

Unit One: Chemistry

Particle Theory of Matter:

- All matter is made up of tiny particles
- Different substances are made up of different kinds of particles
- Particles are in constant motion
- The particles of a substance move faster as its temperature increases
- Particles attract each other

Protons, Electrons, and Neutrons:

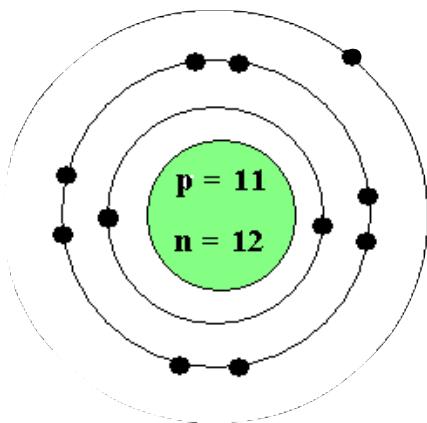
A proton is a positive particle.

An electron is a negative particle.

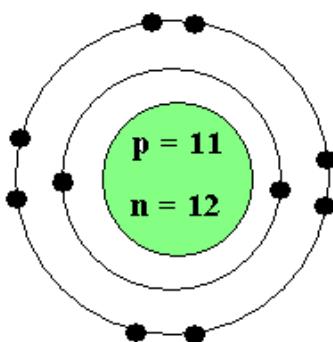
A neutron is a neutral particle (protons = electrons).

Bohr Rutherford Diagrams and Isotopes:

With a Bohr Rutherford diagram, the number of protons and neutrons are written in the nucleus and the electrons are drawn onto the orbitals. There is a pattern to the number of electrons that are drawn in each orbital. First orbital can hold 2 electrons, second can hold 8 electrons, third can also hold 8 electrons, this pattern continues infinitely.



Bohr Model of a Sodium Atom (Na)



Bohr Model of a Sodium Ion (Na +1)

An **Isotope** is an atom with the same number of protons but a different number of neutrons.

The Periodic Table:

Atomic Number: The number of protons found in the nucleus of an element.

Symbol: A one or two letter abbreviation of an element.

Name: An element's common name.

Atomic Mass: The average mass of the atoms in an element.

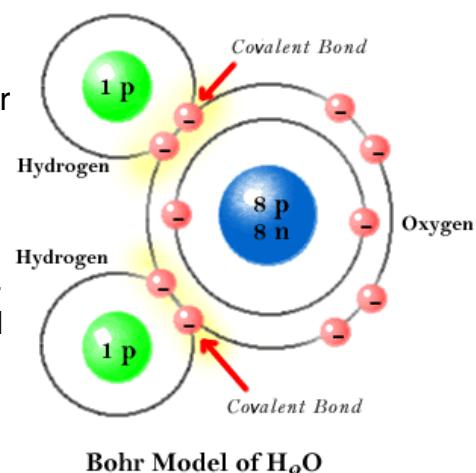
To find the number of protons, take a glimpse at the atomic number — it equals the amount of protons. With electrons, since atoms have no overall electrical charge the amount of protons also equals the amount of electrons. To discover the number of neutrons, subtract the atomic mass by the atomic number.

KRYPTON		
Protons = 36	Electrons = 36	Neutrons = 48

Ionic and Covalent Bonds:

Ionic bonds are bonds created when a cation (metal) and an anion (non-metal) attract each other due to their opposite charges and bond.

Covalent bonds are bonds created when two atoms share electrons to achieve a stable outer orbital. Ions do not form during covalent bonds (non-metal and non-metal). For example: H_2O (water), this covalent bond shows two non-metals (Hydrogen and Oxygen) bonding to create a new substance known as water.



Chemical Families:

Alkali Metals (1 valence electron)

- Shiny, silvery, soft
- Highly reactive (rarely found in pure form)
- React violently with water
- Relatively low densities

Alkaline Earth Metals (2 valence electrons)

- Shiny and silvery, but not soft
- Slightly less reactive than Alkali Metals
- Do not react with water

Halogens (7 valence electrons)

- Very reactive
- Highly poisonous in large amounts
- Useful disinfectant properties in small amounts

Noble Gasses (8 valence electrons)

- Highly stable (non-reactive)
- Colourless, odourless, tasteless, non-toxic
- Glows brightly when electricity passes through them

Density:

Density = Mass / Volume

Mass = Density x Volume

Volume = Mass / Density

You should follow the GRASP method.

Givens - The information provided in the question.

Required - What you need to calculate.

Analysis - The formulas.

Solution - Substitution of numbers into the formulas and the final answer.

Present - Final statement.

Mass = 80g

Volume = 30cm³

Density = ?

Density = M/V

Density = 80g/30cm³

Density = 2.6g/cm³

The density is 2.6g/cm³

Cations and Anions:

Cations: Positively charged ions.

Anions: Negatively charged ions.

For example: Ca²⁺ would be a cation and O²⁻ would be an anion.

Chemical Formulas:

Chemical formulas indicate the number and type of atoms in a substance.

Molecules

- Small units formed when atoms join chemically or bond
- For example: O₂, N₂, H₂O

Molecular Elements

- Contain only one type of element
- Only 7 of these
- H₂, N₂, O₂, F₂, Cl₂, Br₂, I₂

Molecular Compounds

- Contains more than one type of element
- Composed of non-metals
- Different pure substances may contain the same elements just in different proportions
- For example: C₂H₄O₂ = Vinegar, C₆H₁₂O₆ = Glucose (sugar)

Ionic Compounds

- Created when two ions bond together
- A positively charged cation will bond with a negatively charged anion because opposites attract

Observations and Inferences:

Observations — The gathering of information by using our five senses (sight, smell, hearing, taste, touch).

There are two types of observations:

1. Qualitative: A non-numerical observation that describes the quality of objects or events.
2. Quantitative: A numerical observation based on measurements or counting.

Inferences — An explanation for an observation you have made. They are based on past experiences and prior knowledge.

AN EXAMPLE:

Observation: The grass of my lawn is wet.

Possible Inferences: It rained, the sprinkler was on, a dog tinkled.

Mixtures:

Mechanical Mixture — A mixture where you can distinguish different types of matter.

Solution — A uniform mixture of two or more substances. The solute is broken down into its smallest consistent parts, such as individual ions or molecules.

Suspensions — A solution where particles are large enough for gravity to cause them to settle. Particles are large enough to be seen by the naked eye. Shows the Tyndall effect.

Compound — A pure substance composed of two or more different elements that are chemically joined.

Heterogenous — More than one visible phase of matter.

Homogenous — Only one clear distinctive phase of matter.

Colloid — Particles in the mixture are not big enough to see with the naked eye but distorts light.

Physical and Chemical Changes:**Physical Change**

- No new substance is created

Evidence:

- Dissolving
- Change of state
- Conducting electricity
- Cut into smaller pieces

Chemical Change

- A new substance is formed
- Common chemical changes: burning/cooking/baking, rotting, rusting, electrolysis

Evidence:

- Formation of precipitation
- Distinct or unexpected colour change
- Distinct or unexpected odour change
- Light is produced
- Difficult to reverse
- Starting material is used up
- A material with new properties is produced
- Fizzing/bubbling —> formation of gas
- Temperature changes —> releases heat (gets warmer) — exothermic
absorbs heat (gets colder) — endothermic

Unit Two: Electricity**Charging:**

Charging by Contact: When two objects are rubbed together, a transfer of electrons occurs. The object with the weaker hold will lose electrons to the object with a greater hold when rubbed.

Charging by Conduction: When two objects of different electrical charges are brought together and electrons transfer from one to the other, both will end up being the same charge.

Charging by Induction: Charges a neutral object without touching it, this can be temporary or permanent:

- Temporary: A charged object is brought near and electrons shift in position, based on the charge – resulting in an uneven distribution. The electrons will return to their original positions once the charged object is taken away.
- Permanent: A charged object is brought near and electrons shift in position, based on the charge – resulting in an uneven distribution. The neutral object is attached to a ground and the electrons move in or out through the ground, the ground is taken away before the charged object, and the charge becomes permanent.

Formulas:

$$\text{Percent Efficiency} = \text{Energy Out} / \text{Energy In} \times 100\%$$

$$\text{Cost of Electricity} = \text{Power Used (kW)} \times \text{Time Used (hours)} \times \text{Cost of Electricity (cents)}$$

$$\text{Resistance (ohms)} = \text{Potential Difference (volts)} / \text{Current (amperes)}$$

Conductors and Insulators:

A conductor is a material that allows for the movement of electrons.

An insulator is a material that doesn't allow the movement of electrons.

Non-Renewable and Renewable Energy Sources:

Non-Renewable — A resource of economic value that cannot be readily replaced by natural means on a level equal to its consumption. For example: coal, oil, uranium.

Renewable — Energy that comes from resources which are naturally replenished on a human timescale such as sunlight, wind, rain, tides, waves and geothermal heat.

Grounding:

Grounding is when a conducting material is connected to the charged object directly to the ground. It will cause electrons to either move to or from the object to neutralize it.

Lightning Formation and Lightning Rods:

Lightning begins to form over time as charges begin to build up both on the ground and in the clouds. Above the clouds, it's all positive charges. Just under the clouds, it's all negative. The earth's surface is all positive. This follows the Law of Electric Charges, and the two opposite charges attract — which creates lightning.

Lightning rods are made of materials that are great conductors. They are located in a high area (usually on a roof) and provides a safe path for lightning to follow to the ground. This prevents lightning accidents, and also minimizes lightning in unwanted areas.

Factors That Affect Resistance:

All materials have some sort of resistance. The greater the resistance, the lower the current, the warmer the material becomes. The reason for this is electrons will bump into the atoms making up the material, converting electrical energy into thermal energy.

There are four factors that affect resistance:

1. Type of material
 - Insulators have a high resistance so electrons fail to flow
 - Conductors have a low resistance hence why electrons flow well through them
2. Cross-sectional area
 - Thicker wires have less resistance (provides more room for movement)
 - Thinner ones have more resistance
3. Length
 - Resistance increases with the length of the wire
 - For example: longer extension cords will provide more resistance and will get warmer than shorter ones. This can lead to fires, manufacturers can prevent this by using thicker wires.
4. Temperature
 - Resistance increases with temperature since the electrons experience more collisions.

Static Electricity vs. Currently Electricity:

With static electricity, electrons gather in one place and move randomly in all directions – the path is unpredictable.

In current electricity, electrons follow a defined path at a constant speed.

Parts of an Electric Circuit:

1. Energy Source: Where the electricity comes from.
2. Load: Transforms electrical energy into other useful forms of energy.
3. Control Device: Controls current flow. When closed, the path is complete and electrons will flow. When open, the path is incomplete and electrons cannot flow.
4. Connectors/Conductors: Joins all the parts of the circuit. Provides a path for electrons to flow.

Unit 3: Biology**Biotic and Abiotic:**

Biotic - Living things, their remains and features.

Abiotic - Non-living physical, and chemical components of an ecosystem.

Producers and Consumers:

Producer — An organism that makes its own energy-rich food compounds using the sun's energy, found on the first trophic level, and found on the bottom of the food chain.

Consumer — An organism that obtains its energy from consuming other organisms. They can be found on the second, third, or fourth trophic level. There are three types of consumers:

1. Herbivores: Organism only eats plants.
2. Carnivore: Organism that eats meat.
3. Omnivore: Organism that eats both plants and meat.

Food Chains and Food Webs:

Food Chain — A hierarchical series of organisms each dependent on the next as a source of food.

Food Web — Represents all the feeding relationships within a community.

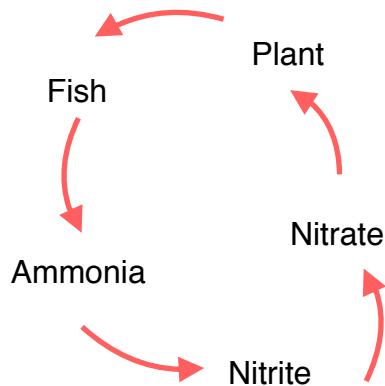
Trophic Levels — Each feeding level is considered to be a trophic level.

1. First Trophic Level: Producers
2. Second Trophic Level: Primary Consumers
3. Third Trophic Level: Secondary Consumers
4. Fourth Trophic Level: Tertiary Consumers

Species in higher trophic levels have less energy available to them than the species below them.

Nitrogen, Carbon, and Water Cycles:

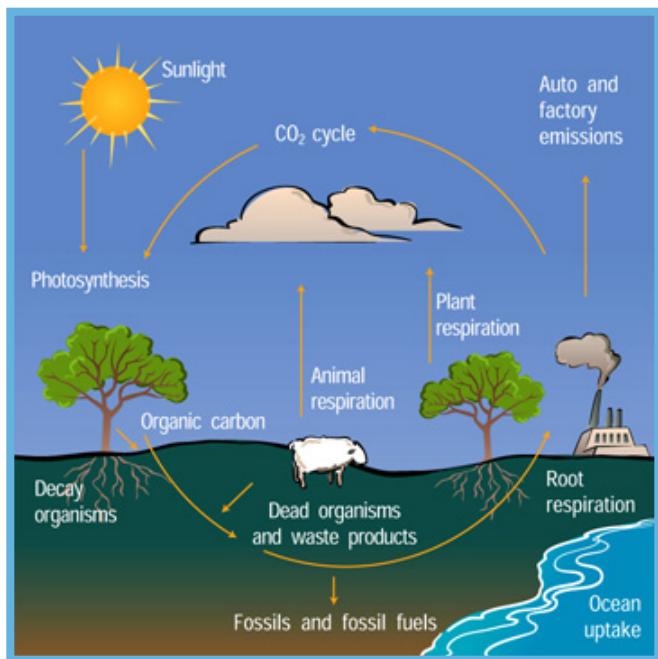
Nitrogen Cycle:



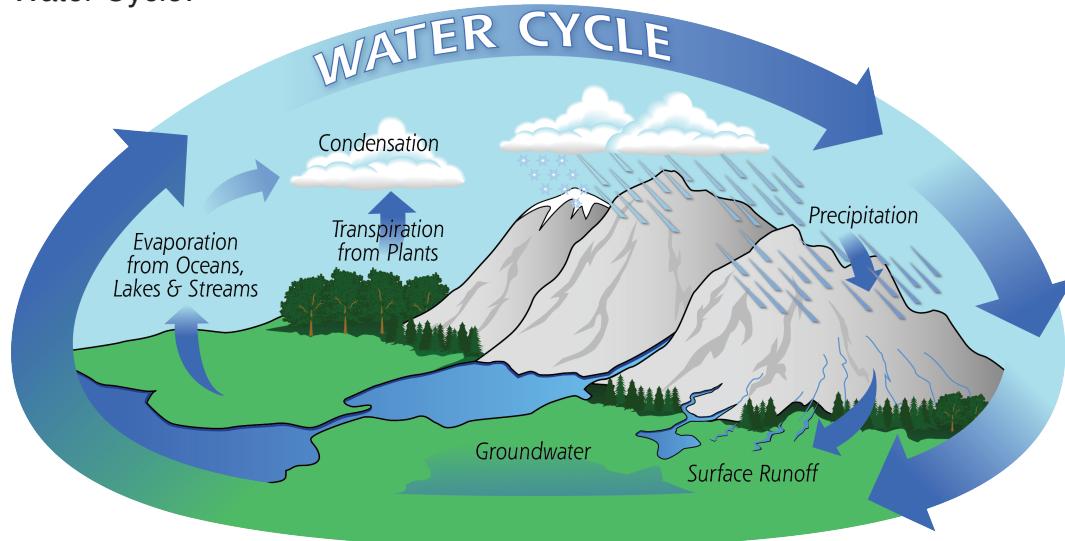
NITROGEN FIXATION

The chemical processes by which atmospheric nitrogen is assimilated into organic compounds, especially by certain microorganisms as part of the nitrogen cycle.

Carbon Cycle:



Water Cycle:



Bioremediation:

The use of micro-organisms to consume and break down environmental pollutants.

Scientific Method:

The scientific method is a way to ask and answer scientific questions by making observations and doing experiments.

1. Ask a question
2. Do background research
3. Construct a hypothesis
4. Test your hypothesis by doing an experiment
5. Analyze your data and draw a conclusion
6. Communicate your results

Pesticides:

A **pesticide** is a substance used for destroying insects or other organisms harmful to cultivated plants or to animals.

Advantages:

- Kills the target
- Reduces crop damage
- Controls population

Disadvantages

- Can do too good of a job (for example, the pesticides used on a fruit will transfer into our bodies after being eaten)
- Hard to target a specific species
- Harmful to soil, air, water
- Bioamplification — Increase in the concentration of a substance as it moves up the food chain
- Pesticide Resistance

Fertilizers:

A chemical or natural substance added to soil or land to increase its fertility.

- Natural — Plant nutrients from natural sources, for example: plant waste and animal manure
- Synthetic — Made using chemical processes, for example: ammonia, synthetic urea, chemicals

Fertilizer (nutrients) -> Crop -> Human food consumption -> Sewage system

Pros:

- Increased food production
- Increased farm profitability

Cons:

- Changes the community of soil organisms and can cause an imbalance
- When leached from the soil, high levels of nitrogen pollute water
- Algal bloom — algae decomposition kills aquatic life

Unit 4: Astronomy

Terms:

Constellations — A grouping of stars as observed from the Earth.

Celestial Object — Any object that is in outer space.

Asteroids — A small rocky body orbiting the sun.

Meteors — A small body of matter from outer space that enters the Earth's atmosphere, becoming incandescent as a result of friction and appearing as a streak of light.

The Planets:

The eight planets are:

1. Mercury — rocky material
2. Venus — rocky material
3. Earth — rocky material
4. Mars — rocky material
5. Jupiter — gas giant
6. Saturn — gas giant
7. Uranus — gas giant
8. Neptune — gas giant

Rocky Material (terrestrial planets) — Small planets with rocky surfaces.

Gas Giants (outer planets) — Large planets, composed mostly of gasses and liquids.

The Sun:

Nuclear Fusion — A nuclear reaction in which atomic nuclei of low atomic number fuse to form a heavier nucleus with the release of energy.

Galaxy Shapes:

With billions of galaxies in the universe, comes various shapes.

1. Spiral: A galaxy in which the stars and gas clouds are concentrated mainly in one or more spiral arms.
2. Elliptical: A galaxy which has an approximately ellipsoidal shape and a smooth, nearly featureless brightness profile.
3. Irregular: A galaxy with no specific form and a relatively low mass.
4. Lenticular: A galaxy which is intermediate between an elliptical galaxy and a spiral galaxy.

Light Year:

A light-year is a unit of distance. It is the distance that light can travel in one year. Light moves at a velocity of about 300,000 kilometres (km) each second. So in one year, it can travel about 10 trillion km. More precisely, one light-year is equal to 9,500,000,000,000 kilometres.

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