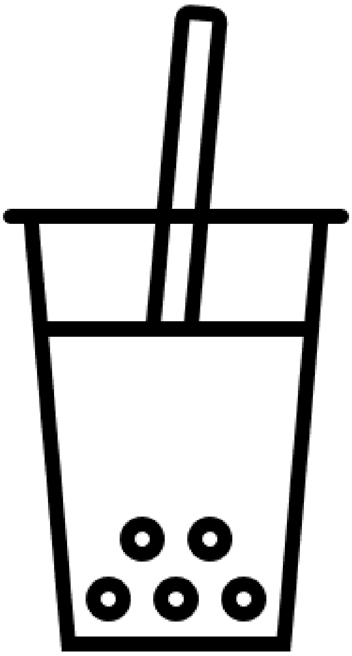
Solubility



and chemical changes

Name	______________________________
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L1 Chemical and Physical changes

Have you ever wondered why some things change in appearance or behaviour? Well, these changes can be divided into two main types: chemical changes and physical changes. Let's dive into what each of these means and how they're different from one another.

Physical Changes:

Think of physical changes as alterations that happen to a substance's appearance, shape, size, or state, but the substance itself remains the same at a fundamental level. It's like giving a toy car a new paint job or breaking a piece of chocolate into smaller bits. These changes are often easy to reverse, meaning you can change the substance back to its original state without creating something entirely new.

Here are some examples of physical changes:

Melting Ice: When you heat ice, it turns into water. This is a physical change because the water is still H2O, just in a different state.

Cutting Paper: If you cut a piece of paper into different shapes, it's still paper; only its appearance has changed.

Boiling Water: Water boils and turns into steam. Again, it's the same substance (water), but in a different state.

Chemical Changes:

Chemical changes, on the other hand, involve substances transforming into entirely new substances with different properties. It's like a magical transformation where the original materials combine and rearrange their atoms to form something new and often with different characteristics. Once a chemical change occurs, you can't usually revert the substances back to their original forms.

Here are some examples of chemical changes:

Burning Wood: When wood burns, it combines with oxygen to form ash and smoke. The wood isn't wood anymore; it's now ash, which is a different substance.

Rusting Metal: When iron rusts, it reacts with oxygen and water to form a new compound called iron oxide, which is quite different from the original iron.

Baking a Cake: Mixing ingredients like flour, eggs, and sugar and then baking them causes a chemical reaction. The result is a delicious cake that's quite different from its individual ingredients.

Independent practice

1. What is the main difference between chemical and physical changes?
2. Can physical changes be easily reversed? Give an example.
3. Give an example of a physical change related to a change in state.
4. Explain why burning wood is a chemical change.
5. When a metal object tarnishes, is it a physical or chemical change? Why?
6. Imagine you have a piece of chocolate that you break in half. Is this a physical or chemical change?
7. What happens when you crumple a piece of paper? Is this a chemical or physical change?
8. Why is mixing sugar and water to make a sweetened drink a physical change?
9. Describe a situation where you might observe rust forming. Is rusting a physical or chemical change?
10. If you paint a wooden chair a different colour, is that a physical or chemical change?
11. How is cooking an egg an example of a chemical change?
12. Why is cutting a piece of fruit considered a physical change?
13. Compare freezing water to baking cookies in terms of physical and chemical changes.

L2 Solubility

Solubility is a property of substances that tells us how much of a particular substance (called the solute) can dissolve in a specific amount of another substance (called the solvent) at a given temperature and pressure. Think of it like making a tasty lemonade: you can only dissolve a certain amount of sugar in a glass of water before it won't dissolve anymore. That's solubility in action!

Solubility is usually measured in grams of solute that can dissolve in 100 millilitres (ml) of solvent at a particular temperature. The units are often given as "g/100 ml." This tells us how concentrated the solution can become before no more solute will dissolve.

Now, let's dive into predicting observations when we have 100 ml of a solution and the mass of solute is either above, below, or equal to the solubility. This is where things get exciting!

When the mass of solute in your solution is equal to the solubility, you have what's called a "saturated solution." At this point, no more solute can dissolve, and you might see some undissolved particles at the bottom. Imagine you're making a cup of hot chocolate, and you add as much cocoa powder as possible – it won't dissolve completely.

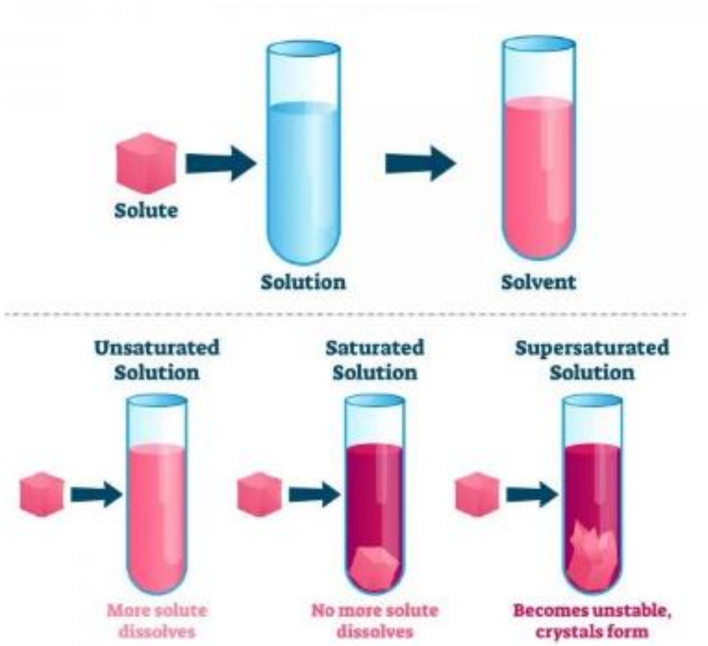
If the mass of solute is below the solubility, you have what's called an "unsaturated solution." In this case, you'll see that all of the solute has dissolved, and your solution might not be as concentrated as it could be. Think of making lemonade with only a little sugar; it all dissolves, and it's not too sweet.

Now, when you have more solute than can dissolve (the mass is above solubility), you have a "supersaturated solution." This is like trying to add too much sugar to your iced tea – you'll see some sugar sinking to the bottom even though it's not hot.

If you cool a saturated solution, something interesting happens. Some of the dissolved solute might start to come out of the solution and form crystals. Imagine you have a cup of hot tea with too much sugar, and when it cools down, sugar crystals start to appear at the bottom.

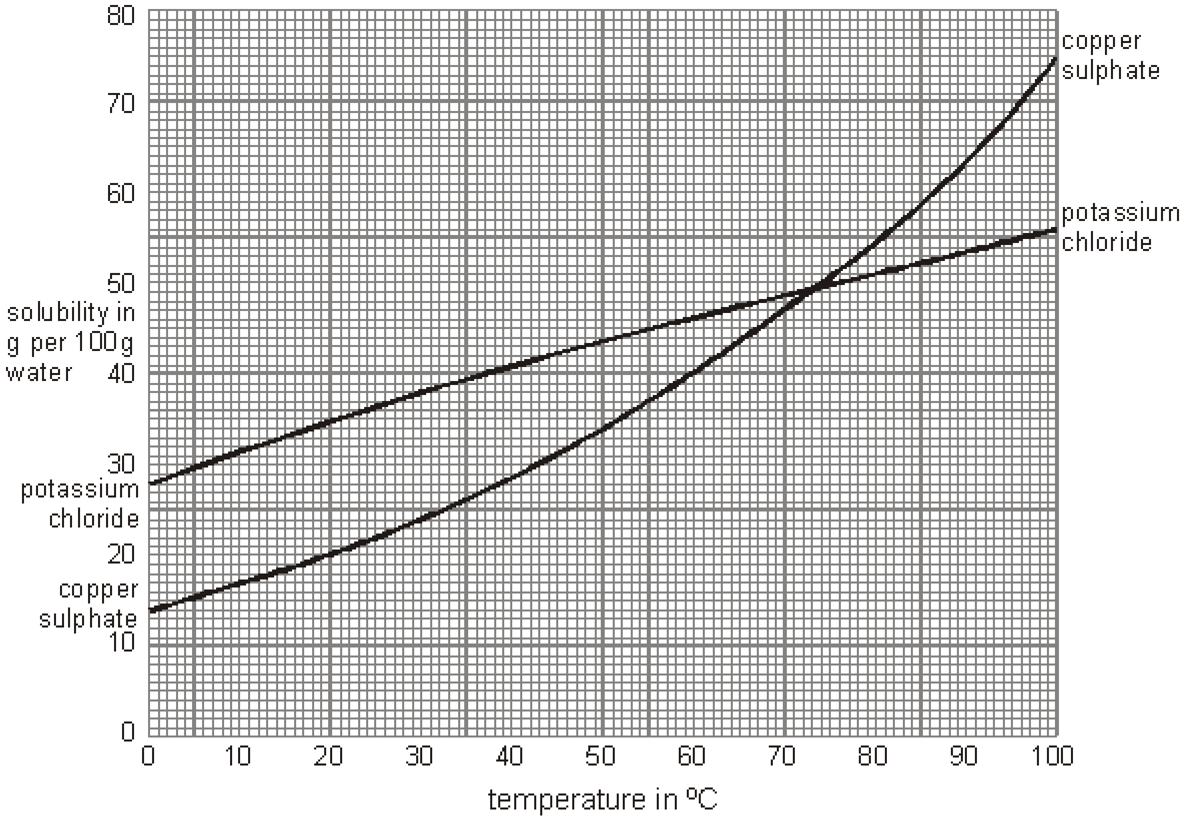
When you cool down an unsaturated solution, nothing much happens. Since all the solute has already dissolved, there are no extra particles to form crystals. It's like your lemonade with just the right amount of sugar; it stays clear.

This is where things get really cool! When you cool a supersaturated solution, the excess solute will suddenly start to crystallize out, almost like magic. It's similar to how snowflakes form when the air gets colder. So, if you had a cup of hot water with way more sugar than it should hold, and then you let it cool, sugar crystals would suddenly appear.



Questions about Solubility:

1. What is solubility, and how is it measured?
2. How can you tell if a solution is saturated?
3. What's the difference between an unsaturated and a supersaturated solution?
4. What happens when the mass of solute is equal to solubility in a solution?
5. Describe what you would see in an unsaturated solution.
6. Explain why a supersaturated solution can be unstable.
7. What happens when you cool down a saturated solution?
8. Why doesn't an unsaturated solution change when it's cooled?
9. How is cooling a supersaturated solution like the formation of snowflakes?
10. The graph shows how the solubility of two salts in water changes with temperature. The solubility is the number of grams of the salt which will dissolve in 100 g of water.



(a) Describe how the solubility of copper sulphate changes with temperature.

(b) Use the information in the graph to answer the questions below.

(i) What is the solubility of potassium chloride at 40°C?

(ii) At what temperature are the solubilities of the two salts the same?

(iii) What is the largest mass of copper sulphate which can be dissolved in 50 g of water at 60°C?

(c) Why is the solubility of salts in water normally given only for temperatures between 0°C and 100°C?

L3 Atoms and chemical reactions

First things first, what exactly is a chemical reaction? Well, a chemical reaction is a process where one or more substances, called reactants, come together and change into different substances, called products. This transformation is what we call a chemical reaction. Imagine it like a recipe: you mix different ingredients (reactants) to create a new dish (products).

Now, let's talk about atoms. Atoms are the smallest units of matter, and they are like the building blocks of everything around us. Elements, like hydrogen, oxygen, carbon, and many others, are made up of unique combinations of atoms.

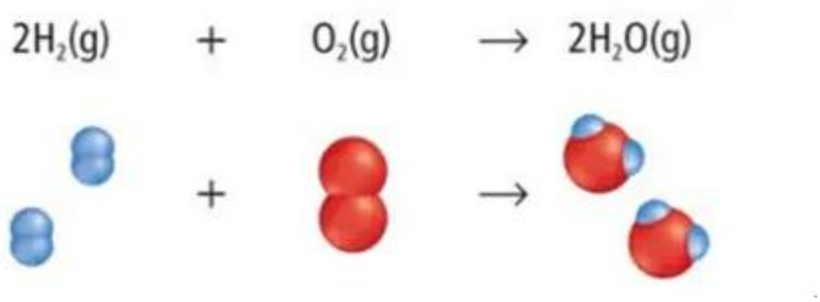
When a chemical reaction occurs, atoms from the reactants rearrange themselves to form the products. Think of it as a cosmic dance of atoms. Atoms don't disappear or get created during a chemical reaction; they simply change partners to create new molecules.

Let's take a simple example: the combustion of hydrogen. In this reaction, two hydrogen atoms (H_2) combine with one oxygen atom (O_2) to form water (H_2O). Here's how it works:

Two hydrogen molecules (H_2) break apart into individual hydrogen atoms (H).

Two oxygen molecules (O_2) break apart into individual oxygen atoms (O).

The hydrogen atoms (H) and oxygen atoms (O) then come together to form water molecules (H_2O).



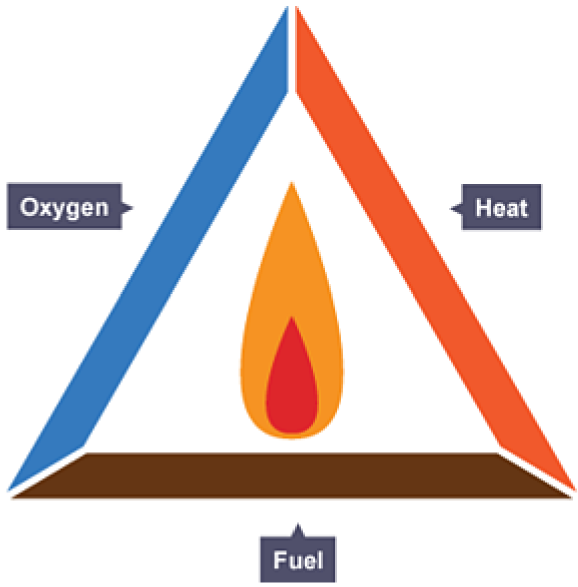
Independent practice

1. What is a chemical reaction, and how is it different from a physical change?
2. Define atoms and explain their significance in chemistry.
3. What happens to atoms during a chemical reaction?
4. Can you give an example of a chemical reaction that involves the rearrangement of atoms?
5. In the combustion of hydrogen, what are the reactants and products?
6. How many hydrogen atoms and oxygen atoms are involved in the formation of a single water molecule during combustion?
7. Do atoms disappear during a chemical reaction? Why or why not?
8. Why is it essential to balance chemical equations?
9. Can you think of a real-life example of a chemical reaction that you've observed?
10. Explain how the rearrangement of atoms in a chemical reaction relates to the law of conservation of mass.
11. What happens when two hydrogen molecules (H_2) break apart during a chemical reaction?
12. What happens when two oxygen molecules (O_2) break apart during a chemical reaction?
13. Describe the role of reactants and products in a chemical reaction.
14. Can you identify any safety precautions that should be followed when dealing with chemical reactions?

L4 Oxidation

Combustion is a process where something burns or catches fire. When we light a match or see a campfire, that's combustion in action! Combustion happens when a substance reacts with oxygen (usually from the air) to produce heat, light, and often, a new substance.

For combustion to occur, you need three essential things:



Fuel: This is the substance that burns. It could be wood, gasoline, paper, or even marshmallows.

Oxygen: We all know we need oxygen to breathe, but it's also necessary for combustion. Oxygen comes from the air.

Heat: To get things started, you need some heat. This could be a spark, a match, or even sunlight in some cases.

What Happens During Combustion?

When you light a match and it burns, you can see and feel the heat and light produced. That's because the fuel (the matchstick) combines with oxygen from the air, creating a chemical reaction. This reaction produces new substances, like ash and smoke, along with the heat and light.

<u>Understanding Oxidation:</u>

Oxidation is a broader concept that involves the interaction between a substance and oxygen. While combustion is a rapid form of oxidation, oxidation reactions can happen more slowly too. It's like a chemical rusting process!

<u>Writing Word Equations:</u>

To write word equations for oxidation reactions, we need to remember a few things:

Reactants: These are the substances at the beginning of the reaction.

Products: These are the substances formed at the end of the reaction.

Arrow: We use an arrow (→) to show the direction of the reaction.

Now, here's a simple word equation for the oxidation of iron:

Iron + Oxygen → Iron Oxide

Remember, combustion and oxidation reactions are all around us. From lighting a candle to cooking food, these reactions play a significant role in our daily lives. Keep your curiosity alive, and you'll discover even more exciting things about the world of chemistry!

Independent practice

1. What is combustion, and why is it exciting?
2. List the three essential things needed for combustion.
3. Can you provide examples of fuel we use in our daily lives?
4. What is oxygen, and where does it come from?
5. Explain how a matchstick works during combustion.
6. When you light a match, what do you observe happening?
7. How do heat and light relate to combustion?
8. What happens when a substance burns in terms of chemistry?
9. How is oxidation different from combustion?
10. Give an example of a slow oxidation reaction you've observed.
11. Why is oxidation sometimes called a "rusting" process?
12. What's the difference between rapid and slow oxidation reactions?
13. Can you think of a situation where oxidation is helpful to us?
14. If combustion needs fuel, oxygen, and heat, can you explain why it's crucial to be cautious with fire?
15. Finish the sentences:
    a. Combustion requires oxygen and…
    b. Combustion requires oxygen so….
    c. Combustion requires oxygen but…..
16. Write word equations for the following reactions:
    a. Iron reacting with oxygen
    b. Copper reacting with oxygen.
    c. Carbon reacting with oxygen.
    d. Sodium reacting with oxygen.
17. Ravi says, “when we pour water on a fire it puts it out by cooling it down”. Explain why Ravi is wrong.

L4 Thermal decomposition

Thermal decomposition is a chemical process where a substance breaks down into simpler substances when heated. Think of it like cooking. Just as you can turn an egg into scrambled eggs by heating it, certain chemicals can change when heated too!

Why do substances decompose when heated?

When you heat a substance, you add energy to its molecules. This extra energy makes the molecules move faster and collide more frequently. Sometimes, this can cause the bonds holding the molecules together to break, leading to a new set of substances.

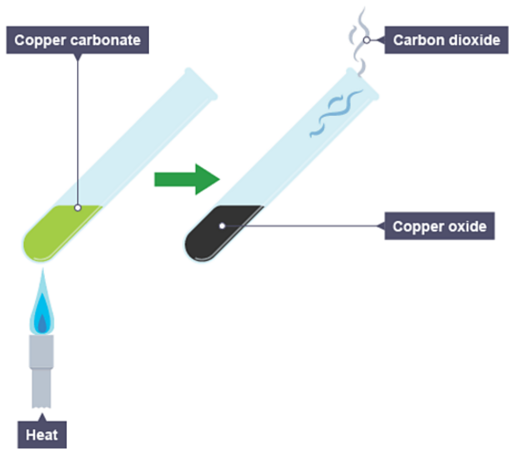
Let's Take an Example: Copper Carbonate ($CuCO_3$)

Imagine you have a substance called calcium carbonate, which is commonly found in chalk, limestone, and seashells. When you heat it, something interesting happens.

The Thermal Decomposition Reaction

Word Equation: Copper Carbonate ($CuCO_3$) → Copper Oxide (CuO) + Carbon Dioxide (CO_2)

So, when you heat calcium carbonate, it decomposes into calcium oxide and carbon dioxide. It's like magic, but it's all about chemistry!



Examples:

Potassium Chlorate ($KClO_3$):

Equation: $2KClO_3(s) \rightarrow 2KCl(s) + 3O_2(g)$

Description: Upon heating, potassium chlorate breaks down into potassium chloride and oxygen gas. This reaction is often used in laboratory experiments to produce oxygen.

Hydrogen Peroxide (H_2O_2):

Equation: $2H_2O_2(l) \rightarrow 2H_2O(l) + O_2(g)$

Description: Hydrogen peroxide decomposes when heated or exposed to light, yielding water and oxygen gas. This decomposition is why hydrogen peroxide solutions gradually lose their potency over time.

Ammonium Nitrate (NH_4NO_3):

Equation: $NH_4NO_3(s) \rightarrow N_2O(g) + 2H_2O(g)$

Description: Ammonium nitrate, often used as a fertilizer and in explosives, decomposes when heated to produce nitrogen oxide (N_2O) and water vapor. The reaction is highly exothermic and can lead to explosive results under certain conditions.

Independent practice

1. What is thermal decomposition?
2. Why do substances decompose when heated?
3. Give an example of a substance that undergoes thermal decomposition.
4. Write the word equation for the thermal decomposition of calcium carbonate.
5. What are the two substances produced when calcium carbonate decomposes?
6. Where can you find calcium carbonate in everyday life?
7. Imagine you have a piece of chalk (made of calcium carbonate). What happens to it when you heat it?
8. What happens to the molecules of a substance when it's heated?
9. Can you relate thermal decomposition to cooking? How?
10. If you have a piece of limestone, what will happen if you heat it strongly?
11. Why do scientists’ study thermal decomposition reactions?
12. How might understanding thermal decomposition be useful in industries like manufacturing and construction?
13. Can you think of other substances in your surroundings that might undergo thermal decomposition when heated?
14. What's the importance of balancing chemical equations like the one for thermal decomposition reactions?