

English for specific purpose

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Week 1

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The difference between Hypothesis, Theory and Law

Hypothesis
vs
Theory
vs
Law

Hypotheses ,Theories and Laws گریمانه ، بیردۆزهکان و یاساکان

- When we find that an **idea** helps us **understand** or connect a lot of different things, we call this idea a **hypothesis**. There are **more tests** we can do to see if our **assumptions are correct**. You can call it a **theory** if it **keeps working** with what you **learned from the experiment**, or you can call it a **law**.

- کاتیک بیرۆکهیهک دهبینین یارمهتیمان دهدا که کۆمهلیک شتی جیاواز بهیهکوه بهستینهوه یان لئی تییگهین ، بهو بیرۆکهیه دهگوتریت **گریمانه**. زۆر له پشکنین ههیه دهتوانین ئهنجامی بدهین بۆ ئهوهی بزانیین گریمانهکانمان راستن. دهتوانی ئهمه به **بیردۆزه** دابنئی ئهگهر بهرداوام بی له کارکردن لهوهی که فییری بووی له پشکنینهکان، یان دهتوانی به **یاسا** ناوی بنییت

A **Theory**, like the **atomic theory**, usually has some idea about the nature of some part of the Universe.

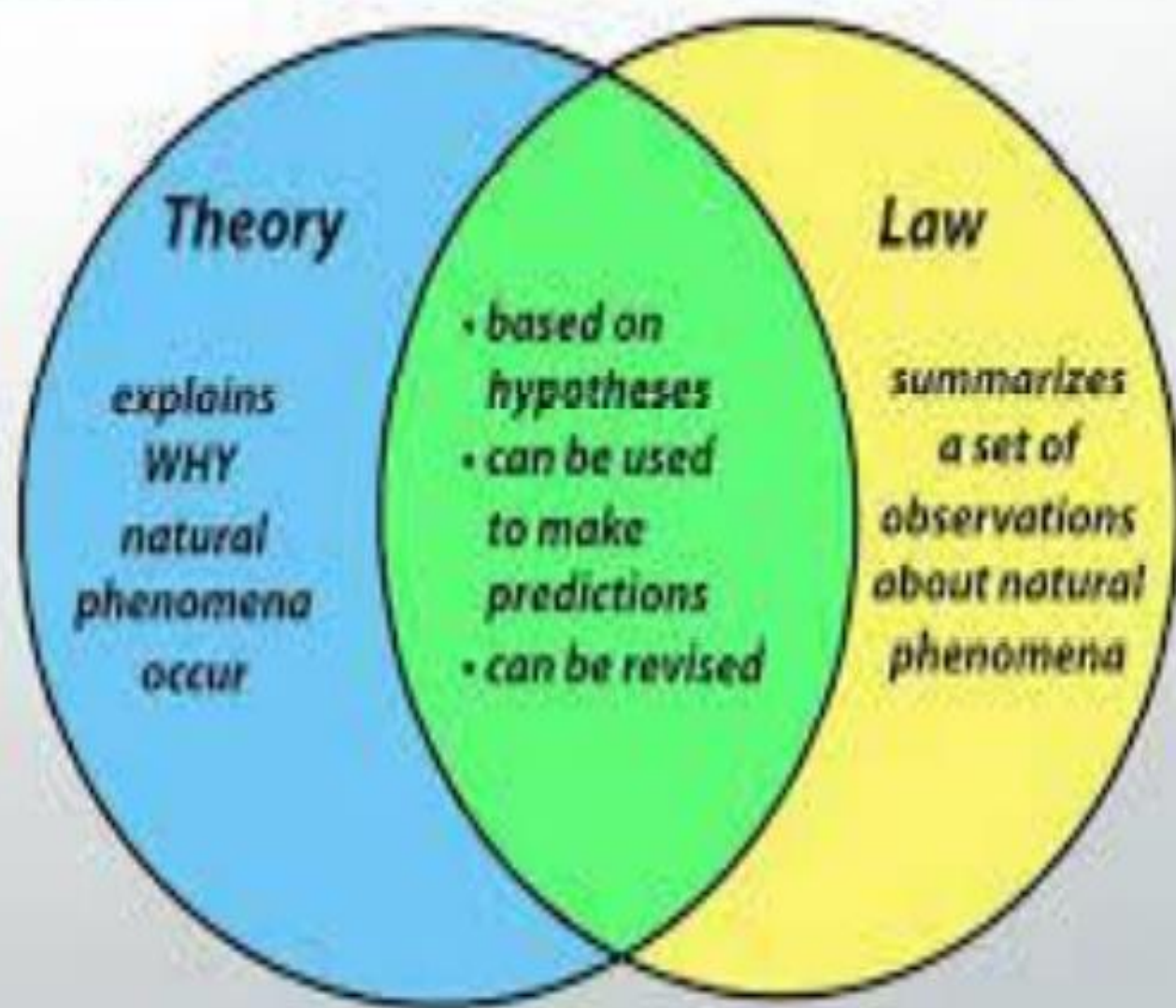
In chemistry and other fields of study, the word "**Theory**" is used in two very different ways.

The **first** meaning of the word is the one above, which is a hypothesis that has been proven true. This is the second time the word "theory" has been used. **It refers to a well-organized body of knowledge that is made up of facts, laws, theories, deductive arguments, and so on.**

له كیمیا و بواره كانی تری خویندن دا ، ووشه‌ی " **بیردۆزه** " به دوو شیوازی ته‌واو جیاواز به‌كاردیت. **مانای یه‌كه‌م** نه‌وه‌ی كه له‌سه‌ره‌وه باسمان كرد ، نه‌ویش گریمانه‌یه كه **راستیه‌كه‌ی سه‌لمینرا** . نه‌مه دووهم جاره ووشه‌ی "بیردۆزه " به‌كاربیت . ده‌ستتیشان كردنه بو كۆمه‌لێك ناوه‌پروکی زانراو له زانیاری كه پیکهاتوو له راستیه‌كان و یاساكان و بیردۆزه‌كان و هه‌لینجانندی به‌لگه‌یی و شتی تر.

Thus, when we talk about the **atomic theory**, we don't just mean the **idea** that **substances** are **made up** of atoms. We also mean all of the **facts** about substances that can be **explained** or **interpreted** in terms of atoms and the **arguments** that **explain** the properties of substances in terms of their atomic structure.

کهواته ، کاتی باسی بیردۆزه‌ی گهردیله‌یی ده‌کەین ، واتای تهنه‌ا ئه‌وه نیه که‌وا مادده‌کان له گهردیله پیکدین . به‌لکو واتای **راستیه‌کانی** په‌یوه‌ست به ههموو **مادده‌کان** که ده‌توانری **لیکدانه‌وه** یان **روونکردنه‌وه‌یان** بو بکریت که باسی سیفته‌ته‌کانی مادده ده‌کات له پرووی پیکه‌ته‌ی گهردیله‌یی.



Summary: A set of **observations** can be used to make a hypothesis, which is a **possible explanation** for the observations made, but note a hypothesis is just a **possible explanation**. Sometimes, we get new **evidence** from an experiment or new observations that **contradict** our hypothesis. **An experiment is a procedure carefully done to examine the validity of a hypothesis.**

In fact, **scientists seek** to test their hypotheses by making **extensive observations** or **conducting** many experiments. The idea is to **prove** a hypothesis by trying to disprove it first. A hypothesis can be **changed** or **reformulated** over a **series** of **observations** or **experiments**. Once a hypothesis holds true, it is accepted as fact.

Over the course of time, a collection of hypotheses can be used to generate either a scientific law or theory.

A scientific law is a statement that summarizes a collection of observations or results from experiments.

Scientific laws are always true under the same conditions and therefore can be used to make predictions.

In fact, our cartoon friend here could use some of the **Laws of Inheritance** to better understand why some cats are gray, while other cats are orange, black, white, or even calico!



In case you've never heard of them, the **Laws of Inheritance** were developed by the Austrian **monk Gregor Mendel** to explain **inheritance patterns** initially observed in **pea plants**.

Collectively, the laws explain how **genes** are passed from parents to their **offspring**. Because Mendel's explanations were true for a variety of organisms, they **became a set of laws**.

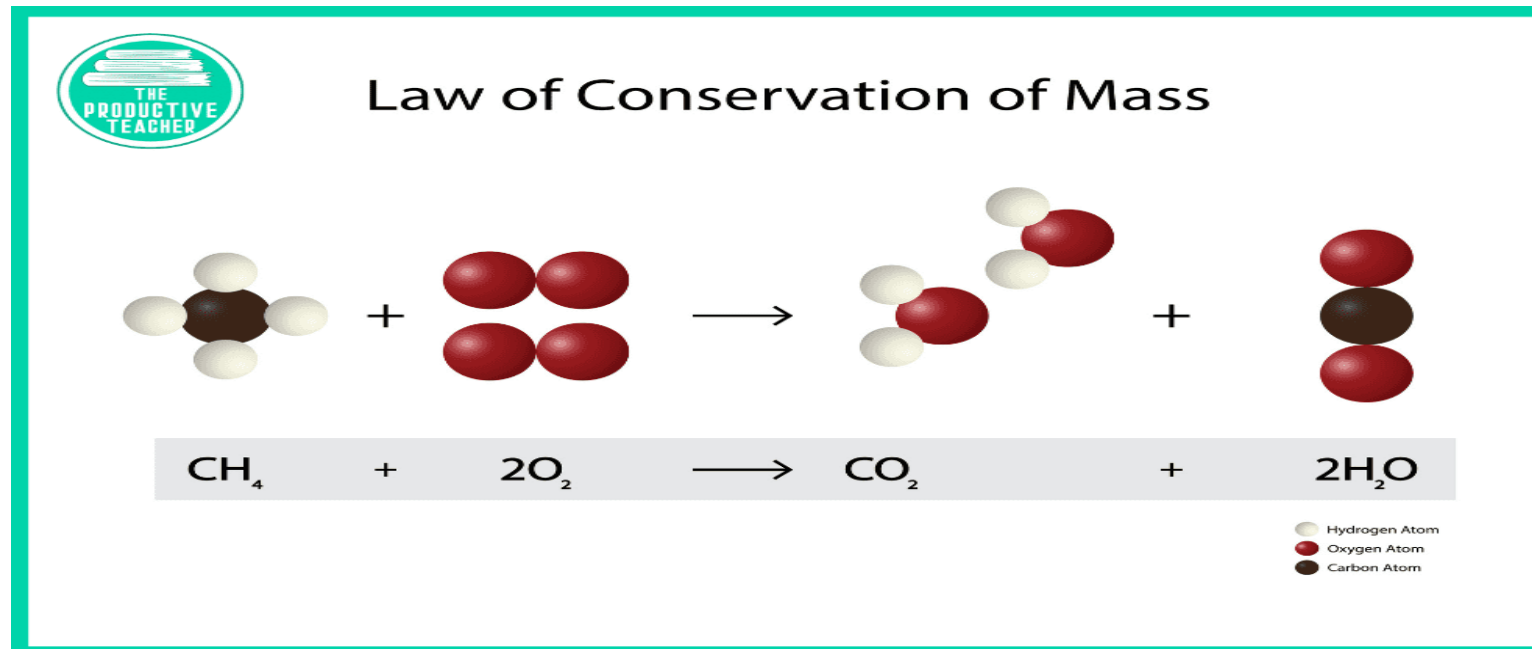
A scientific law may also be referred to as a principle.

Other examples of scientific laws or principles include:

1. The Law of Conservation of Mass
2. Coulomb's Law
3. Newton's Law of Universal Gravitation
4. The Ideal Gas Law
5. Bernoulli's Principle



The Law of Conservation of Mass dates from Antoine Lavoisier's 1789 discovery that **mass is neither created nor destroyed in chemical reactions**. In other words, the mass of any one element at the beginning of a reaction will equal the mass of that element at the end of the reaction. If we account for all reactants and products in a chemical reaction, the total mass will be the same at any point in time in any closed system.



A **theory**, or **model**, is also based on a set of hypotheses. **Unlike a law**, however, a theory describes and explains why a natural **phenomenon** occurs.

In science, **theories** explain **reality** well and are **generally** accepted as **truth**. Theories are based on **information** from many different areas of study.

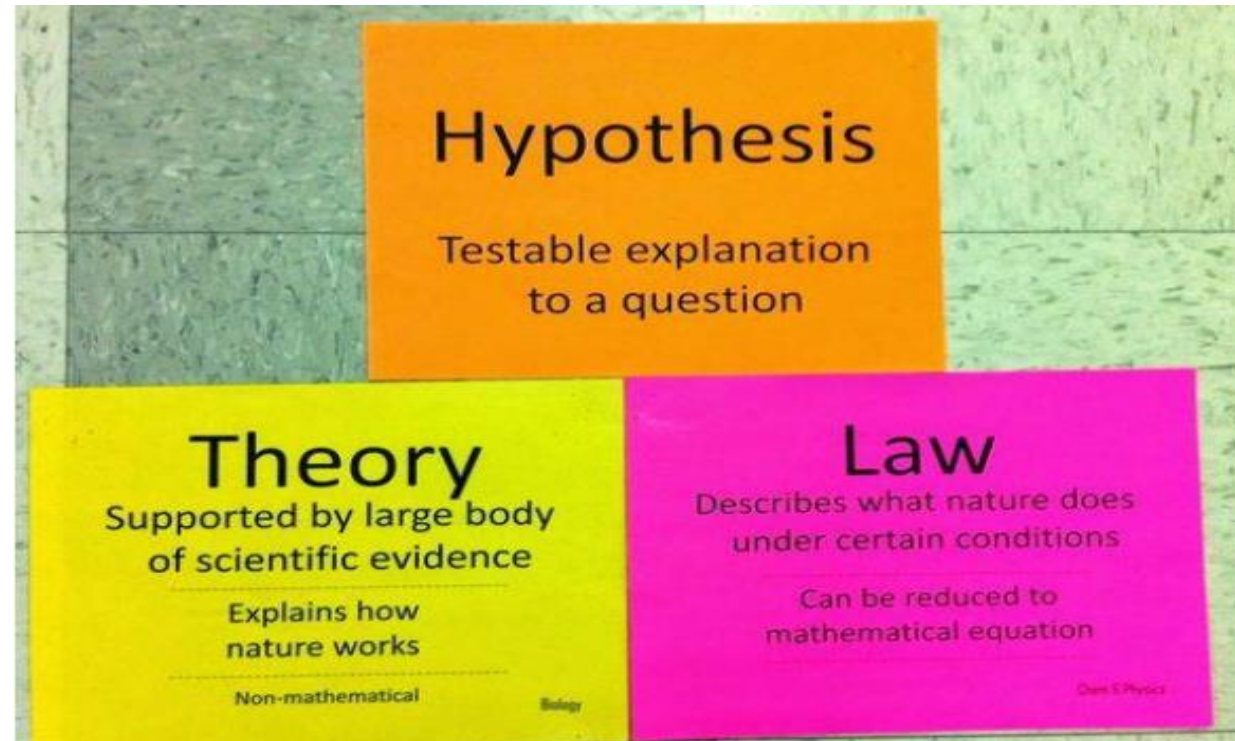
Our cartoon friend might find the **theory of evolution** quite **helpful** when trying to understand where cats came from or why different colored fur might be **beneficial** in helping cats to **survive**.

To briefly summarize, the **theory of evolution** explains that organisms slowly change over time due to **genetic mutations**. Organisms that have beneficial mutations, like the ability to **camouflage** well, are more likely to survive and pass their traits on to their **offspring**.

Theories can also be **changed** or **modified** if new evidence is found!

Examples of theories include:

- Cell Theory
- Theory of Relativity
- Atomic Theory
- Plate Tectonics Theory



Hypotheses vs Theories vs Laws

Hypothesis

- An educated guess based on observations
- A rational explanation of a single event
- Usually can be supported or refuted by continued experimentation or observation

Theory

- What one or more hypotheses become when they have been verified and accepted to be true
- It explains a set of related observation or proven events
- Verified multiple times by separate groups of researchers

Law

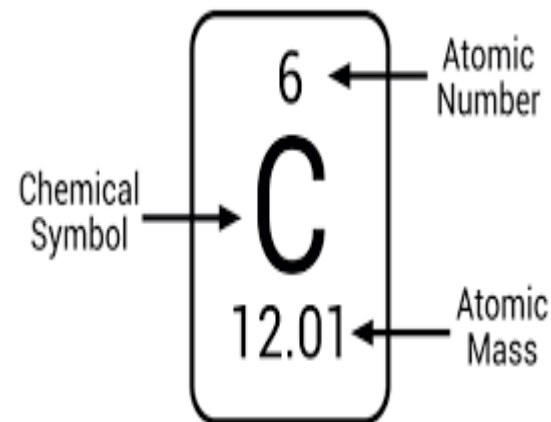
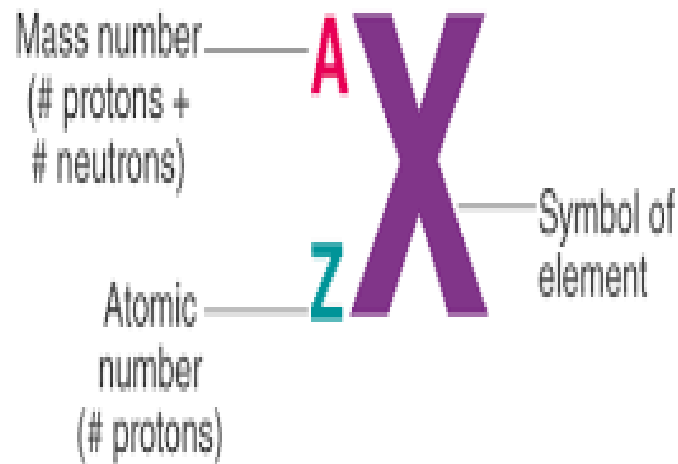
- Describes a single action (usually a mathematical relationship)
- Accepted to be true by the scientific community
- Much less complex compared to a theory

- **Discovery of Neutron, Isotopes, Isobars, Isotones and isoelectronics**

- ❖ Introduction:

- It is a remarkable fact the existence of neutron was not discovered until 1932. The general atomic imagination of the time was protons and electrons

- **scattering** experiments, it was found out that the **Atomic mass number** A of an element is **a bit more** than **twice** the atomic number Z for most atoms and that **essentially** all the mass of an atom was **concentrated** in a very **tiny space** at the **center** of the atom. The **alpha particles** that took a 180-degree turn stand as proof of this.



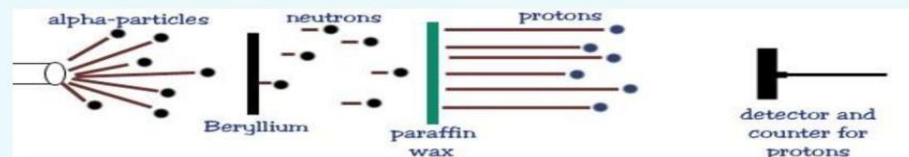
- Until 1930, a few electrons were **thought** to **coexist** with the protons in the **dense nucleus** but the **immense** amount of energy required to **sustain** such a system was way **beyond** the atomic **energies**.
- If we take the size of a Hydrogen atom as 0.2 **nanometers**, then the electron **confinement energy** is 38eV which is the correct magnitude for atomic electrons. But if the electron were to **coexist** with the protons in the nucleus, the electron confinement energy is **approximately** 250Mev! Many magnitudes **huger** than the 38eV.

- **Who discovered the Neutron?**

- A **breakthrough** came when it was shown that the **bombardment** of Beryllium with alpha particles from a **radioactive** source yielded **penetrating** but **non-ionizing** radiation.
- Such neutral radiation confounded the scientists since the only known neutral radiation then were photons.
- The neutral radiation had it been a **photon** would exit the beryllium atom with far more energy than it actually does.

James Chadwick 1932

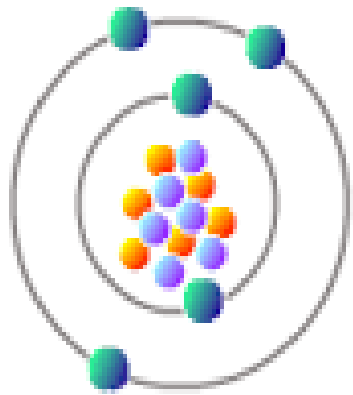
- *James Chadwick bombarded beryllium atoms with alpha particles.*
- *An unknown radiation was produced.*



❖ What is a Neutron?

- The answer to this puzzle was provided by James Chadwick who boldly stated that this was a new type of fundamental particle that is neutral, and he called them Neutrons.
- From the conservation of energy and momentum, he was able to derive with considerable accuracy the mass of this new particle. He found that the mass of a neutron was very close to that of a proton.
- $m_n = 1.00866 \text{ u} = 1.6749 \times 10^{-27} \text{ kg}$
- So now the nucleus had another resident, and the proton-neutron pair was called a Nucleon.
- The discovery of Neutron led to a better understanding of atomic mass and atomic number also with isotopes which is what radioactivity is based on!
- Z – Atomic Number = number of protons/ electrons
- N – Neutron Number = Number of Neutron
- A – Atomic Mass Number = $Z + N$ = Total number of protons and neutrons

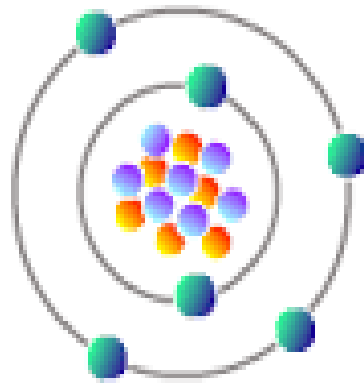
- What are **Isotopes**?
- **Isotopes are variants of a particular element with different number of neutrons.**
- For example, the two isotopes of Uranium are, ${}_{235}\text{U}^{92}$ and ${}_{239}\text{U}^{92}$.
- You will see here that the number of protons is the same in both the isotopes, but they contain **143 and 147 neutrons** respectively.
- The presence of an **extra neutron** significantly changes the **behavior** of that particular atom.
- There are two different types of isotopes, **stable** and **radioactive**. **Stable isotopes are one that can exist in its free state without breaking down spontaneously.**
- **Radioactive isotopes are ones that are too unstable to sustain itself, and they spontaneously break down into two lighter daughter elements with the emission of particles such as alpha, beta, and gamma rays**



Carbon-12

6 Protons

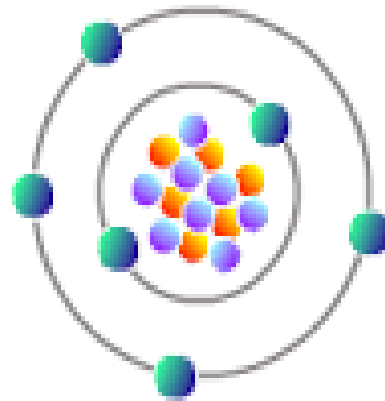
6 Neutrons



Carbon-13

6 Protons

7 Neutrons



Carbon-14

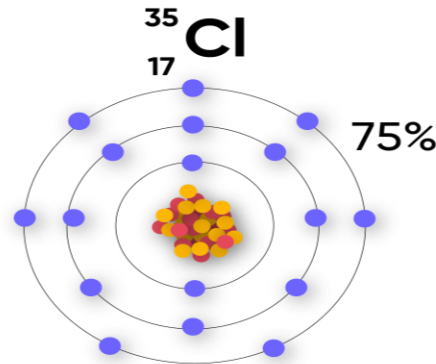
6 Protons

8 Neutrons

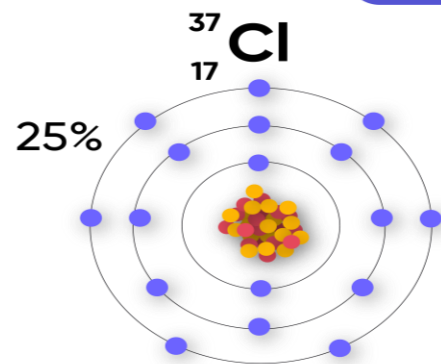
Isotopes of Carbon

ISOTOPES OF CHLORINE

tea



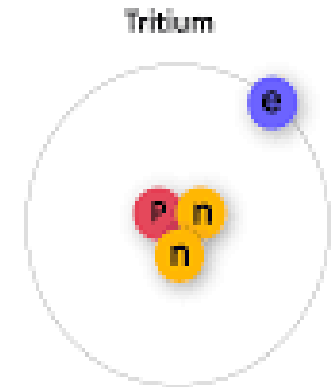
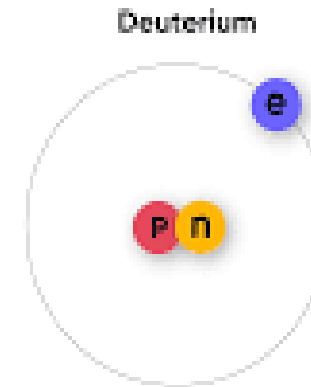
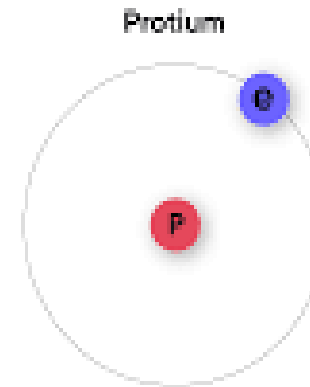
- 17 Protons
- 18 Neutrons
- 17 Electron



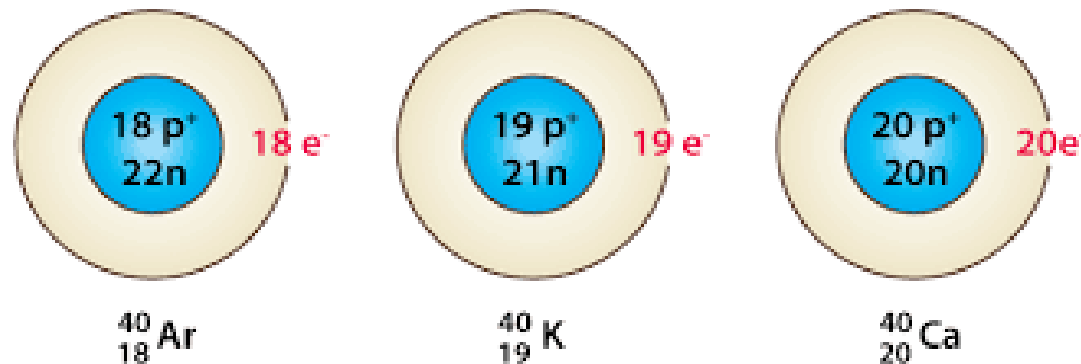
- 17 Protons
- 20 Neutrons
- 17 Electron

ISOTOPES OF HYDROGEN

teachoo



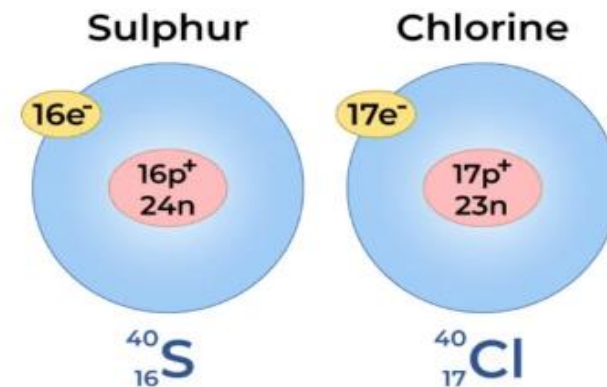
- What are **Isobars**?
- **Isobars are elements that have the same number of nucleons (sum of protons and neutrons).** The series of elements with **40 Mass numbers** serve as a good example; ${}_{40}\text{S}^{16}$, ${}_{40}\text{Cl}^{17}$, ${}_{40}\text{Ar}^{18}$, ${}_{40}\text{K}^{19}$, and ${}_{40}\text{Ca}^{20}$.
- The nucleus of all the above-mentioned elements contain the same number of particles in the nucleus but contain varying numbers of protons and neutrons.



Isobars: atoms of different elements with same atomic mass (40)

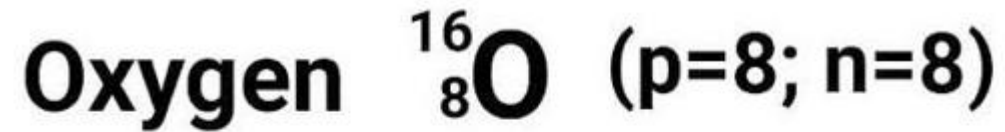
Isobar

- Same atomic mass
- Different elements



- What are **Isotones**?

- **Isotones are atoms that have the same neutron number but different proton number.** For example, ${}_{36}\text{S}^{16}$, ${}_{37}\text{Cl}^{17}$, ${}_{38}\text{Ar}^{18}$, ${}_{39}\text{K}^{19}$, and ${}_{40}\text{Ca}^{20}$ are all isotones of 20 since they all contain 20 neutrons.



What are **Isoelectronic**?

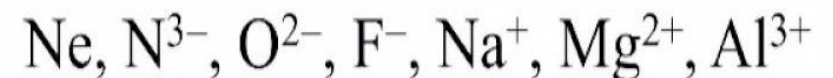
Isoelectronic Series

- **Isoelectronic**: having the same number of electrons
- N^{3-} , O^{2-} , F^- , Ne , Na^+ , Mg^{2+} , and Al^{3+} form an **isoelectronic series**.
 - A group of atoms or ions that all contain the same number of electrons

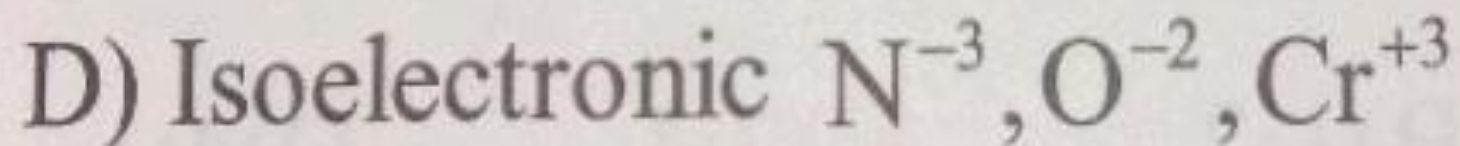
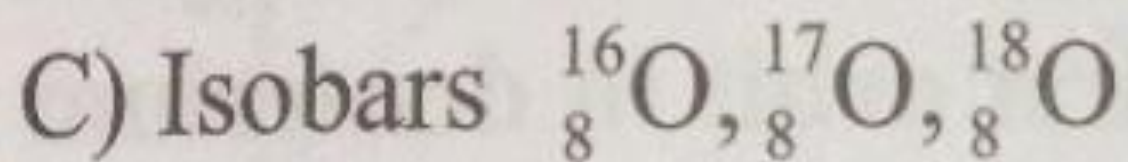
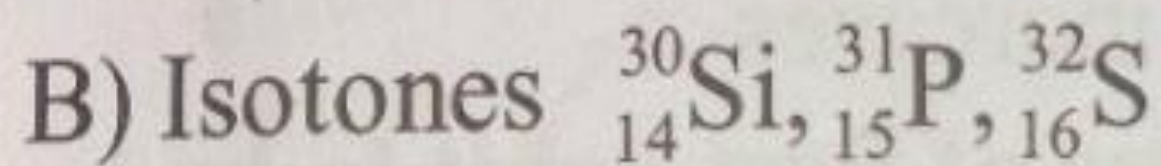
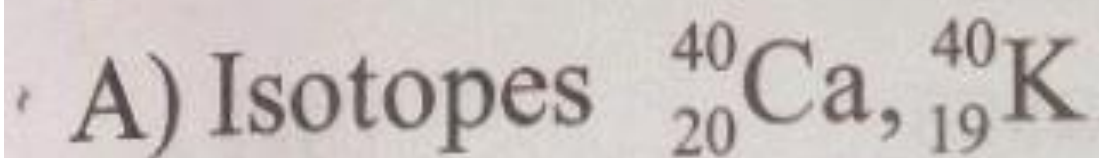
Isoelectronic

Species with the same electron configuration.

These species all have the electron configuration of



Which of the following pairs is correctly matched



Example :

Isoelectronic ions	Mg ²⁺	Na ⁺	F ⁻	O ²⁻
No. of electrons	10	10	10	10
No. of protons	12	11	9	8

List of Some Isoelectronic Species

1. N³⁻, O²⁻, F⁻, Ne, Na⁺, Mg²⁺, Al³⁺, CH₄, NH₃, H₂O, HF
2. P³⁻, S²⁻, Cl⁻, Ar, K⁺, Ca²⁺
3. H⁻, He, Li⁺, Be²⁺
4. CO, CN⁻, N₂
5. N₂O, CO₂, CNO⁻

ChemistNotes.com

ISOELECTRONIC

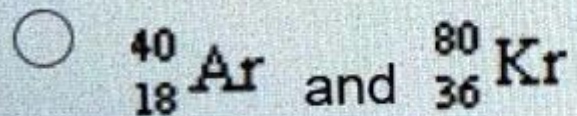
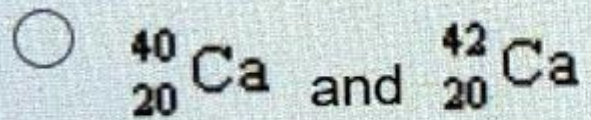
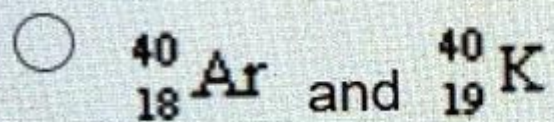
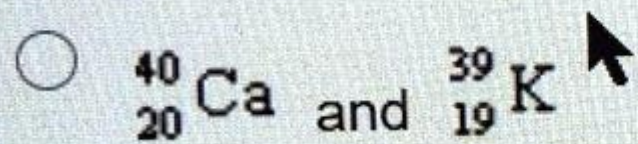
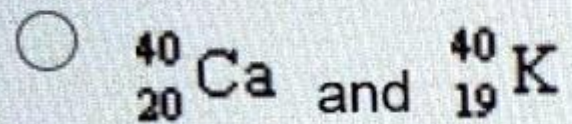
ATOM/ION/ MOLECULE	NO OF ELECTRONS
N ³⁻	7+3=10
O ²⁻	8+2= 10
F ⁻	9+1= 10
Ne	10
Na ⁺	11-1= 10
Mg ²⁺	12-2= 10
Al ³⁺	13-3= 10
Si ⁴⁺	14-4=10

Which of the following species are isoelectronic with Ne?

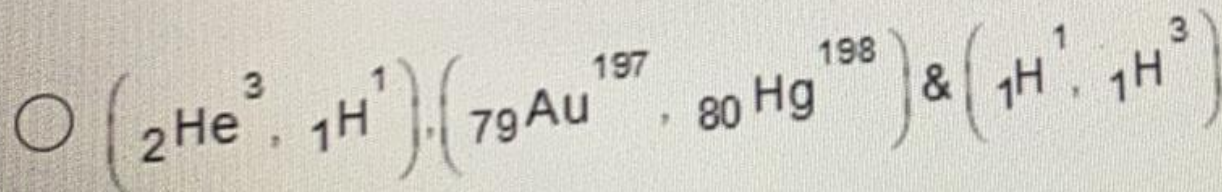
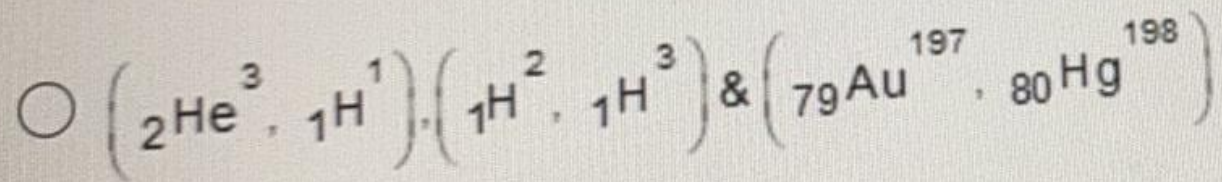
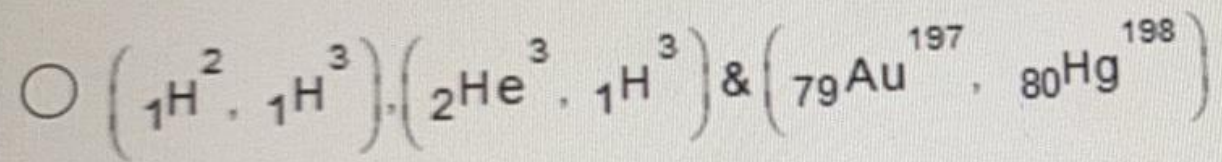
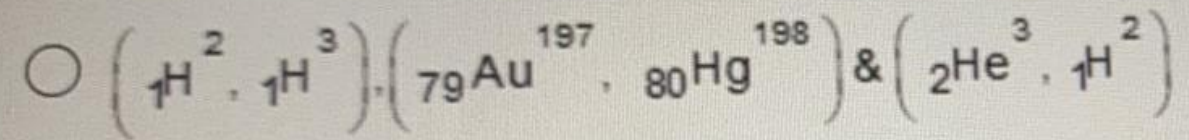
Choose one or more:

- Li
- Li⁺
- F⁻
- Al³⁺
- Na⁺
- Ca
- Mg²⁺

Which of the following are a pair of isotopes?



The set which represents the isotopes, isobars and isotones respectively is



What is the meaning of these terms?

- Science
- Scientific
- Scientist
- Difference
- Different