

Using the Correct Moles Equations to Solve Problems

You will have learned 3 equations that you can use to calculate the **number of moles** of a chemical in several different situations. These are shown below. The difficulty for many students is being able to work out how to apply them in a moles based question.

Here is **one suggested method** for approaching moles questions that may help you. Give it a try.

1.

MASSES

You can calculate the **number of moles, n** , if you are given a **mass, m** . You also need to know the **molar mass, MM** (which is numerically the same as the r.a.m. or r.f.m).

You can use r.a.m or r.f.m. instead and it will still give you the correct **numerical value** for n .

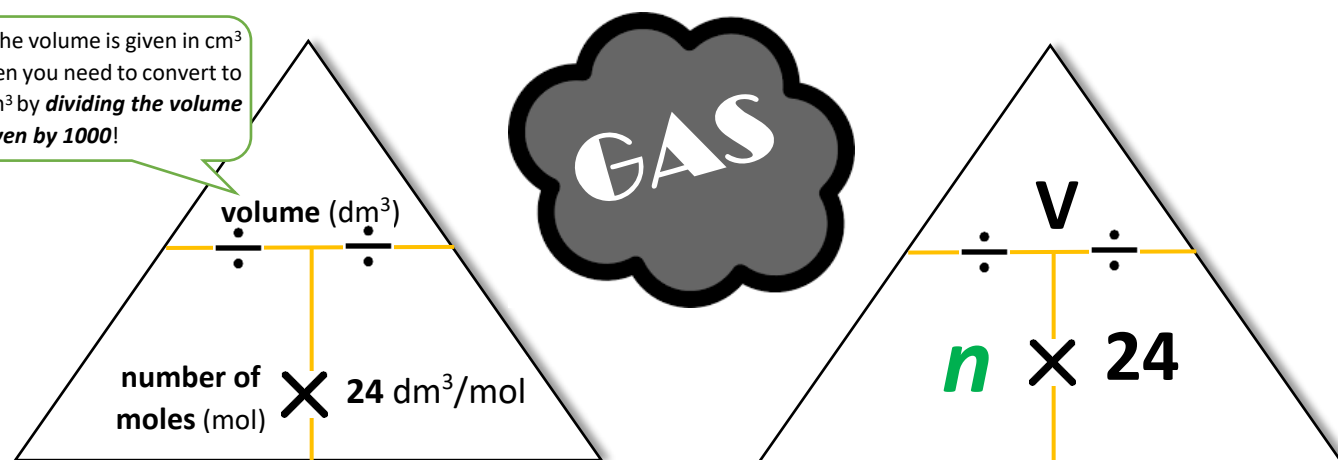


2.

GASES

You can calculate the **number of moles, n** , if you are given a **volume of gas, v** . You also need to know the **molar gas volume** which has a value of $24 \text{ dm}^3/\text{mol}$

If the volume is given in cm^3 then you need to convert to dm^3 by **dividing the volume given by 1000!**



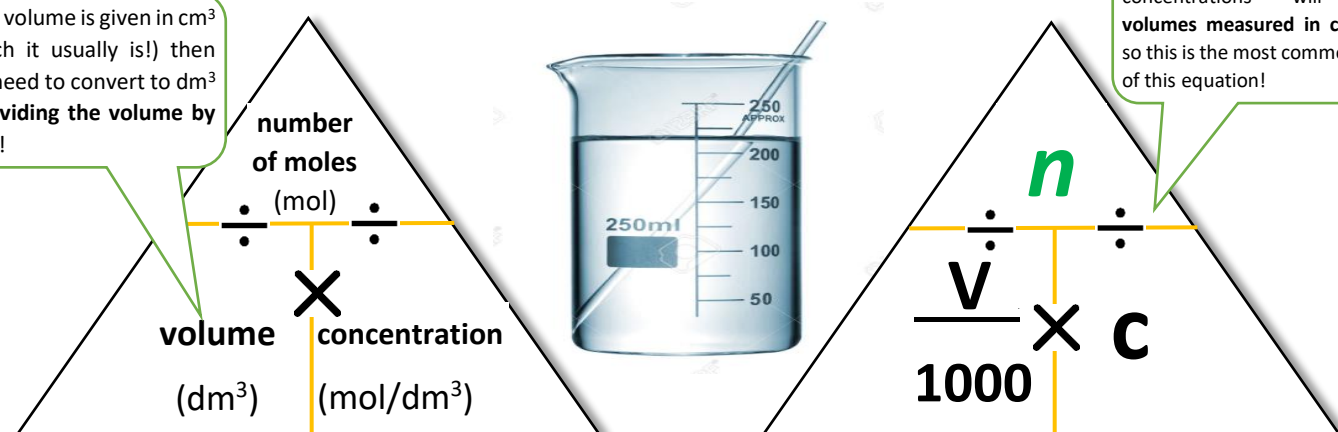
3.

SOLUTIONS

You can calculate the **number of moles, n** , if you are given a **volume of solution, v** and the **concentration, c** . REMEMBER that the volume must be in dm^3 !

If the volume is given in cm^3 (which it usually is!) then you need to convert to dm^3 by **dividing the volume by 1000!**

Most calculations involving concentrations will have **volumes measured in cm^3** and so this is the most common form of this equation!



When you are given a problem that involves moles, you will usually be given some information about one of the chemicals in a chemical reaction and you will be asked to work out something about one of the other chemicals.

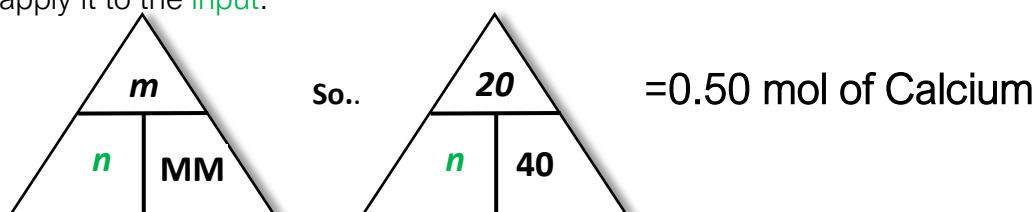
Your job is to **carefully read through all of the problem** to work out **what is the chemical you are being told about** (we could call this the *input*) and which is the chemical that you need to work out the answer for (we could call this the *output*)

For example,

Qu. *If 20g of calcium was reacted with sulfur, what mass of sulfur would be needed to completely react with the calcium?*

Ans In this problem the question tells you something about **calcium** (the *input*) but asks you to work something out for **sulfur** (the *output*). This is the first task done!

Then you need to turn the *input* into a number of moles. To do this you need to **select the correct moles equation out of the three**. This question is clearly about **masses**, so you use the first equation and apply it to the *input*.



You will then need a **balanced equation** to find the **chemical ratio** between your *input* and *output*. The balanced equation may well be given to you.

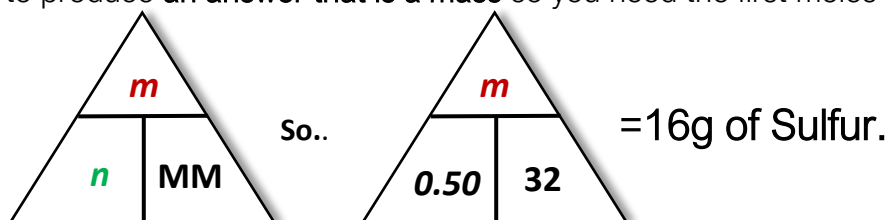


This equation simply tells you that **Ca** atoms and **S** atoms react in **RATIO 1 : 1**

You know that you have **0.50 mol** of **Ca** atoms and so you need **0.50 mol** of **S** atoms to go with them.

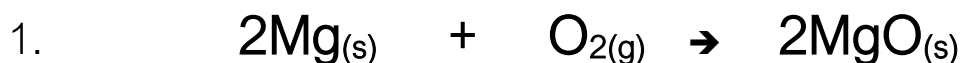
Now you have the moles of the *output*, you need to select the correct moles equation for *output*.

You are asked to produce **an answer that is a mass** so you need the first moles equation again.



In general, the sequence to follow is:

- 1) Find out what chemical is the *input* and which chemical is the *output*.
- 2) Work out the **moles of input** by selecting the correct moles equation (**MASSSES, GASES or SOLUTIONS**).
- 3) Work out the **moles of output** by using the balanced equation (the ratio of **input : output!**)
- 4) Select the correct moles equation for the *output*. Is the *output* required as a **MASS, VOLUME of GAS, or as a SOLUTION?**
- 5) Use the correct moles equation for the *output*. Get the answer!



Qu. If 12g of magnesium was reacted with oxygen, what volume of oxygen gas would be needed to completely react with the magnesium?

Ans. What chemical is the **input**?

What chemical is the **output**?

What moles equation is needed for the **input**? (circle one) masses/gases/solutions

Use the equation to calculate the **moles of input**

moles of **input** = mol

Using the balanced equation, give the **ratio of input : output** :

What is the number of **moles of output**? mol

What moles equation is needed for the **output**? (circle one)
masses/gases/solutions

Use the equation to calculate the **volume of oxygen**.

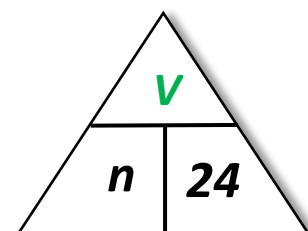
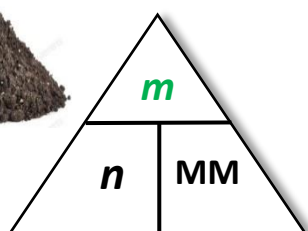
volume of oxygen = dm³

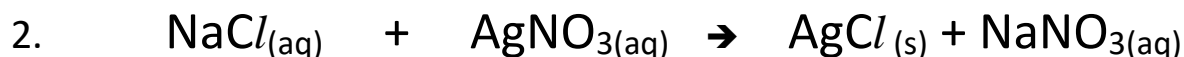
This would be better converted into cm³. You should be able to do this.

volume of oxygen = cm³

So we have followed a sequence:

mass of input → moles of input → (balanced equation) → moles of output → **volume of output**





Qu. 250 cm^3 of 2.0 mol/dm^3 sodium chloride solution was reacted with an excess of silver nitrate solution. Solid silver chloride precipitate (solid) was made in the reaction. The reaction is shown above.

What mass of silver chloride would be made in this reaction?

Ans. What chemical is the input?

What chemical is the output?

What moles equation is needed for the **input**? masses/gases/solutions

Use the equation to calculate the **moles of input**

moles of input = mol

Using the balanced equation, give the **ratio of input : output** :

What is the number of **moles of output**? mol

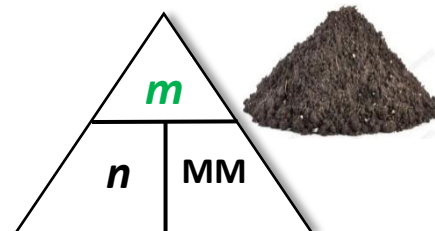
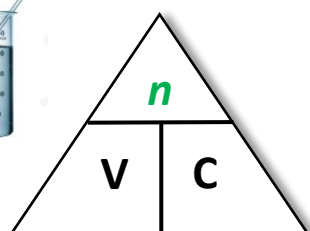
What moles equation is needed for the **output**? masses/gases/solutions

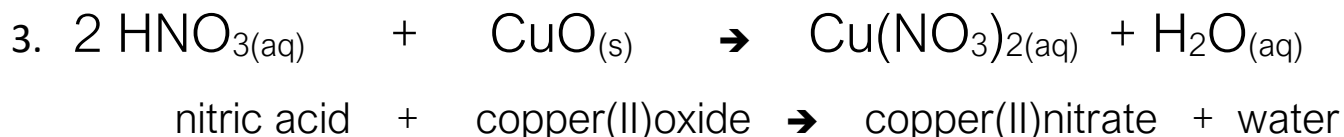
Use the equation to calculate the **mass of silver chloride ($\text{AgCl}_{(s)}$)**

mass of silver chloride ($\text{AgCl}_{(s)}$) =g

So we have followed a sequence:

vol and conc. of input \rightarrow moles of input \rightarrow (balanced equation) \rightarrow moles of output \rightarrow mass of output





Qu. An excess of copper(II)oxide solid was added to 100 cm³ of 3.0 mol/dm³ nitric acid and the solution heated. Unreacted copper(II)oxide was filtered off to leave a blue solution of copper(II)nitrate. The final volume of the solution was reduced to 90cm³ because of the heating.

Calculate the concentration of the copper(II)nitrate.

Ans. What chemical is the input?

What chemical is the output?

What moles equation is needed for the **input**? masses/gases/solutions

Use the equation to calculate the **moles of input**

moles of input = mol

Using the balanced equation, give the **ratio of input : output** :

What is the number of **moles of output**? mol

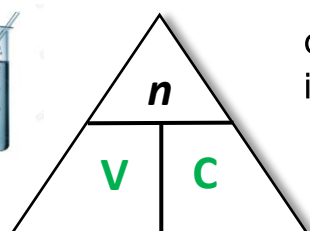
What moles equation is needed for the **output**? masses/gases/solutions

Use the equation to calculate the **concentration of the copper(II)nitrate**.

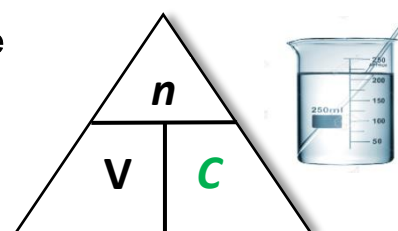
concentration of the copper(II)nitrate.mol/dm³

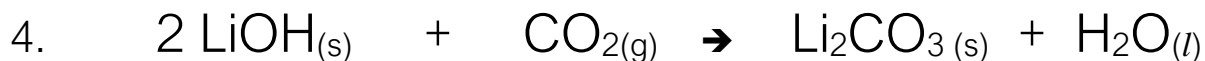
So we have followed a sequence:

vol and conc. of input \rightarrow moles of input \rightarrow (balanced equation) \rightarrow moles of output \rightarrow **conc. of output**



don't forget that these volumes are in cm³ so need converting to dm³!





Qu. On spacecraft, toxic carbon dioxide, exhaled by astronauts must be 'scrubbed' from the atmosphere within the spacecraft atmosphere. It is done by continually passing carbon dioxide rich atmosphere through canisters containing highly reactive dry lithium hydroxide. A canister contains 1 kg of LiOH.

How many canisters would be required to scrub 1500 dm³ of carbon dioxide from the spacecraft atmosphere?

Ans. What chemical is the input?

What chemical is the output?

What moles equation is needed for the **input**? masses/gases/solutions

Use the equation to calculate the **moles of input**

moles of input = mol

Using the balanced equation, give the **ratio of input : output** :

What is the number of **moles of output**? mol

What moles equation is needed for the **output**? masses/gases/solutions

Use the equation to calculate the **mass of LiOH**.

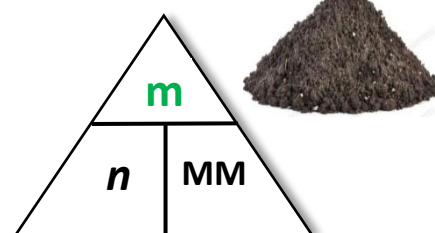
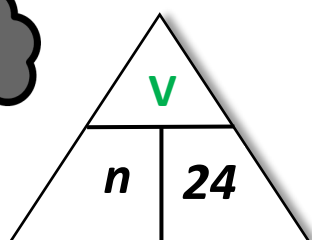
mass of LiOH =g

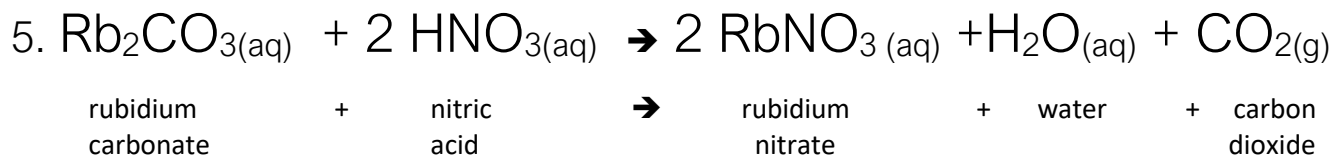
Calculate the number of canisters required.

Number of canisters =

So we have followed a sequence:

volume of input → moles of input → (balanced equation) → moles of output → mass of output





Qu. A **titration** was carried out to find the concentration of rubidium carbonate solution using nitric acid of known concentration.

The concentration of the nitric acid was 0.150 mol/dm^3 .

25.0 cm^3 portions of rubidium carbonate solution were titrated against the nitric acid. The volumes (titres) of nitric acid were found to be 27.45 cm^3 , 26.65 cm^3 and 26.55 cm^3 .

Find the concentration of rubidium carbonate in mol/dm^3 .

Ans. What chemical is the input?

What chemical is the output?

What moles equation is needed for the **input**? masses/gases/solutions

Use the equation to calculate the **moles of input**

moles of input = mol

Using the balanced equation, give the **ratio of input : output** :

What is the number of **moles of output**? mol

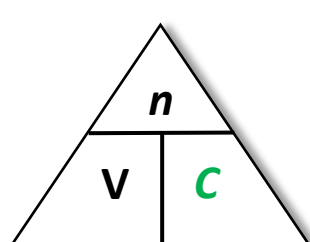
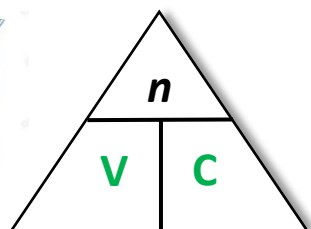
What moles equation is needed for the **output**? masses/gases/solutions

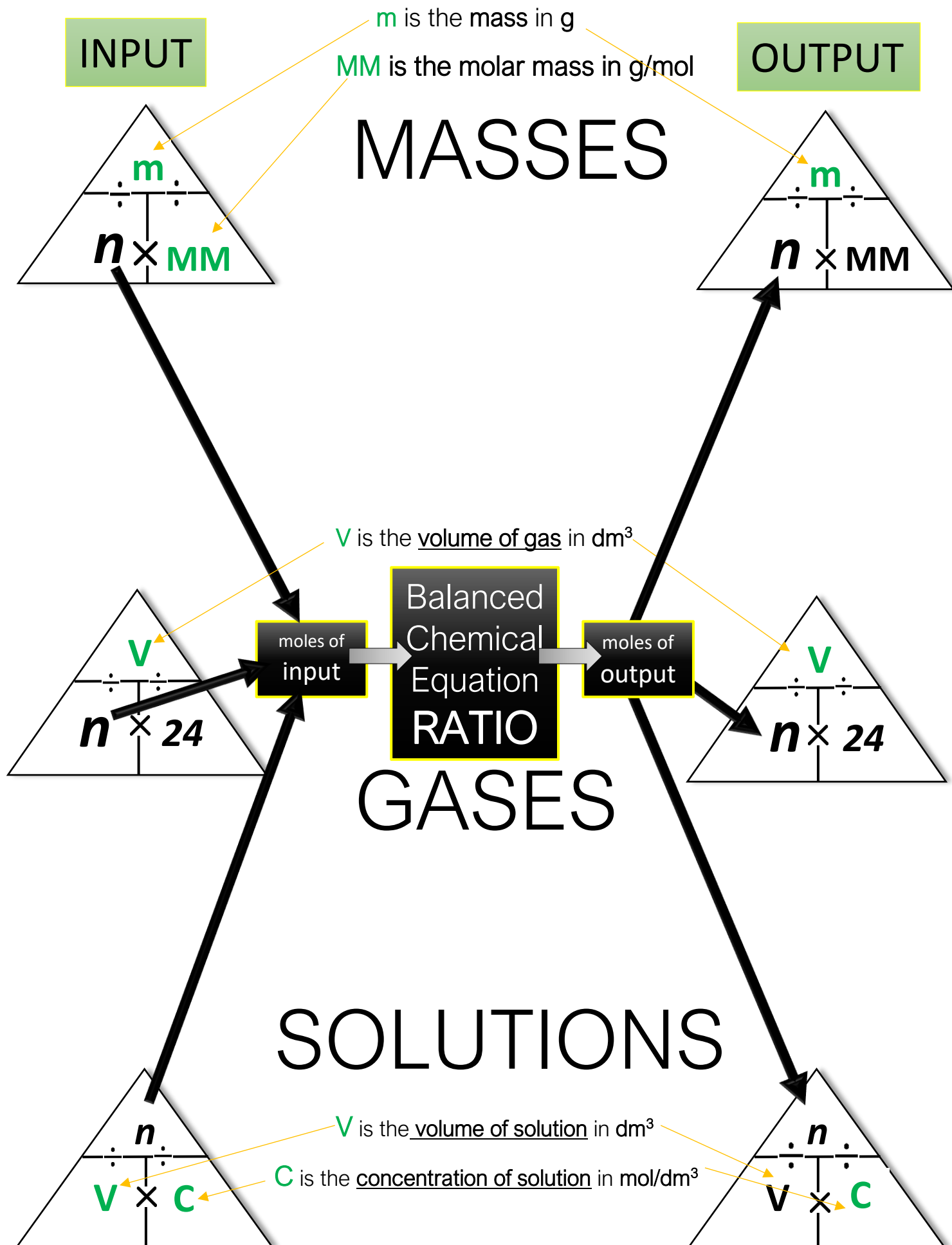
Use the equation to calculate the **concentration of Rb_2CO_3 solution**.

concentration of the Rb_2CO_3 mol/dm^3

So we have followed a sequence:

vol and conc. of input → moles of input → (balanced equation) → moles of output → conc. of output





Answers to the questions.

Qu	INPUT			Ratio Input:output	OUTPUT			Answer
	Input chemical	moles equation needed	Moles of input		Output chemical	Moles of output	moles equation needed	Mass/vol of gas/ conc. of soln
1	magnesium	masses	0.50 mol	2:1	oxygen	0.25 mol	gases	6.0dm³ 6000cm³
2	Sodium chloride	solutions	0.50 mol	1:1	Silver chloride	0.50 mol	masses	71.8g
3	Nitric acid	solutions	0.30 mol	2:1	Copper(II) nitrate	0.15 mol	solutions	1.67 mol/dm³
4	Carbon dioxide	gases	62.5 mol	1:2	Lithium hydroxide	125 mol	masses	3000g so 3 canisters
5	Nitric acid	solutions	0.0039 or 3.9x10 ⁻³ mol	2:1	Rubidium carbonate	0.00195 or 1.95 x 10 ⁻³ mol	solutions	0.078 mol/dm³