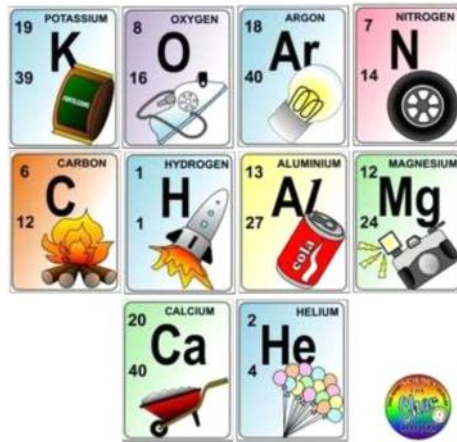


Science 9

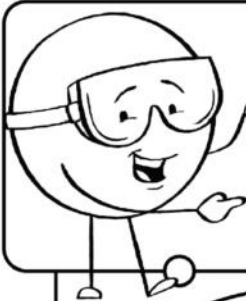
Unit 2: Chemistry



BOOK 2: Atoms, The Periodic Table & Bohr Models

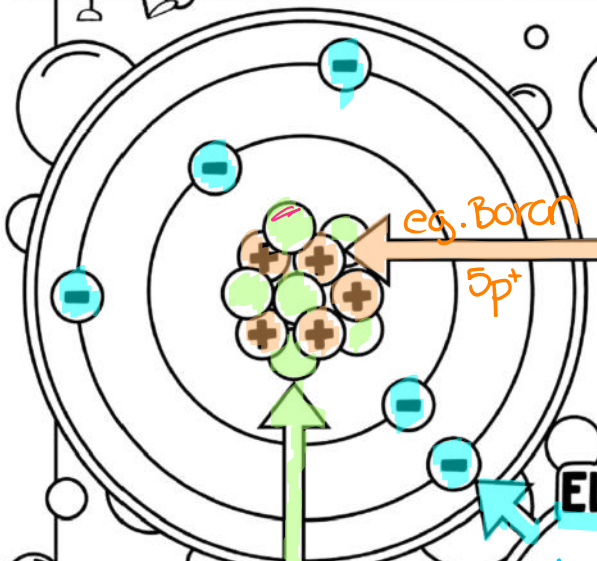
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PART A: THE ATOM & SUBATOMIC PARTICLES



PARTS OF AN ATOM

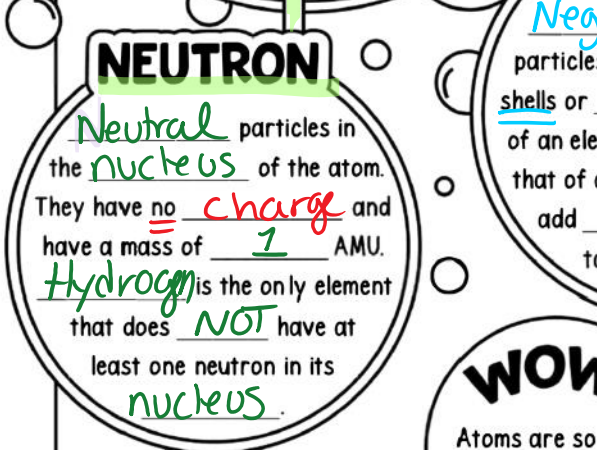
All **matter** is made of tiny particles called **ATOMS**.
 Atoms are made of even smaller **sub-atomic** particles called **protons**, **neutrons** and **electrons**.



PROTON

Positively charged particles in the **nucleus** that have a mass of **1** AMU. The number of protons determines the **Element** of an atom. For example hydrogen has **1**, helium has **2**.

eg. Boron $5p^+$



ELECTRON

Negatively charged particles in the **electron shells** or **orbitals**. The mass of an electron is **much less** than that of a proton, so it **does not** add **much** mass to the **atom**.

almost 0 AMU

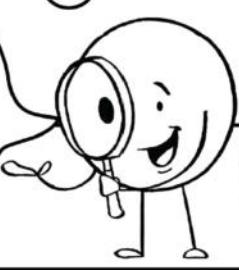

NEUTRON

Neutral particles in the **nucleus** of the atom. They have **no charge** and have a mass of **1** AMU. **Hydrogen** is the only element that does **NOT** have at least one neutron in its **nucleus**.

AMU = ATOMIC MASS UNIT
units for ATOMS

Atoms are mostly **EMPTY** space. The **mass comes** from the **Protons** and **Neutrons** in the nucleus!

WOW!
 Atoms are so small! The dot on this i contains about 1 trillion atoms!

What are atoms and how do we know they exist?

- An atom is the smallest particle of an element that still has the identity and properties of the element. *eg. 1 Cu atom has the same properties as 1 trillion Cu atoms*
- Atoms are made up of sub-atomic particles (*particles that are smaller than atoms*).
- These particles are protons, neutrons and electrons

Summary of the Parts of an Atom:

Name	Symbol	Charge	Location	Relative Mass (AMU)
proton	p ⁺	+1	nucleus	1
neutron	n ⁰	0	nucleus	1
electron	e ⁻	-1	electrons shells	0

The Nucleus

- At the center of every atom is a nucleus *shells are very spread out.*
- 99.9% of the space inside an atom is taken up by the electrons the nucleus is very small.
- As atoms get bigger, the protons in the nucleus repel (*push away from*) each other more. *← ⊕ ⊕ →*
more neutrons are required to make the nucleus stable.
 - Neutrons are thought to be needed to hold all the protons together in the nucleus.
 - The bigger the nucleus, the more neutrons are needed.

PRACTICE True or False:

a) All matter is made of small particles called atoms	<u>T</u>
b) Atoms of one element are different ^{from} the atoms of other elements	<u>T</u>
c) Electrons are located [↓] in the nucleus of an atom	<u>F</u>
d) Most of the mass of an atom is concentrated in it's electrons	<u>F</u>
e) The nucleus contains protons and electrons	<u>F</u>
f) The nucleus is the tiny, dense, central core of the atom.	<u>T</u>

Atomic Number (Z)

The number of protons in an atom is known as the atomic number or proton number.

It is the smaller of the two numbers shown in most periodic tables. (usually on top... depends where you're looking)

3 Li Lithium 6.9	+	4 Be Beryllium 9.0	2+
11 Na Sodium 23.0	+	12 Mg Magnesium 24.3	2+

atomic number = number of protons.

- always the SAME for a particular element.
- The number of protons identifies the element!
- is also equal to the positive charge of the nucleus
 - this is also called the positive nuclear charge
- in their periodic table atoms are listed from left to right by increasing atomic number

PRACTICE

If an atom has a $Z = 12$, then it MUST be an atom of:	Mg = magnesium
If an atom has a nuclear charge of +24, then it MUST be an atom of:	Cr = chromium
What is the atomic number of polonium? (Po)	$Z = 84$
What is the positive nuclear charge of lead? (Pb)	+82

The overall charge on an atom is zero because the number of protons = number of electrons
 $\oplus = \ominus$

How many electrons?

Atoms have no overall electrical charge and are neutral $\oplus = \ominus$

This means atoms must have the SAME number of positive protons and negative electrons.

The number of electrons is therefore the same as the atomic number (Z)

Atoms	Protons	Neutrons	Electrons
helium	2	$4 - 2 = 2$	2
copper	29	$64 - 29 = 35$	29
iodine	53	$127 - 53 = 74$	53

↑ Atomic number (Z)
 ↑ neutrons = mass - protons number

Mass Number (A)

$$\text{mass number} = \# \text{protons} + \# \text{neutrons}$$

24
Mg
12

The BIGGER number in the Periodic Table (rounded to whole number)

- Atoms of a certain element always have the same number of Protons, but can have different numbers of neutrons... these are called isotopes. They are the different "versions" of an atom of an element that can exist.
- Mass number = the total number of particles with mass (p^+ + n^0) in the nucleus of an element
 - electrons have a mass of almost zero, which means that the mass of each atom results almost entirely from the number of protons and neutrons, NOT electrons.
- Mass number is ALWAYS reported as a WHOLE NUMBER.
- The mass number DOES NOT appear exactly like this on the periodic table.

16	2-	17	-
S		Cl	
Sulfur		Chlorine	
32.1		35.5	
34	2-	35	-
Se		Br	
Selenium		Bromine	
79.0		79.9	

BE CAREFUL! The larger of the two numbers (usually on the bottom) shown on your periodic table is the relative atomic mass. It is the average mass number of the element (average of the isotopes).

We must ROUND the atomic mass to the nearest WHOLE NUMBER in order to determine the number of neutrons.

RULE: numbers 0-4 = ROUND \downarrow 5-9 ROUND \uparrow

- isotopes are different atoms of a particular element that have the SAME number of protons but a DIFFERENT number of neutrons. "different versions"
- The mass number CAN NOT be used to identify the element.
- Example: Both He and H can have a mass number of 3.

PRACTICE

H: 1 p, 2 n, He: 2 p, 1 n
Hydrogen-3 Helium-3

"isotopes" of H and He (different versions) where the mass is the same

What's the mass number?

$$\text{mass number} = \text{number of protons} + \text{number of neutrons}$$

How many neutrons?

$$\text{neutrons} = \text{mass number (A)} - \# \text{ of protons}$$

Atoms	Protons	Neutrons	Mass (A)
helium	2	2	4
copper	29	35	64
cobalt	27	32	59
iodine	53	74	127
germanium	32	41	73

Atomic Number (Z)

Atoms	Mass number	# protons	Neutrons
helium	4	2	2
fluorine	19	9	10
strontium	88	38	50
zirconium	91	40	51
uranium	238	92	146

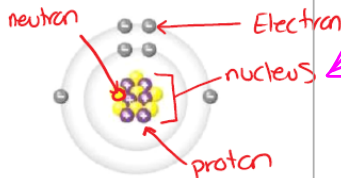
Example: Calculating the number of neutrons in an atom of lithium

Overall charge of an atom:

is zero because $\#p^+ = \#e^-$

PRACTICE

- Label the parts of the atom to the right. Include the following labels: proton, electron, neutron, nucleus.
- What elements is represented by this diagram? How do you know?



$6p^+$ means C = Carbon

- What is the charge of this nucleus? What is the charge of this atom overall?

nuclear charge: +6 atom charge: 0 [atoms are always neutral]

- What is the mass of this atom?

$$\text{mass number} = p^+ + n^0 = 6 + 7 = 13 \text{ AMU}$$

- Using a periodic table, look up titanium.

- What is its atomic number?
Ti = Titanium = 22
- How many protons does a titanium atom have?
22
- How many electrons does it have?
22

- What element has 78 protons?

Pt = Platinum

- What is the atomic mass of a sample of chlorine that has 19 neutrons?

$$\text{Cl} = \text{Chlorine has } 17p^+ \text{ atomic mass} = 17 + 19 = 36$$

- What atom has 18 electrons?

Argon = Ar

p. 7 HW Today (Oct 9)
+
work on your LAB => due Friday