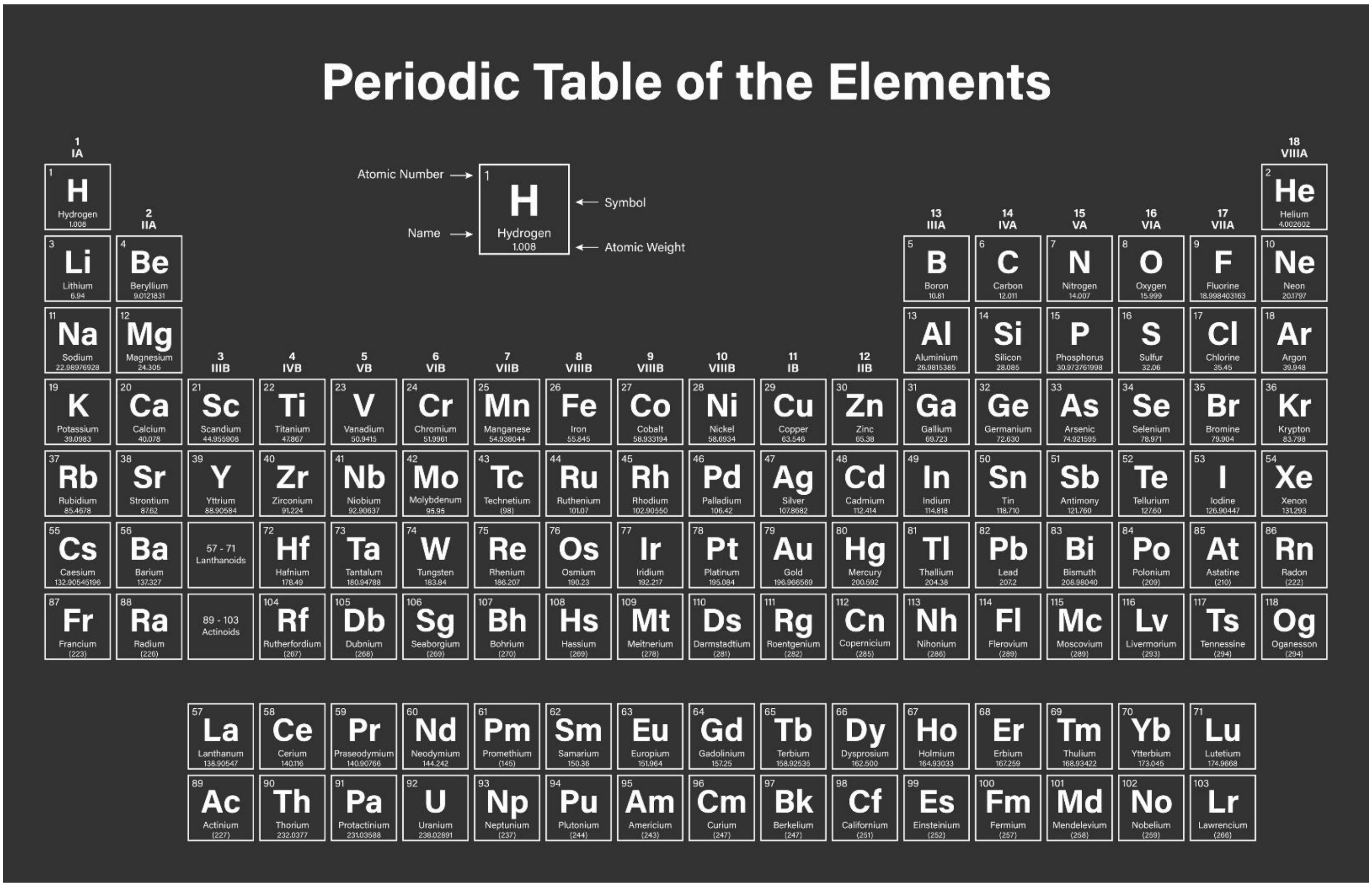
Periodic Table



Name ______________________________

Class ______________________________

Teacher ______________________________

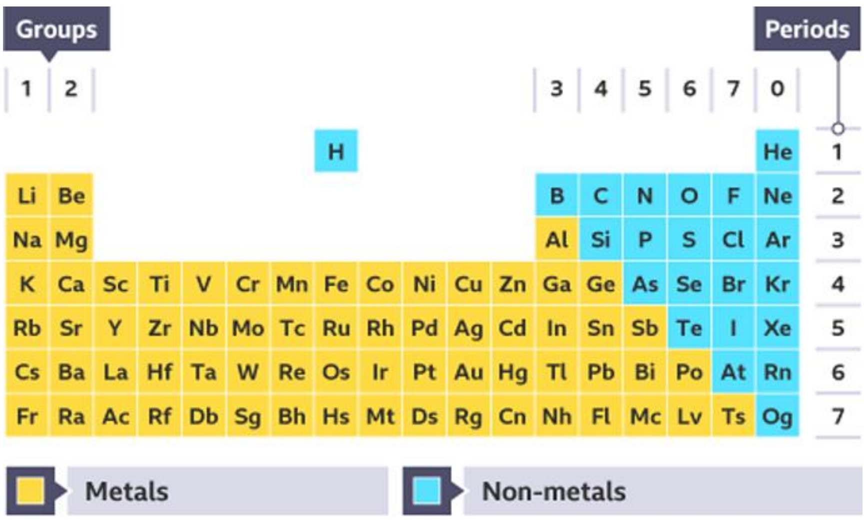
L1 Metals and non-metals

There are two different types of elements – metals and non-metals. Metals have many important uses in everyday life such as jewellery, cars, electrical wiring, and saucepans. The reason why they are so useful is due to the properties which they have.

Metals can conduct electricity as they have free electrons which are able to move and therefore carry charge. As metals can conduct electricity, they are often used to make wires and parts of electrical circuits. Metals are also able to conduct heat which is why they are used for saucepans. Metals are strong and tough, which makes them good for building materials, and this is because there are strong forces between the metal atoms that hold them together. Metals have high melting and boiling points because of the strong forces between the metal atoms, for example copper has a melting point of 1085 degrees and a boiling point of 2562 degrees. The melting point of a substance is the temperature at which a solid changes into a liquid. The boiling point of a substance is the temperature at which a liquid changes into a gas. Metals are also malleable which means they can be easily shaped and ductile which means they can be bent and stretched to form wires.

In contrast, non-metals are poor conductors of electricity. This is because there are no free electrons and hence charge is unable to be carried throughout the metal structure. Non-metals are also poor conductors of heat and so can be said to be insulators. They also have low melting and boiling points, and this is due to the forces which hold the atoms together being very weak and so not much energy is needed to overcome them. For example, the melting point of oxygen is -218 degrees, and its boiling point is -183 degrees, hence we find oxygen as a gas. Non-metals are also weak and brittle and again this is due to the forces between the atoms being weak.

The most reactive metals are found within group 1 and 2 of the periodic table. These groups can be referred to as the alkali metals. This is because when any of the metals within these groups react with water, they will form an alkaline solution.



Independent practice

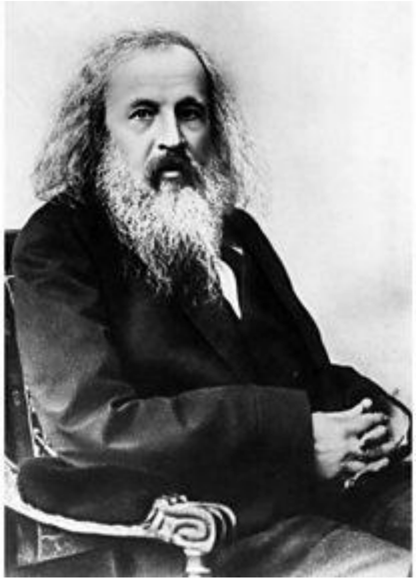
1. Complete the table below to show the differences in properties between metals and non-metals.

Properties of metals	Properties of non-metals

2. What is the definition of melting point?
3. What is the definition of boiling point?
4. **Extended writing (1 paragraph needed):** Compare the metals and the non-metals.
5. Why are group 1+2 referred to as the alkaline metals?
6. Why can metals conduct electricity?
7. Why do metals have high melting and boiling points?
8. What is meant by ductile?
9. Why are non-metals referred to as insulators?
10. **Extended writing (paragraph needed):** Cobalt is a metal. Describe and explain three properties of cobalt.
11. Why can't non-metals conduct electricity?
12. Why do non-metals have low melting and boiling points?
13. Why are non-metals weak?

L2 The periodic table

Chemical elements are the building blocks of matter. Everything around us, from the air we breathe to the water we drink, is composed of chemical elements. Each element consists of a unique type of atom with distinct properties. Long before the modern periodic table, ancient civilizations like the Greeks and Egyptians knew about some elements like gold and silver. However, it was a challenging task to organize them systematically.



In the 19th century, a Russian chemist named Dmitri Mendeleev changed the game. He arranged the known elements based on their atomic mass and observed that elements with similar properties occurred at regular intervals. He left gaps for undiscovered elements, predicting their properties based on their position in the table. Mendeleev's work led to the formulation of the periodic law, which states that when elements are arranged by increasing atomic number (the number of protons in the nucleus), their properties recur periodically.

Today's periodic table has evolved from Mendeleev's original version. It organizes elements by atomic number rather than atomic mass, which makes more sense since the number of protons defines an element's identity. The periodic table is divided into rows called periods and columns called groups. Each period represents a new energy level for electrons, while each group contains elements with similar chemical properties.

Elements are classified into three main categories based on their properties. Metals are shiny, conduct heat and electricity, and are typically solid at room temperature. Non-metals are the opposite, often being gases or brittle solids. Metalloids have properties in between.

Group 0 of the periodic table consists of noble gases. These elements are incredibly stable because their electron configurations are full. Helium, neon, argon, krypton, xenon, and radon are all noble gases.

As you move across a period from left to right or down a group from top to bottom, you'll notice specific trends in the properties of elements. These trends include atomic radius, ionization energy, electronegativity, and metallic character.

Each element has a unique symbol, typically one or two letters. For example, 'H' stands for hydrogen, 'O' for oxygen, and 'Fe' for iron. The symbols often originate from the element's Latin or Greek name.

Over time, scientists have discovered more elements to fill the gaps Mendeleev left in his periodic table. These elements are typically created in laboratories using particle accelerators. The periodic table we use today is a testament to centuries of scientific discovery and collaboration. It has 118 confirmed elements, with the last four being added relatively recently.

The periodic table is more than just a chart on the wall of a chemistry classroom. It's a crucial tool for scientists and engineers. It helps predict chemical reactions, design new materials, and understand the behaviour of matter in the universe. As science advances, our understanding of elements deepens, and new elements may be discovered. The periodic table will continue to evolve as we unlock more of the universe's secrets.

The periodic table is a testament to human curiosity and scientific progress. It has come a long way since ancient civilizations first discovered elements like gold and silver. Thanks to the brilliant minds of scientists like Dmitri Mendeleev, we now have a comprehensive system for organizing and understanding the building blocks of our world. As you continue your journey through chemistry, remember that the periodic table is your trusty guide, always there to help you make sense of the elements and their fascinating properties.

Independent practice

1. What are chemical elements, and why are they important in chemistry?
2. **Extended writing (paragraph needed):** Describe the early attempts at organizing chemical elements.
3. Who was Dmitri Mendeleev, and what was his contribution to the development of the periodic table?
4. Explain the periodic law and its significance.
5. **Extended writing (paragraph needed):** How is the modern periodic table organized differently from Mendeleev's original version?
6. What are periods and groups on the periodic table?
7. Name and describe the three main categories of elements based on their properties.
8. Which group of elements is known for its stability and why?
9. List and briefly explain some periodic trends.
10. How are elements named and represented on the periodic table?
11. How are new elements discovered, and where do they come from?
12. How many elements are currently on the periodic table, and what is the highest atomic number?
13. Discuss some practical applications of the periodic table in science and engineering.
14. What does the future hold for the periodic table, and why is it expected to evolve further?

L3 Group 1

Group 1 is also known as the Alkali Metals, and they are some of the most exciting elements you'll encounter in chemistry. Let's begin our journey by understanding what makes these metals so special.

Group 1 metals are the elements found in the first column of the periodic table. They include lithium (Li), sodium (Na), potassium (K), rubidium (Rb), cesium (Cs), and francium (Fr). Today, we'll focus on the first three: lithium, sodium, and potassium.

<u>Properties of Group 1 Metals:</u>

Group 1 metals share some common properties:

- Softness: These metals are incredibly soft and can be easily cut with a knife.
- Low Density: They have low densities, which means they are lightweight for their size.
- Low Melting Points: They have low melting points, making them easy to melt.
- Good Conductors: They are excellent conductors of heat and electricity.
- Silvery Appearance: They have a shiny, silvery appearance when freshly cut, but they quickly tarnish in the air due to reactions with oxygen and moisture.

<u>Reactions with oxygen</u>

When exposed to oxygen, they undergo a chemical reaction. This reaction forms a metal oxide, which is a compound made of the metal and oxygen. Here's how it happens:

- Lithium (Li) reacts with oxygen (O_2) to form lithium oxide (Li_2O).
- Sodium (Na) reacts with oxygen (O_2) to form sodium oxide (Na_2O).
- Potassium (K) reacts with oxygen (O_2) to form potassium oxide (K_2O).

<u>Reactions with water</u>

Now, let's explore how these metals react with water, another essential substance. The reaction with water is even more exciting! Here's what happens:

- Lithium (Li) reacts slowly with water, producing lithium hydroxide (LiOH) and hydrogen gas (H_2).
- Sodium (Na) reacts more vigorously with water, also forming sodium hydroxide (NaOH) and hydrogen gas (H_2).
- Potassium (K) reacts explosively with water, producing potassium hydroxide (KOH) and a big burst of hydrogen gas (H_2).

<u>Reactivity as You Move Down the Group:</u>

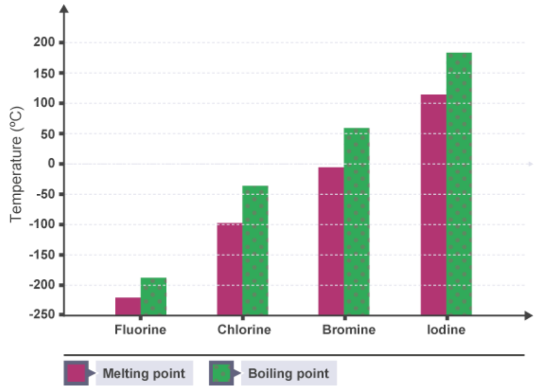
One of the most intriguing things about Group 1 metals is how their reactivity changes as you move down the group. Reactivity means how readily an element reacts with other substances. In this case, we're talking about how readily these metals react with oxygen and water.

As you go down the group, the reactivity of these metals increases. In other words, potassium is more reactive than sodium, and sodium is more reactive than lithium. This means that as you move from the top (lithium) to the bottom (potassium), the metals become more explosive when they encounter water and oxygen.

<u>Independent practice</u>

1. What is the common name for Group 1 metals in the periodic table?
2. **Extended writing (paragraph needed):** Describe the properties of group 1 metals.
3. Describe What happens when Group 1 metals react with oxygen?
4. Which Group 1 metal reacts most explosively with water?
5. What gas is produced when Group 1 metals react with water?
6. How does reactivity change as you move down the Group 1 metals?
7. Which Group 1 metal is the least reactive with water?
8. What is the chemical formula for sodium oxide?
9. Why do Group 1 metals tarnish quickly in the air?
10. What is the common appearance of freshly cut Group 1 metals?
11. What is the common name for the compound formed when sodium reacts with water?
12. If you were to perform an experiment, how would you predict the reactivity of cesium (Cs) with water compared to sodium (Na)?

L4 Group 7



What are the Group 7 Elements?

The Group 7 elements are a family of elements found in Group 7 of the periodic table. There are four elements in this group: fluorine (F), chlorine (Cl), bromine (Br), and iodine (I). Astatine (At) is also sometimes included, but it's quite rare and not as well-known.

<u>Properties of the Halogens:</u>

Physical State: Halogens exist in different physical states at room temperature. Fluorine and chlorine are gases, bromine is a liquid, and iodine is a solid.

Color: These elements have distinct colors. Fluorine is pale yellow, chlorine is greenish-yellow, bromine is reddish-brown, and iodine is dark purple.

Odor: Halogens have strong and pungent odors. Chlorine, for example, smells like bleach.

<u>Reactivity of the Halogens:</u>

Now, let's talk about reactivity. The halogens are known for their reactivity, but their reactivity decreases as you move down the group.

- Fluorine (F): Fluorine is the most reactive halogen. It's so reactive that it can react explosively with many substances. Due to its extreme reactivity, it's never found as a free element in nature.
- Chlorine (Cl): Chlorine is also highly reactive, but not as much as fluorine. It's often used to disinfect water and swimming pools because of its ability to kill harmful microorganisms.
- Bromine (Br): Bromine is less reactive than both fluorine and chlorine. It's often used in flame retardants and photography.
- Iodine (I): Iodine is the least reactive of the halogens. It's an essential element for our bodies, as we need it to make thyroid hormones that regulate our metabolism.

<u>Reactions of the Halogens:</u>

Now, let's explore some of the interesting reactions of the halogens.

Reaction with Metals: Halogens can react with metals to form compounds called metal halides. For example, when chlorine gas is passed over sodium metal, it forms sodium chloride, which is common table salt ($NaCl$).

- Displacement Reactions: Halogens can also displace each other in reactions. This means a more reactive halogen can replace a less reactive one in a compound. For example, chlorine can displace iodine from potassium iodide to form potassium chloride and free iodine.
- Reaction with Hydrogen: Halogens can react with hydrogen gas to form hydrogen halides, like hydrogen chloride (HCl) and hydrogen bromide (HBr). These are highly acidic and can be quite dangerous.
- Reaction with Nonmetals: Halogens can also react with nonmetals to form compounds. For example, when chlorine reacts with oxygen, it forms chlorine dioxide ($ClO2$), a powerful disinfectant.

- Reaction with Alkalis: Halogens can react with alkali metals like sodium and potassium to form salts. For instance, chlorine reacts with sodium hydroxide ($NaOH$) to produce sodium hypochlorite ($NaClO$), which is used in bleach.
- Halogen Lamps: Bromine is used in halogen lamps. These lamps produce very bright and white light because of the intense heat generated when bromine reacts with the filament.

Independent practice What are the Group 7 elements also known as?

1. Name the four main Group 7 elements.
2. **Extended writing (paragraph needed):** Describe the properties of the group 7 elements.
3. Which halogen is the most reactive?
4. **Extended writing (paragraph needed):** Compare the reactivity of the group 7 elements.
5. Why is fluorine never found as a free element in nature?
6. What is the primary use of chlorine in everyday life?
7. What type of compounds do halogens form with metals?
8. Explain the concept of displacement reactions among halogens.
9. What are hydrogen halides, and why are they dangerous?
10. Give an example of a halogen reacting with a nonmetal.
11. How are halogens used in disinfectants?
12. Which halogen is used in halogen lamps?

L5 Group 0

Group 0 elements are the last column on the right side of the periodic table. They include helium (He), neon (Ne), argon (Ar), krypton (Kr), xenon (Xe), and radon (Rn). These elements are called "noble gases" because they were once considered to be too proud to react with other elements. We now know that they do react, but their reactivity is quite limited compared to other elements.

Atomic Structure:

One of the reasons noble gases are less reactive is their atomic structure. Noble gases have a full complement of electrons in their outermost energy level. This stable electron configuration makes them less likely to form chemical bonds with other elements. Imagine these electrons as content and happy, and they don't want to share with anyone else!

Properties of Noble Gases:

Inertness: Noble gases are incredibly stable and unreactive under normal conditions. They don't easily combine with other elements to form compounds.

Colourless: They are typically colourless gases.

Odourless: They have no distinct smell.

Tasteless: You wouldn't want to taste them, but they are tasteless as well!

Low Boiling and Melting Points: Noble gases exist as gases at room temperature due to their low boiling and melting points.

Density: They are less dense than most other gases in the atmosphere.

Reactivity of Noble Gases:

While noble gases are generally unreactive, they can still participate in some interesting reactions under special conditions or with a lot of energy applied. Here are a few examples:

Glowing Lights: When electricity is passed through neon gas, it emits a bright orange-red glow. This is why neon lights are used in signs and displays.

Helium Balloons: Helium, the lightest noble gas, is used to fill balloons. It makes balloons float because it is less dense than the air we breathe.

Argon Welding: Argon is used in welding because it can protect metals from reacting with oxygen in the air.

Xenon Lamps: Xenon is used in high-intensity lamps, such as those in projectors and car headlights, because it produces a very bright light when an electric current passes through it.

Applications of Noble Gases:

Noble gases may be rare and unreactive, but they have important applications in our daily lives. Some of these applications include:

Medical Imaging: Xenon can be used in medical imaging to enhance the quality of MRI scans.

Lasers: Helium-neon lasers are used in barcode scanners and laser pointers.

Cryogenics: Helium is used to cool down equipment in scientific experiments and medical devices.

Deep-Sea Exploration: Argon and xenon are used in research submarines to simulate the high-pressure conditions of the deep sea.

Space Exploration: Noble gases are used in ion propulsion systems on spacecraft.

Independent practice

1. What is another name for Group 0 elements in the periodic table?
2. Name the six noble gases.
3. Why are noble gases called "noble"?
4. What is the atomic structure of noble gases?
5. What makes noble gases less reactive compared to other elements?
6. List three properties of noble gases.
7. **Extended writing (paragraph required):** Compare the properties of the noble gasses and the group 7 elements.
8. What happens when electricity is passed through neon gas?
9. Why is helium used to fill balloons?
10. What role does argon play in welding?
11. Where can you find xenon lamps being used?
12. **Extended writing (paragraph required):** Describe the Noble gasses and explain 2 uses.

Key

relative atomic mass **atomic symbol** name atomic (proton) number

1	2											3	4	5	6	7	0
							1 **H** hydrogen 1										4 **He** helium 2
7 **Li** lithium 3	9 **Be** beryllium 4											11 **B** boron 5	12 **C** carbon 6	14 **N** nitrogen 7	16 **O** oxygen 8	19 **F** fluorine 9	20 **Ne** neon 10
23 **Na** sodium 11	24 **Mg** magnesium 12											27 **Al** aluminium 13	28 **Si** silicon 14	31 **P** phosphorus 15	32 **S** sulfur 16	35.5 **Cl** chlorine 17	40 **Ar** argon 18
39 **K** potassium 19	40 **Ca** calcium 20	45 **Sc** scandium 21	48 **Ti** titanium 22	51 **V** vanadium 23	52 **Cr** chromium 24	55 **Mn** manganese 25	56 **Fe** iron 26	59 **Co** cobalt 27	59 **Ni** nickel 28	63.5 **Cu** copper 29	65 **Zn** zinc 30	70 **Ga** gallium 31	73 **Ge** germanium 32	75 **As** arsenic 33	79 **Se** selenium 34	80 **Br** bromine 35	84 **Kr** krypton 36
85 **Rb** rubidium 37	88 **Sr** strontium 38	89 **Y** yttrium 39	91 **Zr** zirconium 40	93 **Nb** niobium 41	96 **Mo** molybdenum 42	[98] **Tc** technetium 43	101 **Ru** ruthenium 44	103 **Rh** rhodium 45	106 **Pd** palladium 46	108 **Ag** silver 47	112 **Cd** cadmium 48	115 **In** indium 49	119 **Sn** tin 50	122 **Sb** antimony 51	128 **Te** tellurium 52	127 **I** iodine 53	131 **Xe** xenon 54
133 **Cs** caesium 55	137 **Ba** barium 56	139 **La*** lanthanum 57	178 **Hf** hafnium 72	181 **Ta** tantalum 73	184 **W** tungsten 74	186 **Re** rhenium 75	190 **Os** osmium 76	192 **Ir** iridium 77	195 **Pt** platinum 78	197 **Au** gold 79	201 **Hg** mercury 80	204 **Tl** thallium 81	207 **Pb** lead 82	209 **Bi** bismuth 83	[209] **Po** polonium 84	[210] **At** astatine 85	[222] **Rn** radon 86
[223] **Fr** francium 87	[226] **Ra** radium 88	[227] **Ac*** actinium 89	[261] **Rf** rutherfordium 104	[262] **Db** dubnium 105	[266] **Sg** seaborgium 106	[264] **Bh** bohrium 107	[277] **Hs** hassium 108	[268] **Mt** meitnerium 109	[271] **Ds** darmstadtium 110	[272] **Rg** roentgenium 111	Elements with atomic numbers 112 – 116 have been reported but not fully authenticated						

* The Lanthanides (atomic numbers 58 – 71) and the Actinides (atomic numbers 90 – 103) have been omitted.

Relative atomic masses for **Cu** and **Cl** have not been rounded to the nearest whole number.