1.7

Balancing with particles

Name _____ Class _____ Mark _____ / 19

What you are practising

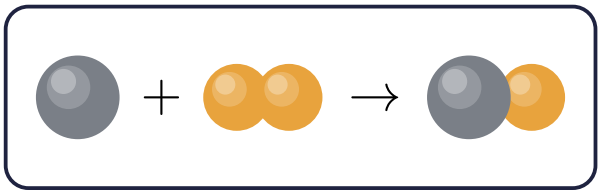
I can use particle pictures to balance an equation: the same atoms must appear on both sides, and I change only the number of particles, never what is inside a particle.

Key

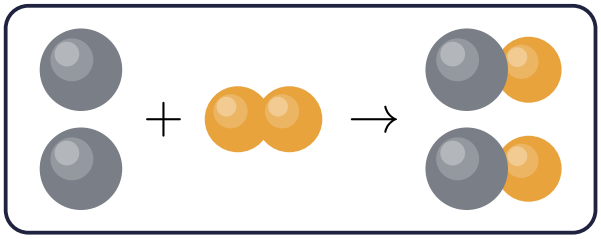
hydrogen (H) oxygen (O) nitrogen (N) chlorine (Cl) magnesium (Mg) sodium (Na)

Bigger atoms are drawn bigger, so you can tell them apart on a black-and-white copy too.

Worked example: magnesium burns in oxygen



One of each: 1 Mg on the left, 1 Mg on the right; 2 O on the left, only 1 O on the right.



Add a second MgO to fix oxygen. Now 2 Mg on the right, so add a second Mg on the left.

The rule: you may add more whole particles. You may not change a particle: MgO cannot become MgO_2, because that is a different substance.

Check: count each type of atom on both sides.

Mg: 2 on the left, 2 on the right.
O: 2 on the left, 2 on the right.

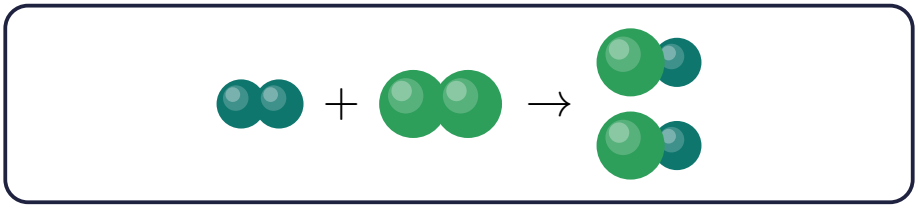
$$\boxed{2}\,Mg\,(s) + \boxed{1}\,O_2\,(g) \longrightarrow \boxed{2}\,MgO\,(s)$$

Page done? Tick it off

1 Read the picture [3]

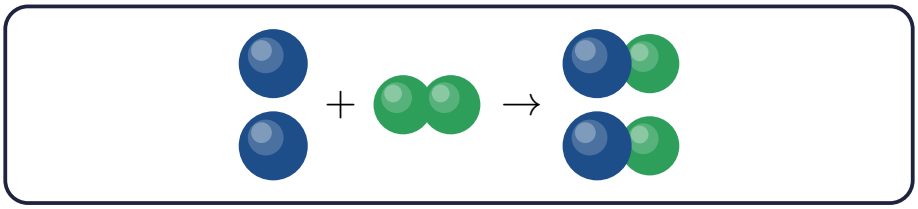
Each picture is already balanced. Count the particles and write the numbers in the boxes. One mark each.

(a) Level 1



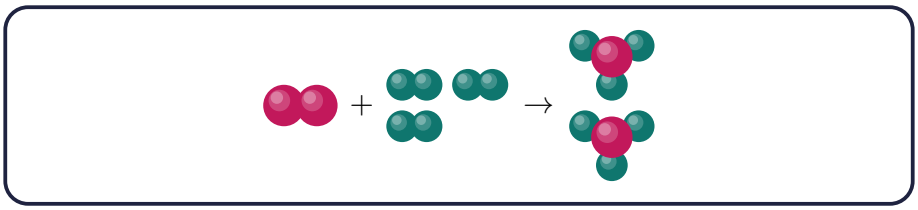
☐ $H_2\,(g)$ + ☐ $Cl_2\,(g)$ → ☐ $HCl\,(g)$

(b) Level 2



☐ $Na\,(s)$ + ☐ $Cl_2\,(g)$ → ☐ $NaCl\,(s)$

(c) Level 2

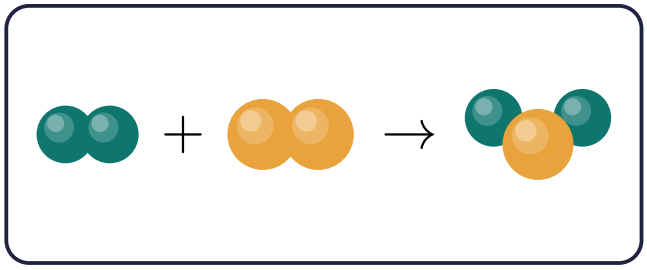


☐ $N_2\,(g)$ + ☐ $H_2\,(g)$ → ☐ $NH_3\,(g)$

2 Hydrogen burns in oxygen

Level 1 [2]

Draw extra whole particles in the right-hand box until every type of atom balances. Use the step table to count: compound with the most atoms first, elements on their own last, recount after every change. Then write the numbers in the boxes; write 1 if no number is needed. One mark for the picture, one for the equation.



Draw the balanced picture

One of each

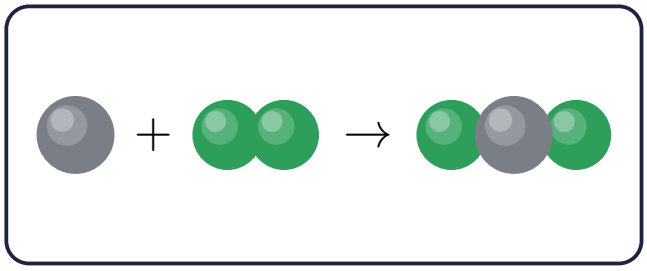
Balanced

☐ H_2 (g) + ☐ O_2 (g) → ☐ H_2O (l)

Step	What I changed	H		O	
		L	R	L	R
Start	count the atoms				
1					
2					
3					

3 Magnesium burns in chlorine

Level 1 [2]



Draw the balanced picture

One of each

Balanced

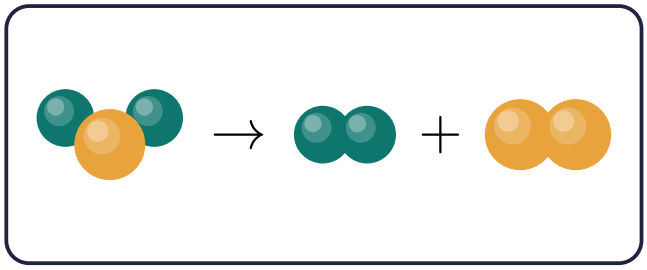
☐ Mg (s) + ☐ Cl_2 (g) → ☐ $MgCl_2$ (s)

Step	What I changed	Mg		Cl	
		L	R	L	R
Start	count the atoms				
1					
2					
3					

Page done? Tick it off

4 Water is split by electricity

Level 2 [2]



Draw the balanced picture

One of each

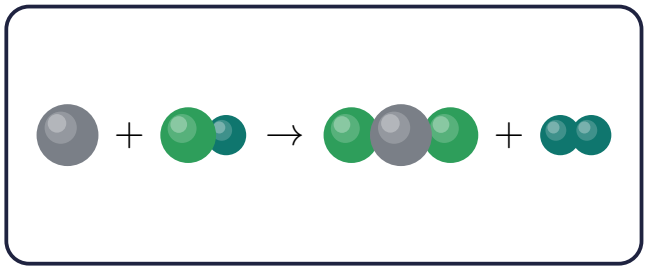
Balanced

$\square\ H_2O\,(l) \longrightarrow \square\ H_2\,(g) + \square\ O_2\,(g)$

Step	What I changed	H		O	
		L	R	L	R
Start	count the atoms				
1					
2					
3					

5 Magnesium and hydrochloric acid

Level 2 [2]



Draw the balanced picture

One of each

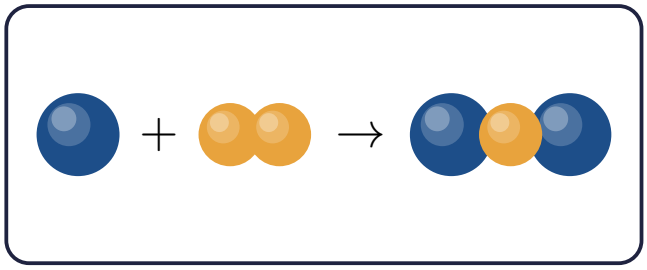
Balanced

$\square\ Mg\,(s) + \square\ HCl\,(aq) \longrightarrow \square\ MgCl_2\,(aq) + \square\ H_2\,(g)$

Step	What I changed	Mg		H		Cl	
		L	R	L	R	L	R
Start	count the atoms						
1							
2							
3							

6 Sodium burns in oxygen

Level 3 [2]



Draw the balanced picture

One of each

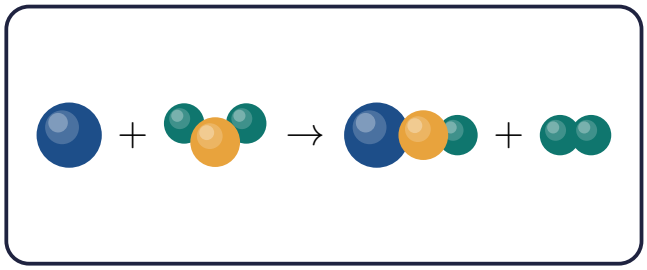
Balanced

☐ Na (s) + ☐ O_2 (g) ⟶ ☐ Na_2O (s)

Step	What I changed	Na		O	
		L	R	L	R
Start	count the atoms				
1					
2					
3					

7 Sodium and water

Level 3 [2]



Draw the balanced picture

One of each

Balanced

☐ Na (s) + ☐ H_2O (l) ⟶ ☐ NaOH (aq) + ☐ H_2 (g)

Step	What I changed	Na		H		O	
		L	R	L	R	L	R
Start	count the atoms						
1							
2							
3							

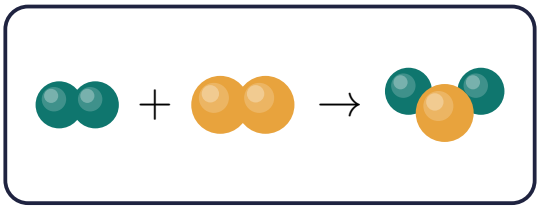
Page done? Tick it off

8 Explain [2]

Why must the number of each type of atom be the same on both sides of an equation? Use what happened to the mass when you burned magnesium.

9 Who is right? [2]

Leo and Mia were given this unbalanced picture for hydrogen and oxygen:



Leo
"There is one O too few on the right. I added it to the water particle, so the product is H_2O_2. Now it balances."

Mia
"I drew a second water particle. Then I needed 4 H on the left, so I drew a second H_2. Now it is $2H_2 + O_2 \rightarrow 2H_2O$."

Who is right? What rule did the other person break?

Debrief

I can count the atoms in a particle picture. 1 2 3 4

I can draw extra particles to balance an equation. 1 2 3 4

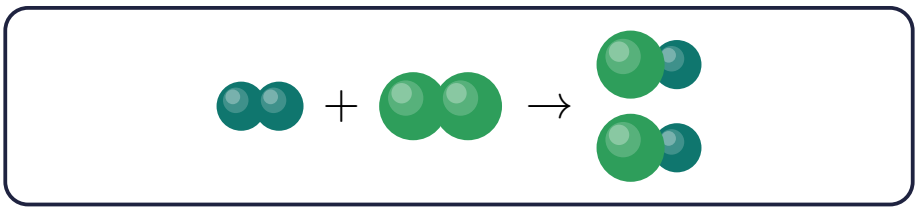
I can write the balanced equation from the picture. 1 2 3 4

1 = not yet 2 = with help 3 = on my own 4 = could teach it

Answers

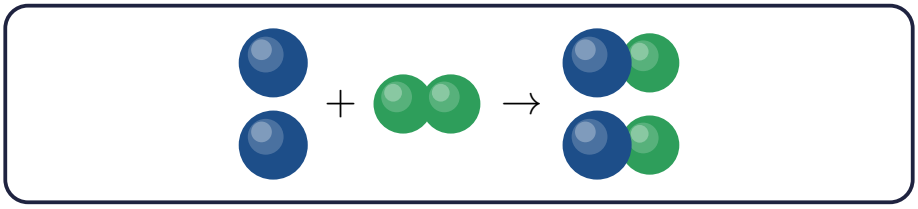
1 Read the picture [3]

(a) Level 1



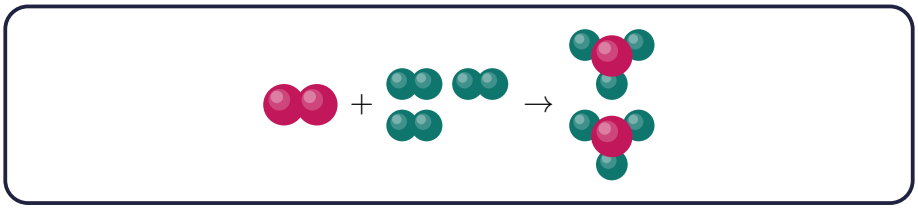
$$\boxed{1}\ H_2\,(g) + \boxed{1}\ Cl_2\,(g) \longrightarrow \boxed{2}\ HCl\,(g)$$

(b) Level 2



$$\boxed{2}\ Na\,(s) + \boxed{1}\ Cl_2\,(g) \longrightarrow \boxed{2}\ NaCl\,(s)$$

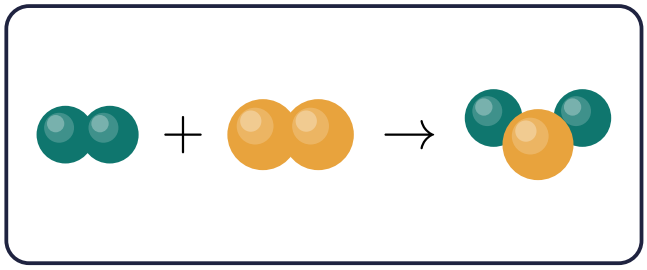
(c) Level 2

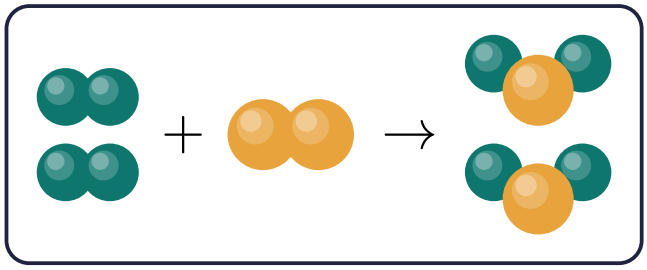


$$\boxed{1}\ N_2\,(g) + \boxed{3}\ H_2\,(g) \longrightarrow \boxed{2}\ NH_3\,(g)$$

2 Hydrogen burns in oxygen

Level 1 [2]





One of each

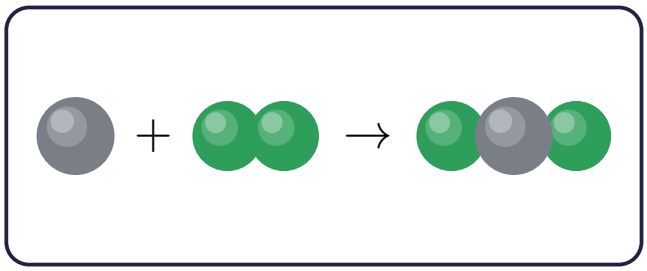
Balanced

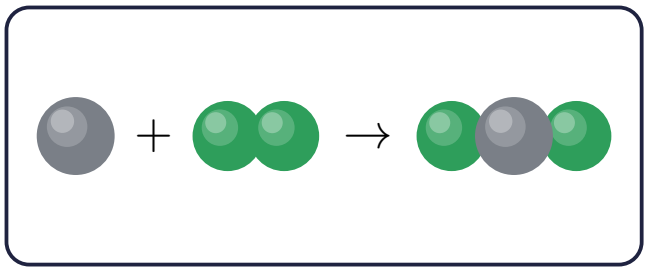
2 $H_2(g)$ + 1 $O_2(g)$ → 2 $H_2O(l)$

Step	What I changed	H		O	
		L	R	L	R
Start	count the atoms	2	2	2	1
1	2 in front of H_2O	2	4	2	2
2	2 in front of H_2	4	4	2	2

3 Magnesium burns in chlorine

Level 1 [2]





One of each

Balanced

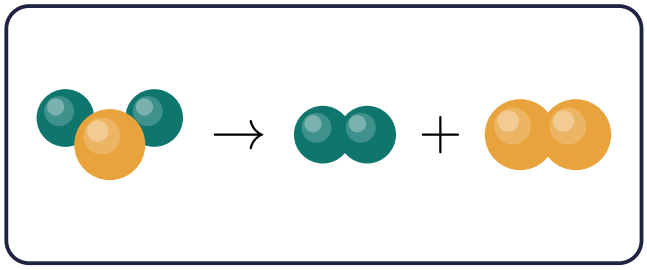
1 $Mg(s)$ + 1 $Cl_2(g)$ → 1 $MgCl_2(s)$

Step	What I changed	Mg		Cl	
		L	R	L	R
Start	count the atoms	1	1	2	2

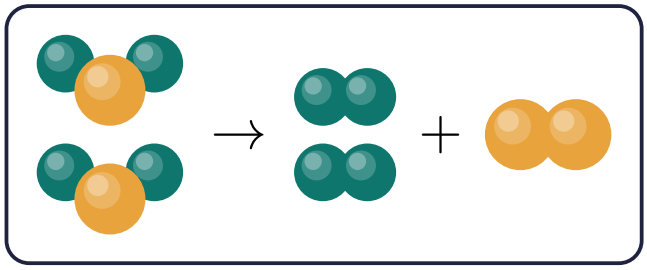
Page done? Tick it off

4 Water is split by electricity

Level 2 [2]



One of each



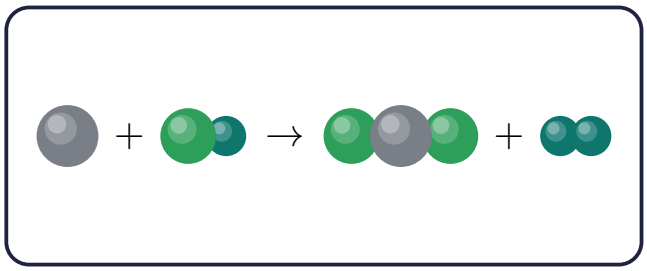
Balanced

2 $H_2O\,(l)$ → 2 $H_2\,(g)$ + 1 $O_2\,(g)$

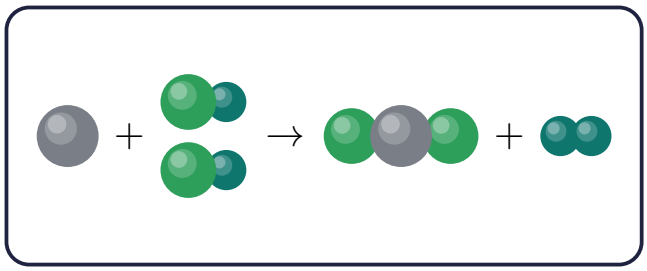
Step	What I changed	H		O	
		L	R	L	R
Start	count the atoms	2	2	1	2
1	2 in front of H_2O	4	2	2	2
2	2 in front of H_2	4	4	2	2

5 Magnesium and hydrochloric acid

Level 2 [2]



One of each



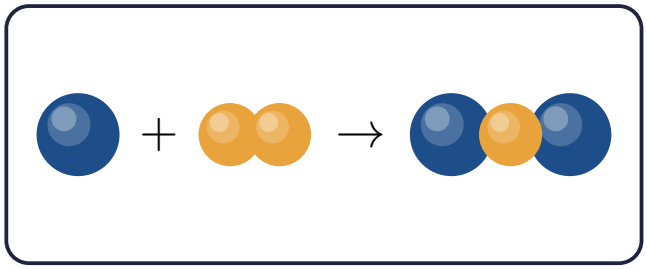
Balanced

1 $Mg\,(s)$ + 2 $HCl\,(aq)$ → 1 $MgCl_2\,(aq)$ + 1 $H_2\,(g)$

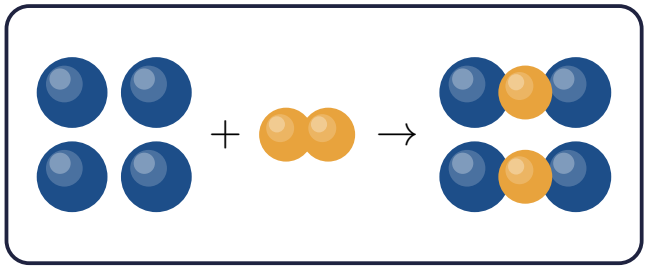
Step	What I changed	Mg		H		Cl	
		L	R	L	R	L	R
Start	count the atoms	1	1	1	2	1	2
1	2 in front of HCl	1	1	2	2	2	2

6 Sodium burns in oxygen

Level 3 [2]



One of each



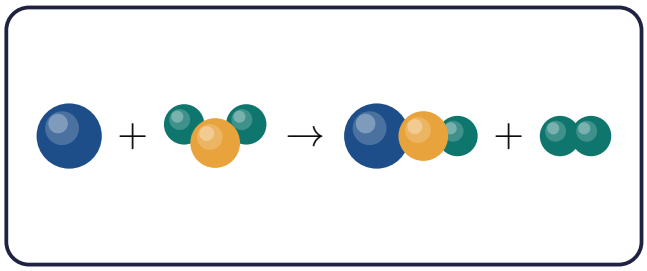
Balanced

4 Na (s) + 1 O_2 (g) → 2 Na_2O (s)

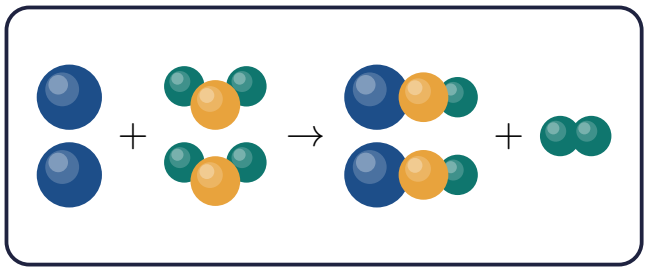
Step	What I changed	Na		O	
		L	R	L	R
Start	count the atoms	1	2	2	1
1	2 in front of Na_2O	1	4	2	2
2	4 in front of Na	4	4	2	2

7 Sodium and water

Level 3 [2]



One of each



Balanced

2 Na (s) + 2 H_2O (l) → 2 NaOH (aq) + 1 H_2 (g)

Step	What I changed	Na		H		O	
		L	R	L	R	L	R
Start	count the atoms	1	1	2	3	1	1
1	2 in front of NaOH	1	2	2	4	1	2
2	2 in front of H_2O	1	2	4	4	2	2
3	2 in front of Na	2	2	4	4	2	2

8 Explain

[2]

Atoms are not made or destroyed in a reaction; they are only rearranged into new particles. [1] The magnesium oxide was heavier because the oxygen atoms from the air were added to it, so all the atoms, and the mass, are still there. [1]

9 **Who is right?** **[2]**

Mia is right. [1] **Leo changed the inside of a particle. H_2O_2 is a different substance (hydrogen peroxide), not water. You may only add whole particles.** [1]

How to revise this

Cover the answer pictures, redraw the balanced picture from the ”one of each” box, then check. Repeat only the ones you missed.