Science Year 9
Reaction Types
Term 2 Week 2 (4^{th} May to 8^{th} May)

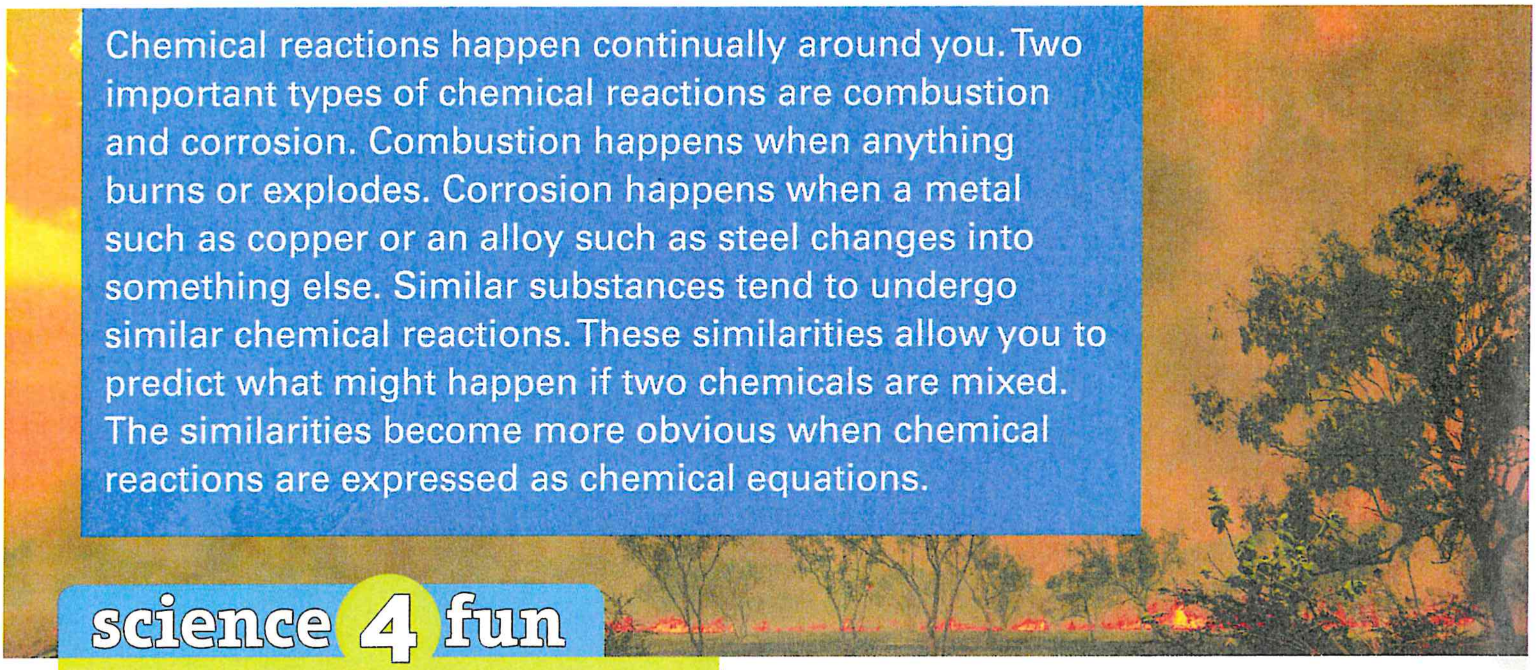
Note to students: Hi Everyone. This week we will be starting another chemistry unit called Reaction Types. If you have the ingredients at home, I encourage you to have a go at making sherbet. The recipe is on the front page in the Science4fun box. The skills that will be covered this week are writing word equations and balanced chemical equations. You will need to read the text supplied very carefully and follow the instructions given. Please contact me if you have problems.
My email: lorraine.cave@education.wa.edu.au
Due date for this week's work is: Friday 15th May.

Lesson	Content
1	**Combustion and corrosion reactions** Read pages 76 & 77, then try the three questions on page 77. After that the worksheet for Lesson 1 needs to be done.
2	**Combustion and corrosion reactions continued** Read pages 78 to 82. Please pay special attention to p 81 and 82, trying the 2 questions on page 82. The worksheet for Lesson 2 then needs to be done.
3	**More balancing equations** Lesson 3 is more practice on balancing equations. Remember, practice, practice, practice.
4 & 5	**Review questions** Please complete the review questions 1 to 15. I have allocated 2 lessons for this.

MODULE

3.1 Combustion and corrosion reactions

Chemical reactions happen continually around you. Two important types of chemical reactions are combustion and corrosion. Combustion happens when anything burns or explodes. Corrosion happens when a metal such as copper or an alloy such as steel changes into something else. Similar substances tend to undergo similar chemical reactions. These similarities allow you to predict what might happen if two chemicals are mixed. The similarities become more obvious when chemical reactions are expressed as chemical equations.



science 4 fun

Eating sherbet

YES

An endothermic reaction absorbs energy from its surroundings. What does an endothermic reaction feel like?

Collect this ...

- ½ teaspoon of citric acid
- ¼ teaspoon of baking soda (bicarbonate of soda, $NaHCO_3$)
- 3 teaspoons of icing sugar
- clean mixing bowl, cup or mug
- teaspoon

SAFETY

You should never eat in the laboratory, so only eat sherbet that you have made at home.

Do this ...

1. Add all the ingredients to the small mixing bowl or mug.
2. Use the back of the teaspoon to crush any lumps and to mix everything together.
3. Keep it in a dry place until ready to eat!

Record this ...

1. Describe what happened in your mouth when you ate the sherbet.
2. Explain why you think this happened.

Try This

Chemical reactions

In a chemical reaction, new substances form and old ones disappear. **Reactants** are the old substances you started with before the chemical reaction. **Products** are the new substances formed by the chemical reaction.

A chemical equation is a convenient way of showing what happens to different substances in a chemical reaction. A chemical reaction is always written in the form:

reactants → products

A **word equation** is a simple description of what is happening in a reaction. It shows the names of all the chemicals that are reactants and all those that are products. An example of a word equation is:

nitrogen gas + hydrogen gas → ammonia

This word equation shows that nitrogen gas and hydrogen gas reacted to form ammonia. Another, more detailed way of showing what is happening in a reaction is to write **a balanced equation**. The balanced equation for the above reaction between nitrogen and hydrogen gases is:

$$N_2 + 3H_2 \rightarrow 2NH_3$$

A balanced equation shows exactly what is happening in a reaction. The big numbers in front of each substance are called **coefficients**. These numbers show how much of each substance reacted and how much of each reactant was produced. For example, the balanced equation above shows that:

- every single molecule of nitrogen reacts with three molecules of hydrogen
- two molecules of ammonia were formed.

SkillBuilder

Writing word equations

To write a word equation, follow the steps below.

Identify the reactants and products.

As an example, consider the chemical reaction between copper and sulfur dioxide. This reaction forms copper sulfide and oxygen gas. You started with copper and sulfur dioxide, so these are the reactants. Copper sulfide and oxygen gas were produced. These are the products.

Write a word equation.

A word equation is a simple written description of what is happening in the reaction. The reactants are placed on the left side of the arrow and the products on the right.

reactants → products

copper + sulfur dioxide → copper sulfide + hydrogen gas

Worked example

Writing word equations

Problem

A piece of aluminium was dropped into hydrochloric acid. The aluminium dissolved and reacted to form aluminium chloride. As it did so, hydrogen gas bubbled to the surface. Write a word equation for this reaction.

Solution

Thinking: Identify the reactants and products.

Working: Reactants = aluminium, hydrochloric acid

Products = aluminium chloride, hydrogen gas

Thinking: Write a word equation.

Working: reactants → products

aluminium + hydrochloric acid → aluminium chloride + hydrogen gas

Try yourself

Construct word equations for the following reactions.

1 Sodium reacts with iron(II) chloride to form sodium chloride and iron.

2 When propanol is burnt in oxygen gas, carbon dioxide and water are formed.

3 Hydrogen peroxide splits to form water and oxygen gas.

AB 3.2

Energy in reactions

An endothermic reaction is a reaction that absorbs heat, taking it from the surroundings and making them feel colder.

In endothermic reactions, the products have more energy than the reactants. Endothermic reactions need energy to proceed and they get their energy from what is around them. An example is what happens in a chemical cold pack that you might use when you have an injury. Packets of ammonium nitrate and water are broken, allowing these substances to mix and react. As they react, they absorb energy from their surroundings, cooling the surroundings down. The sherbet in Figure 3.1.1 acts in a similar way.

While endothermic reactions absorb energy, exothermic reactions release energy. In exothermic reactions, the reactants have more energy than the products. During the reaction, energy is released into the surroundings, usually as heat and/or light.

FIGURE 3.1.1 Sherbet leaves your tongue cold because an endothermic reaction absorbs heat from your mouth.

Combustion

Combustion reactions are examples of exothermic reactions. **Combustion** occurs whenever something reacts with oxygen gas (O_2), burning or exploding as it does so. A bushfire is a series of combustion reactions. The chemicals in living plants, dead twigs and leaves burn in oxygen, releasing huge amounts of heat and light energy as they react.

Combustion reactions belong to a type of reaction known as an oxidation reaction—in its simplest form, an oxidation reaction is when an element reacts with oxygen.

SciFile

That's shocking!

Explosions generate hot gases that suddenly expand at speeds of up to 8 kilometres per second! These expanding gases form blasts of wind called shockwaves, which can be as deadly as the explosion itself. A shockwave leaves a vacuum at the site of the explosion, and air flowing into this carries rubbish and debris.

Combustion of fossil fuels

Bunsen burners, gas stoves, water heaters and central heating furnaces produce a hot blue flame by burning methane or ethane gas in oxygen (Figure 3.1.2). The reactions are:

methane + oxygen gas → carbon dioxide + water

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

ethane + oxygen gas → carbon dioxide + water

$$2C_2H_6 + 7O_2 \rightarrow 4CO_2 + 6H_2O$$

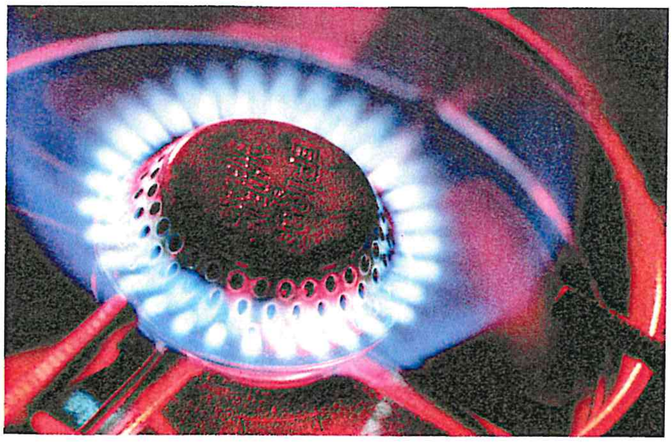


FIGURE 3.1.2 A gas stove uses combustion to release its heat (and light).

Petrol is a mixture of highly combustible chemicals called **hydrocarbons**, the most important of which is octane. Octane combusts via the chemical equation:

octane + oxygen gas → carbon dioxide + water

$$2C_8H_{18} + 25O_2 \rightarrow 16CO_2 + 18H_2O$$

Incomplete combustion

The above combustion reactions all need an unlimited supply of oxygen fed into them. These reactions are known as **complete combustion**.

However, oxygen supply is sometimes restricted in some way. This might happen if there is not enough oxygen or the oxygen cannot mix properly with the fuel. This might happen if a fire was started indoors or the substance burning is so dense or tightly packed that oxygen cannot get into it. If the oxygen supply is restricted in some way, then other reactions occur instead. This is known as **incomplete combustion**. Incomplete combustion is still exothermic but does not release as much heat or light energy as complete combustion does.

The reactions below show what happens to methane if oxygen is restricted.

methane + oxygen gas → carbon monoxide + water

$$2CH_4 + 3O_2 \rightarrow 2CO + 4H_2O$$

At the same time another reaction occurs.

methane + oxygen gas → carbon + water

$$CH_4 + O_2 \rightarrow C + 2H_2O$$

Incomplete combustion reactions are 'dirty' because they produce carbon, which is left behind as soot, charcoal or smoke, like that seen in Figure 3.1.3. They also produce the poisonous gas carbon monoxide. In contrast, complete combustion reactions are 'clean'.

FIGURE 3.1.3 Smoke and soot are an indication of incomplete combustion.

For example, a sheet of paper burns quickly without much smoke. This is because oxygen can easily get to all parts of the paper, allowing all parts to burn at once. However, crumple the paper into a tight ball and it will burn slowly and produce lots of smoke. This happens because only the outside gets enough oxygen to undergo complete combustion. The supply of oxygen to the inner layers of paper is very limited so much of the ball will undergo incomplete combustion. Hence it will burn slowly and produce lots of smoke.

A Bunsen burner can show both complete and incomplete combustion. If the flow of oxygen to it is good (open airhole), then combustion is complete and the flame is hot, clean and blue. If the air flow is restricted (closed airhole), then combustion is incomplete and a cooler, dirty yellow flame is produced.

SciFile

Suffocating fires

Fires consume oxygen, so there is less of it to breathe in the region of the fire. During World War II, the German city of Dresden was firebombed. Many of the 25000 people killed in the attack are thought to have suffocated because of this lack of oxygen.

Pollution and climate change

Water vapour and carbon dioxide are released into the atmosphere whenever fossil fuels such as gas, petrol, oil, coal, diesel and aviation fuel are burnt. Carbon dioxide is a greenhouse gas that traps heat within the atmosphere. Over the past 150 years, we humans have burned huge quantities of fossil fuels to power our cars, ships and aircraft, and to heat their homes and generate electricity. For this reason, the amount of carbon dioxide in the atmosphere has increased to levels that most scientists agree are increasing the atmosphere's average temperature. If this view is correct, then the burning of fossil fuels could be affecting Earth's climate.

If the combustion of these fossil fuels is incomplete, then carbon monoxide and carbon are released.

Carbon adds relatively harmless but dirty soot to the atmosphere. Carbon monoxide gas has no smell, but it is so poisonous that even small amounts of it can kill. Petrol also contains additives that release other poisonous chemicals when burnt. These include oxides of nitrogen and sulfur, both of which can combine with moisture in the air to form smog and acid rain.

Other combustion reactions

A much slower and controlled combustion reaction occurs within the cells of your own body. **Aerobic respiration** combines the sugar **glucose** from the digestion of your food with the oxygen you breathe in. This reaction releases the energy that the cells of your body need. A waste product is carbon dioxide, which you breathe out (Figure 3.1.4).

$$\text{glucose} + \text{oxygen gas} \rightarrow \text{carbon dioxide} + \text{water}$$
$$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$$

FIGURE 3.1.4 Respiration gives your body the energy it needs. The reaction needs glucose (from your food) and oxygen (breathed in). You breathe out its product, carbon dioxide.

Not all combustion reactions produce carbon dioxide and water vapour. When burnt, magnesium reacts to form magnesium oxide. No other products form.

$$\text{magnesium} + \text{oxygen gas} \rightarrow \text{magnesium oxide}$$
$$2Mg + O_2 \rightarrow 2MgO$$

You can see this reaction happening in Figure 3.1.5.

FIGURE 3.1.5 The light released by the combustion of magnesium is so bright that it can quickly damage your eyes.

Prac 1 p. 84
Prac 2 p. 85
Prac 3 p. 86

Corrosion reactions

Most metals corrode when exposed to water, air or other chemicals. **Corrosion** is a chemical reaction that forms other compounds from these metals.

For example, the iron/steel body of a car slowly reacts with water and oxygen in the air and will corrode until all that is left is a pile of rust.

In a similar way, copper corrodes by reacting with gases in the air to form green **verdigris**, a mixture of copper(II) hydroxide and copper(II) carbonate. The typical green colouring of verdigris is obvious in Figure 3.1.6. The chemical equation is:

copper + water + carbon dioxide + oxygen gas → copper(II) hydroxide + copper(II) carbonate

$$2Cu + H_2O + CO_2 + O_2 \rightarrow Cu(OH)_2 + CuCO_3$$

FIGURE 3.1.6 This copper roof has corroded to form a green coating called verdigris.

Pure silver reacts with sulfur to form a black coating called **tarnish** (silver sulfide). This sulfur comes from hydrogen sulfide in air pollution or from foods such as eggs, fish, onions and pea soup.

silver + hydrogen sulfide → silver sulfide + hydrogen gas

$$2Ag + H_2S \rightarrow Ag_2S + H_2$$

Pure sodium and potassium are such reactive metals that they react with just about anything. Their corrosion is very quick and often explosive because of the hydrogen gas that their reactions produce. Their chemical reactions with water are shown below.

sodium + water → sodium hydroxide + hydrogen gas

$$2Na + 2H_2O \rightarrow 2NaOH + H_2$$

potassium + water → potassium hydroxide + hydrogen gas

$$2K + 2H_2O \rightarrow 2KOH + H_2$$

Rusting

Iron and its alloy, steel, are common and relatively cheap. This makes them the most used metals on Earth. Unfortunately, iron and most types of steel react with air and water to form **rust** (Figure 3.1.7). Rust is known chemically as hydrated iron(III) oxide (chemical formula $Fe_2O_3.H_2O$). Rust is flaky and easy to dislodge. This allows the rusting process to continue into the next layer, progressively making the iron or steel thinner and weaker.

FIGURE 3.1.7 Rust forms when iron is exposed to oxygen and water.

Although an extremely complex reaction, rusting can be summarised by the chemical equation:

iron + oxygen gas + water → hydrated iron(III) oxide

$$4Fe + 3O_2 + 2H_2O \rightarrow 2Fe_2O_3{\cdot}H_2O$$

This equation is often simplified to:

iron + oxygen gas → iron(III) oxide

$$4Fe + 3O_2 \rightarrow 2Fe_2O_3$$

In its simplest form, an oxidation reaction involves an element joining with oxygen in a chemical reaction. For this reason, rusting is considered to be an oxidation reaction.

Corrosion of aluminium

Aluminium is very reactive. The surface metal reacts almost immediately with oxygen in the air, forming a fine layer of dull, grey aluminium oxide (Al_2O_3).

aluminium + oxygen gas → aluminium oxide

$$4Al + 3O_2 \rightarrow 2Al_2O_3$$

Unlike rust, this layer does not flake but acts instead like a tightly bound layer of paint, protecting the aluminium from further corrosion. **Anodising** is a process that deliberately builds up a layer of aluminium oxide to protect the aluminium underneath (Figure 3.1.8).

FIGURE 3.1.8 These cups are made of anodised aluminium. Their surface is a layer of aluminium oxide that was deliberately built up on the surface of the metal and then coloured.

SkillBuilder

Writing balanced equations

Chemists use balanced equations to accurately show what is happening in a chemical reaction. To construct a balanced formula equation, follow the steps below.

Write an unbalanced equation.

Replace the names of each substance in a word equation with their element symbols or chemical formulas. This gives you an unbalanced equation. Consider the reaction:

copper + sulfur dioxide → copper sulfide + oxygen gas

Copper has the symbol Cu and the chemical formula of sulfur dioxide is SO_2, copper sulfide is Cu_2S and oxygen gas is O_2.

Replacing their names with their formulas gives the unbalanced equation:

$$Cu + SO_2 \rightarrow Cu_2S + O_2$$

Identify what elements are unbalanced.

An equation is unbalanced when it has unequal numbers of atoms of a particular element on both sides of the arrow. As Figure 3.1.9 shows, the above unbalanced equation starts with one copper atom, one sulfur atom and two oxygen atoms. However, the equation ends up with two copper atoms, one sulfur atom and two oxygen atoms.

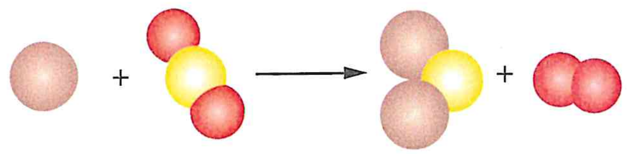


FIGURE 3.1.9

A count of atoms of each element on both sides of the arrow gives:

reactants	→	products
1 × Cu	→	2 × Cu
1 × S	→	1 × S
2 × O	→	2 × O

This suggests that a copper atom appeared from nowhere! That is impossible because atoms never just appear in chemical reactions. Nor do they disappear. They only change in the way they are arranged. This fundamental principle of chemistry is known as the **law of conservation of mass**. To describe accurately the rearrangement that is happening in the reaction, chemical equations need to be balanced.

Balance the equation.

A **balanced equation** has the same numbers of each type of atom on both sides of the arrow. The above reaction would be balanced if the reaction used up two atoms of copper instead of just one. When balancing an equation, you cannot change the small numbers (subscripts) within a chemical formula since that changes the chemical itself (for example, from water H_2O to the bleach hydrogen peroxide H_2O_2). For this reason, you can only change the coefficients of each reactant or product. The coefficients are the big numbers that appear in front of some of the chemicals in a chemical equation. Hence, the correct way of balancing the above equation is:

$$2Cu + SO_2 \rightarrow Cu_2S + O_2$$

Figure 3.1.10 shows what is happening to the atoms in this reaction.

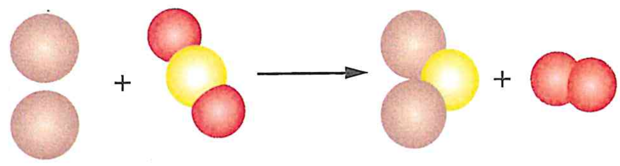


FIGURE 3.1.10 Atoms can't appear from nothing and can't disappear. This is why chemical equations must be balanced.

Check your equation.

Your equation should now be balanced. To make sure that it is, check how many atoms of each element are on either side of the arrow.

reactants	→	products
2 × Cu	→	2 × Cu
1 × S	→	1 × S
2 × O	→	2 × O

Worked example

Writing balanced equations

Problem

Tin (IV) oxide (SnO_2) reacts with hydrogen gas (H_2) to form tin (Sn) and water (H_2O).

Construct a balanced formula equation for this reaction.

Solution

Thinking: Write the unbalanced equation.

Working: $SnO_2 + H_2 \rightarrow Sn + H_2O$

Thinking: Identify which elements are unbalanced.

Working: reactants → products

$1 \times Sn \rightarrow 1 \times Sn$

$2 \times H \rightarrow 2 \times H$

$2 \times O \rightarrow 1 \times O$

Thinking: Balance the equation

Oxygen is unbalanced. By doubling the number of water molecules produced, oxygen becomes balanced. Hence change H_2O to $2H_2O$.

$2H_2 = 2 \times 2$ Hs.

Working: $SnO_2 + H_2 \rightarrow Sn + 2H_2O$

Thinking: Sometimes balancing one element causes another element to become unbalanced. This is what has happened here to hydrogen. The equation now has:

Working: reactants → products

$1 \times Sn \rightarrow 1 \times Sn$

$2 \times H \rightarrow 4 \times H$

$2 \times O \rightarrow 2 \times O$

Thinking: However, doubling the number of H_2 molecules reacting solves the problem:

Working: $SnO_2 + 2H_2 \rightarrow Sn + 2H_2O$

Thinking: Check your equation.

Working: reactants → products

$1 \times Sn \rightarrow 1 \times Sn$

$4 \times H \rightarrow 4 \times H$

$2 \times O \rightarrow 2 \times O$

Try yourself

1 Calcium (Ca) burns in oxygen (O_2) to form calcium oxide (CaO). Construct a balanced formula equation for this reaction.

2 Construct balanced equations by adding coefficients where indicated.

a $CH_4 + O_2 \rightarrow CO_2 +$ .....H_2O

b .....AgBr + $GaPO_4 \rightarrow Ag_3PO_4 + GaBr_3$

c .....NaBr + $Cl_2 \rightarrow$ .....NaCl + Br_2

d $SiCl_4 +$ .....$H_2O \rightarrow SiO_2 +$ .....HCl

e $Au_2S_3 +$ .....$H_2 \rightarrow$ .....Au + ...H_2S

AB 3.3 AB 3.4

3.2 Analysing a reaction

Science inquiry skills

FOUNDATION	STANDARD	ADVANCED

Processing & Analysing | Evaluating | Questioning & Predicting

A bright blue solution of copper sulfate ($CuSO_4$) was poured into a beaker containing a colourless solution of barium chloride ($BaCl_2$). A white powder (a precipitate) of barium sulfate ($BaSO_4$) formed immediately. It then settled to the bottom of the beaker. A clear, bright blue solution of copper chloride ($CuCl_2$) remained on top.

The masses of all reactants, products and their beakers were measured. There were four trials in the experiment. The results are shown in the table below.

Reaction	Results of trials with mass in grams (g)			
	Trial 1	Trial 2	Trial 3	Trial 4
Before reaction				
beaker 1 + $BaCl_2$	225.2	225.7	230.1	228.4
beaker 2 + $CuSO_4$	150.1	149.6	149.8	148.1
total				
After reaction				
beaker 1 + $BaSO_4$ + $CuCl_2$	293.8	293.2	299.4	283.3
empty beaker 2	81.5	81.9	80.2	93.2
total				

1. Calculate the total masses before and after each trial. Enter your results in the table above.

2. Analyse your totals and assess whether the results prove or disprove the Law of conservation of mass.

____

3. Justify your answer to question 2.

____

____

4. In Trial 4, the mass of beaker 2 after the reaction was quite different from all the other measurements of this beaker. Analyse the results and propose a reason why.

____

____

5. Construct a word equation for the reaction.

__________ + __________ → __________ + __________

RATE MY UNDERSTANDING
Shade the face that shows your rating ☺ 😐 ☹

Lesson 2

3.3 Balancing chemical equations 1

Science understanding

FOUNDATION	STANDARD	ADVANCED

1 Classify the following formula equations as balanced or unbalanced. If unbalanced, identify the elements that are not balanced.

	Balanced/ unbalanced equation	Unbalanced element(s)
(a) $H_2O \rightarrow H_2 + O_2$		
(b) $Fe_2O_3 + 2CO \rightarrow 2Fe + 3CO_2$		
(c) $2K + 2H_2O \rightarrow 2KOH + H_2$		
(d) $2CH + 22O_2 \rightarrow 16CO_2 + 18H_2O$		
(e) $C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$		
(f) $C_2H_6 + 7O_2 \rightarrow 2CO_2 + 3H_2O$		
(g) $2CH + 3O \rightarrow 2CO + 4H_2O$		
(h) $2Al + 3O_2 \rightarrow 4Al_2O_3$		
(i) $CaCO_3 + H_2SO_4 \rightarrow CaSO_4 + H_2O + CO_2$		
(j) $CH_3COOH + NaHCO_3 \rightarrow NaCH_3COO + H_2O + CO_2$		

2 Determine the missing number that will balance the following formula equations.

(a) ________ $HCl + CaCO_3 \rightarrow CaCl_2 + H_2O + CO_2$

(b) $CH_4 +$ ________ $O_2 \rightarrow CO_2 +$ ________ H_2O

(c) $C_3H_8 +$ ________ $O_2 \rightarrow 3CO_2 +$ ________ H_2O

(d) $Ca +$ ________ $HCl \rightarrow CaCl_2 + H_2$

(e) $4Fe +$ ________ $O_2 \rightarrow$ ________ Fe_2O_3

3 Modify the following equations to make them balanced. Note that some of them might already be balanced.

(a) $H_2SO_4 + NaOH \rightarrow Na_2SO_4 + H_2O$

(b) $Mg + O_2 \rightarrow MgO$

(c) $H_2O + CO_2 \rightarrow H_2CO_3$

(d) $Ag + H_2S \rightarrow Ag_2S + H_2$

(e) $Na + H_2O \rightarrow NaOH + H_2$

(f) $HCl + Mg \rightarrow MgCl_2 + H_2$

(g) $H_2SO_4 + Fe \rightarrow FeSO_4 + H_2$

(h) $HNO_3 + K_2O \rightarrow KNO_3 + H_2O$

(i) $HCl + CaCO_3 \rightarrow CaCl_2 + H_2O + CO_2$

(j) $NO_2 + H_2O \rightarrow HNO_2 + HNO_3$

(k) $SO_2 + H_3O + O_2 \rightarrow H_2SO_4$

4 Identify the elements present in each of the following equations.

(a) State how many atoms of each element are present in the reactants and the products. The first question is done for you.

(b) Is the equation is balanced (B) or unbalanced (U)? Circle the correct alternative.

Equation elements and atoms	Elements	No. of atoms in reactants	No. of atoms in products	Balanced or unbalanced?	
(i) $C_7H_{16} + O_2 \rightarrow CO_2 + H_2O$	carbon hydrogen oxygen	7 16 2	1 3 2	B	U
(ii) $C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$				B	U
(iii) $FeCl_3 + 3NaOH \rightarrow Fe(OH)_3 + 3NaCl$				B	U
(iv) $Mg(OH)_2 + 2HCl \rightarrow MgCl_2 + H_2O$				B	U
(v) $Ca(OH)_2 + H_3PO_4 \rightarrow Ca_3(PO_4)_2 + H_2O$				B	U

5 For each equation in question 4 that you identified as unbalanced, rewrite the balanced equation.

____

____

____

____

____

____

RATE MY UNDERSTANDING Shade the face that shows your rating	☺	😐	☹

3.4 Balancing chemical equations 2

Science understanding

FOUNDATION	STANDARD	ADVANCED

(1) Balance the following equations.

(a) ____H_2SO_4 + ____HI → ____H_2S + ____I_2 + ____H_2O

(b) ____FeS_2 + ____O_2 → ____Fe_2O_3 + ____SO_2

(c) ____Na_2CO_3 + ____HCl → ____NaCl + ____CO_2 + ____H_2O

(d) ____$KClO_3$ → ____KCl + ____O_2

(e) ____NaOH + ____H_2CO_3 → ____Na_2CO_3 + ____H_2O

(f) ____Li + ____$AlCl_3$ → ____LiCl + ____Al

(g) ____SiF_4 + ____H_2O → ____H_4SiO_4 + ____H_2SiF_6

(h) ____$Fe_2(SO_4)_2$ + ____KOH → ____K_2SO_4 + ____$Fe(OH)_2$

(i) ____$Al(OH)_3$ + ____H_2CO_3 → ____$Al_2(CO_3)_2$ + ____H_2O

(j) ____$NaHCO_3$ + ____H_2SO_4 → ____Na_2SO_4 + ____CO_2 + ____H_2O

(k) ____$Pb(NO_3)_2$ → ____PbO + ____NO_2 + ____O_2

(l) ____$SrBr_2$ + ____ $(NH_4)_2CO_3$ → ____$SrCO_3$ + ____NH_4Br

(m) ____ $(NH_4)_2Cr_2O_7$ → ____NH_3 + ____Cr_2O_3 + ____O_2 + ____H_2O

(n) ____$Fe_2(C_2O_4)_3$ → ____FeC_2O_4 + ____CO_2

(o) ____MnO_2 + ____HCl → ____$MnCl_2$ + Cl_2 + ____H_2O

(p) ____$CoBr_3$ + ____$CaSO_4$ → ____$CaBr_2$ + ____$Co_2(SO_4)_3$

(q) ____NaCN + ____$CuCO_3$ → ____Na_2CO_3 + ____$Cu(CN)_2$

(r) ____BaO + ____HOCl → ____$BaCl_2$ + ____O_2 + ____H_2O

(s) ____$Ca(PO_4)_2$ + ____SiO_2 + ____C → ____P_4+ ____CO + ____$CaSiO_3$

(t) ____Ba_3N_2 + ____H_2O → ____$Ba(OH)_2$ + ____NH_3

(u) ____$TiCl_4$ + ____H_2O → ____TiO_2 + ____HCl

(v) ____$Hg(OH)_2$ + ____H_3PO_4 → ____$Hg_3(PO_4)_2$ + ____H_2O

(w) ____C_2H_6O + ____O_2 → ____CO_2 + ____H_2O

(x) ____$BaCl_2$ + ____Na_2SO_4 → ____NaCl + ____$BaSO_4$

(y) ____$Pb(NO_3)_2$ + ____H_2SO_4 → ____$PBSO_4$ + ____HNO_3

(z) ____C_2H_5OH + ____O_2 → ____CO_2 + ____H_2O

RATE MY UNDERSTANDING
Shade the face that shows your rating
☺ 😐 ☹

MODULE 3.1

Review questions

Remembering

1 Define the terms:
- a endothermic
- b verdigris
- c anodising
- d tarnish.

2 What term best describes each of the following?
- a a reaction that releases energy
- b a burning reaction
- c a rusting reaction
- d a reaction involving the joining of an element with oxygen.

3 What substance is always required for combustion to occur?

4 What is the word equation and balanced chemical equation for each of the following reactions?
- a combustion of octane
- b corrosion of copper.

Understanding

5 How can a Bunsen burner display both complete and incomplete combustion?

6 Explain why the rusting of iron makes it get thinner and thinner.

7 a Explain what a balanced chemical equation is.
- b The law of conservation of mass states that mass is never created nor is it destroyed. Explain how this law requires all chemical equations to be balanced.

Applying

8 Identify the reactants and products for each of these reactions:
- a iron + sulfur → iron sulfide
- b propane + oxygen → carbon dioxide + water.

9 Identify the products formed when fossil fuels undergo:
- a complete combustion
- b incomplete combustion.

10 The combustion of butene is shown by the following word and balanced formula equations.

butene + oxygen gas → carbon dioxide + water

$$C_4H_8 + 6O_2 \rightarrow 4CO_2 + 4H_2O$$

Identify:
- a the chemical formula for butene
- b reactants for the reaction
- c products of the reaction.

Analysing

11 Classify the following reactions as endothermic or exothermic.
- a A bushfire burns down a forest.
- b A sparkler on a birthday cake is alight.
- c Sherbet cools your mouth.

12 Contrast the corrosion of iron with the corrosion of aluminium.

Evaluating

13 Magnesium is a metal but it burns in oxygen to form magnesium oxide. Assess whether this reaction could also be classified as a corrosion reaction.

Creating

14 Construct word equations for the following combustion reactions.
- a Benzene burns in oxygen gas to produce carbon dioxide and water vapour.
- b Carbon dioxide and water form when hexane burns in oxygen.

15 Zinc corrodes in air by reacting with oxygen gas. It forms a dull, grey substance called zinc oxide. Its balanced formula equation is:

$$2Zn + O_2 \rightarrow 2ZnO$$

- a Use this equation to identify the chemical formula for zinc oxide.
- b Construct a word equation to show what is happening in this reaction.
- c Construct a table to prove that this equation is balanced.

16 Construct word equations for the:
- a complete combustion of pentane
- b incomplete combustion of octane.