{2(g)}$$

- What mass of calcium carbonate is required to make **112 g** of **calcium oxide**?

Question 3.

$$CaCO_{3(s)} \rightarrow CaO_{(s)} + CO_{2(g)}$$

- What mass of calcium carbonate is required to make **112 g** of **calcium oxide**?

- First, calculate the number of moles of calcium oxide that are formed:

moles = mass in grams ÷ M_r

= 112 ÷ (40.0 + 16.0) = **2.00 mol**

Question 3.

$$CaCO_{3(s)} \rightarrow CaO_{(s)} + CO_{2(g)}$$

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- First, calculate the number of moles of calcium oxide that are formed:

moles = mass in grams ÷ M_r

= 112 ÷ (40.0 + 16.0) = **2.00 mol**

- Next, calculate the moles of calcium carbonate that are required to make 2.00 mol of calcium oxide:

From the balanced chemical equation…

2.00 mol CaO comes from ($^{1}/_{1}$ × 2.00) mol $CaCO_3$ = **2.00 mol**

Question 3.

$$CaCO_{3(s)} \rightarrow CaO_{(s)} + CO_{2(g)}$$

- What mass of calcium carbonate is required to make **112 g** of **calcium oxide**?

- First, calculate the number of moles of calcium oxide that are formed:

  moles = mass in grams ÷ M_r

  = 112 ÷ (40.0 + 16.0) = **2.00 mol**

- Next, calculate the moles of calcium carbonate that are required to make 2.00 mol of calcium oxide:

  From the balanced chemical equation…

  2.00 mol CaO comes from ($^1/_1 \times 2.00$) mol $CaCO_3$ = **2.00 mol**

- Finally, calculate the mass in grams of 2.00 mol of $CaCO_3$:

  = moles × M_r = 2.00 × (40 + 12 + (3 × 16.0)) = **200 g**

Mole Concept

Calculation of Formula from Percentage Composition

- The formula of a compound tells us the number of moles of each element present in one mole of the compound.

- Consider glucose:

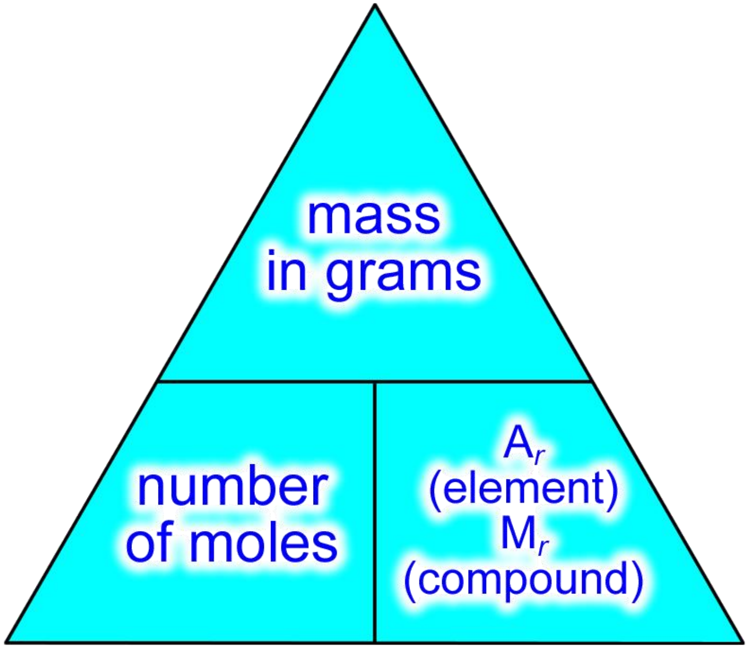
$C_6H_{12}O_6$

One mole of glucose molecules contain:

6 mol of carbon atoms

12 mol of hydrogen atoms

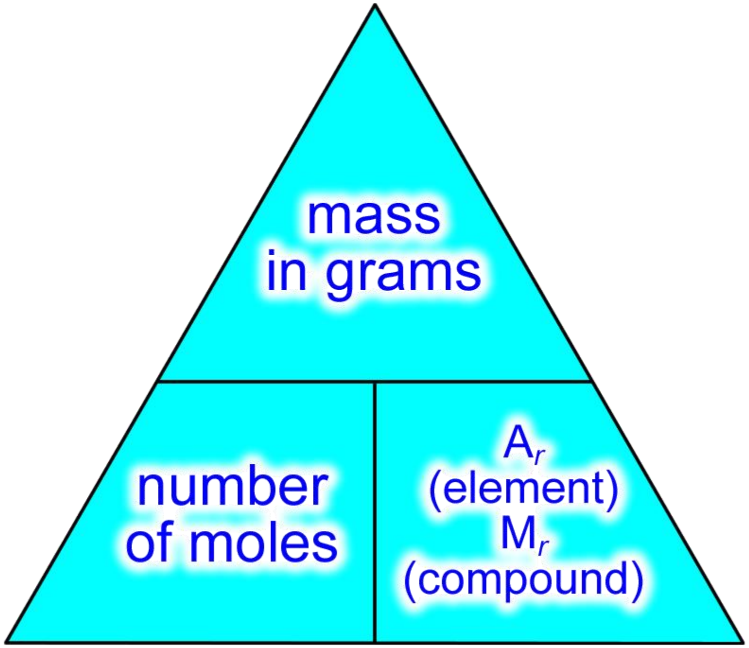
6 mol of oxygen atoms.



Mole Concept

Calculation of Formula from Percentage Composition

- The number of moles of each element present in the compound equals the element's mass in grams divided by the element's relative atomic mass.

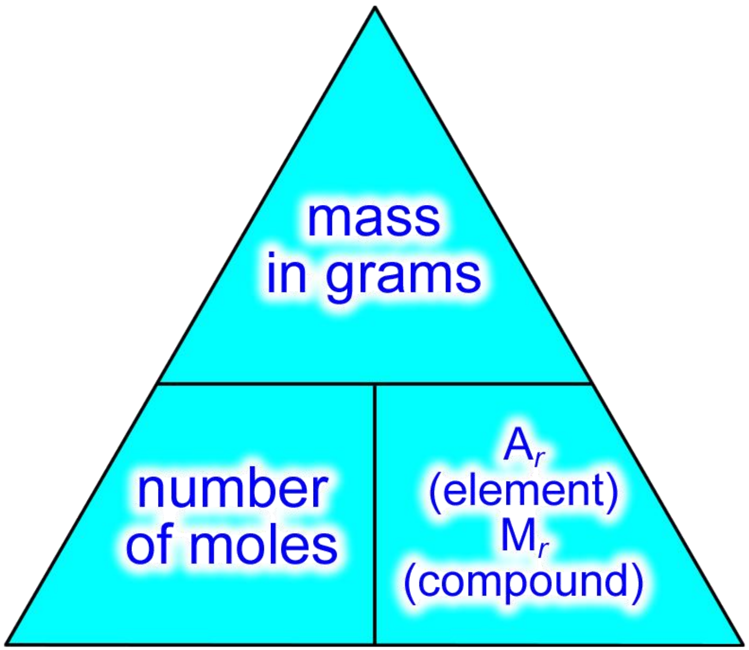


Mole Concept

Calculation of Formula from Percentage Composition

- When given the *percentage* of an element in a compound, we simply imagine that we have *100 g* of the compound. The percentage composition can then be directly translated into a mass in grams.

- For example, if a compound is 80.0 % carbon and 20.0 % hydrogen, then 100 g of the compound would contain 80.0 g of carbon and 20.0 g of hydrogen.



Mole Concept

Calculation of Formula from Percentage Composition

- Calculate the *empirical formula* of the hydrocarbon that has the following percentage composition:

C = 85.7%   H = 14.3 %

- Given that the relative molecular mass of the hydrocarbon is 42.0, calculate the *molecular formula* of the hydrocarbon.

Mole Concept

Calculation of Formula from Percentage Composition

Element:	Carbon 85.7%	Hydrogen 14.3%

Mole Concept

Calculation of Formula from Percentage Composition

Element:	Carbon 85.7%	Hydrogen 14.3%
1: Divide percentage by relative atomic mass:		

Mole Concept

Calculation of Formula from Percentage Composition

Element:	Carbon 85.7%	Hydrogen 14.3%
1: Divide percentage by relative atomic mass:	85.7 ÷ 12 = 7.14	14.3 ÷ 1 = 14.3

Mole Concept

Calculation of Formula from Percentage Composition

Element:	Carbon 85.7%	Hydrogen 14.3%
1: Divide percentage by relative atomic mass:	85.7 ÷ 12 = 7.14	14.3 ÷ 1 = 14.3
2: Divide through by the smallest answer to simplify the ratio:		

Mole Concept

Calculation of Formula from Percentage Composition

Element:	Carbon 85.7%	Hydrogen 14.3%
1: Divide percentage by relative atomic mass:	$85.7 \div 12 = 7.14$	$14.3 \div 1 = 14.3$
2: Divide through by the smallest answer to simplify the ratio:	$7.14 \div 7.14 = 1$	$14.3 \div 7.14 = 2$

Mole Concept

Calculation of Formula from Percentage Composition

Element:	Carbon 85.7%	Hydrogen 14.3%
1: Divide percentage by relative atomic mass:	85.7 ÷ 12 = 7.14	14.3 ÷ 1 = 14.3
2: Divide through by the smallest answer to simplify the ratio:	7.14 ÷ 7.14 = 1	14.3 ÷ 7.14 = 2
3: Empirical formula:		

Mole Concept

Calculation of Formula from Percentage Composition

Element:	Carbon 85.7%	Hydrogen 14.3%
1: Divide percentage by relative atomic mass:	$85.7 \div 12 = 7.14$	$14.3 \div 1 = 14.3$
2: Divide through by the smallest answer to simplify the ratio:	$7.14 \div 7.14 = 1$	$14.3 \div 7.14 = 2$
3: Empirical formula:	CH_2	

Mole Concept

Calculation of Formula from Percentage Composition

Step 4: Calculate the relative molecular mass of the compound’s empirical formula.

$$= C + (2 \times H)$$

$$= 12.0 + (2 \times 1.0)$$

$$= 14.0$$

Mole Concept

Calculation of Formula from Percentage Composition

Step 5: Divide the relative molecular mass of the compound’s molecular formula by the relative molecular mass of the compound’s empirical formula.

$$= 42.0 \div 14.0$$

$$= 3.00$$

Mole Concept

Calculation of Formula from Percentage Composition

Step 6: Multiply the empirical formula by the answer to Step 5 to determine the compound's *molecular formula*.

$$= CH_2 \times 3.00$$

$$C_3H_6$$

Mole Concept

Presentation on
Mole Concept

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"It's a terrible thing, I think, in life to wait until you're ready. I have this feeling now that actually no one is ever ready to do anything. There is almost no such thing as ready. There is only now. And you may as well do it now. Generally speaking, now is as good a time as any."

Hugh Laurie