

PRACTICE

Problem: If an ion of sulfur has a charge of 2-, how many electrons does it have?

Ion Charge = Number of protons - Number of electrons

PART C: ION FORMATION

When atoms gain or lose electrons, they become electrically charged particles called ions.

Metal atoms, for example, lose electrons to form positively charged ions called cations.

Many metals can form a cation only in one way.

For example, aluminum forms a cation by losing three electrons to become Al³⁺.

13	3+
Al	
Aluminum	
27.0	

ion charge

Figure 4.4A
Aluminum forms a 3+ ion as a result of losing three electrons.

Some metals are multivalent, which means they can form ions in **more than one way**, depending on the chemical reaction they undergo.

For example, iron is a **multivalent** element because it can lose 2 or 3 electrons to become Fe³⁺ ions and Fe²⁺ ions.

26	3+
Fe	2+
Iron	
55.8	

Look at the periodic table. Which metals are multivalent?

Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Sn, Pb, etc.
(transition metals) Many non-metals also form ions.

However, since non-metal atoms, with very few exceptions, gain electrons, they form negative ions called ANIONS.

17	-
Cl	
Chlorine	
35.5	

Figure 4.4C Chlorine forms a negative ion.

For example, the periodic table shows that chlorine will form a negative-1 ion. This happens when a chlorine atom gains one electron.



Review....AND NEW

What is in the box?

Test your knowledge how information is displayed for each element in the periodic table.

1. Use the vocabulary words listed to label the diagram.

Vocabulary	
ion charge	name
atomic number	symbol
average atomic mass	

(a) → 22 4+ (e)
(b) → **Ti** 3+
(c) → Titanium
(d) → 47.9

Examine the periodic table entry for each of the following elements and complete the blanks below.

2.

12	2+
Mg	
Magnesium	
24.3	

- (a) atomic number 12
(b) average atomic mass 24.3
(c) ion charge +2
(d) number of protons 12

3.

19	+
K	
Potassium	
39.1	

- (a) name of element Potassium
(b) ion charge +1
(c) number of protons 19
(d) average atomic mass 39.1

4.

8	2-
O	
Oxygen	
16.0	

- (a) atomic number 8
(b) average atomic mass 16.0
(c) ion charge -2
(d) symbol of element O

5.

15	3-
P	
Phosphorus	
31.0	

- (a) name of element Phosphorus
(b) average atomic mass 31.0
(c) ion charge -3
(d) number of protons 15

PART D: ION PATTERNS IN THE PERIODIC TABLE

* when atoms form ions they either "downsize" - lose e^- or "upgrade" - gain e^- to have a full valence shell

The outermost shell that contains electrons is called the valence shell. The electrons in the valence shell are called the valence electrons.

Valence electrons are involved in chemical bonding.

FOR EXAMPLE...

- The atoms of each element in group 1, hydrogen, have only 1 electron in their valence shell.
- Group 2 elements have 2 electrons in their valence shell.
- Group 13 elements have 3 electrons in their valence shell.
- Group 14 has 4 electrons, and so on through group 18.
- All group 18 elements have filled valence shells. Helium has two electrons filling its valence shell. Neon and argon each have eight electrons, or a stable octet, filling their valence shell.

Ion Charge:

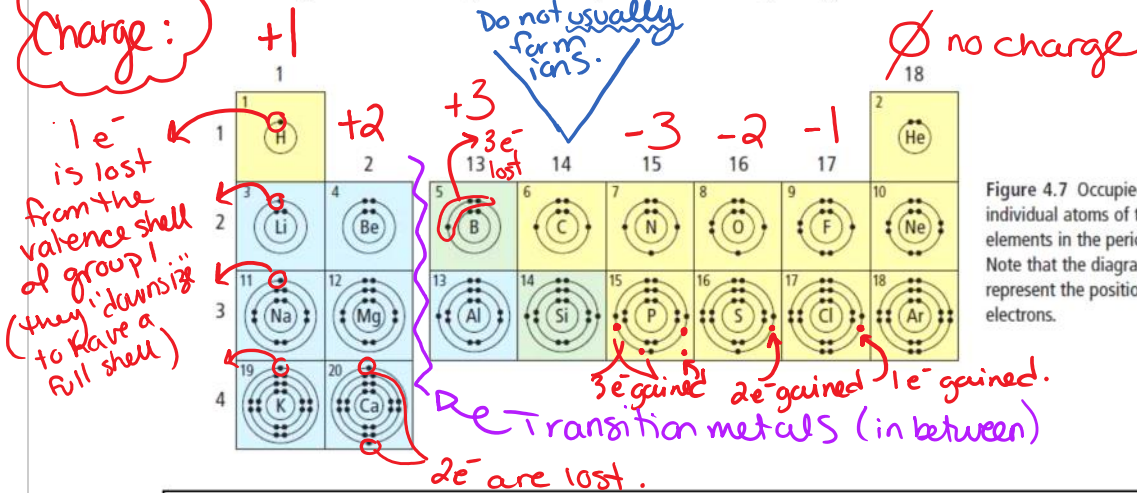


Figure 4.7 Occupied shells for individual atoms of the first 20 elements in the periodic table. Note that the diagrams do not represent the position or path of electrons.

PRACTICE

Element	Atomic Number	Ion Charge	Atom or Ion	Number of Protons	Number of Electrons
Beryllium	4	2+	Ion	4	2
Sodium	11	0	Atom	11	11
Argon	18	0	Atom	18	18
Chlorine	17	0	Atom	17	17
Nitrogen	7	3-	ion	7	10

↑ gained $3e^-$ to now make 6 (means as a neutral atom it was $7e^-$)

Homework

ASSIGNMENT #1: Atomic & Ions Practice

This assignment is to be completed below in the space provided.

Remember your formulas:

Formula 1. atomic number = number of protons

Formula 2. atomic mass = number of protons + number of neutrons

number of protons = atomic mass – number of neutrons

number of neutrons = atomic mass – number of protons

Formula 3. atomic charge = number of protons – number of electrons

number of protons = number of electrons + atomic charge

number of electrons = number of protons – atomic charge

Element Name	Atomic Number	Atomic Mass	Number of Protons	Number of Electrons	Number of Neutrons	Atomic Charge
beryllium	4	9	4	4	5	0
sodium	11	23	11	11	12	0
argon	18	40	18	18	22	0
calcium	20	40	20	20	20	0
chlorine	17	36	17	17	19	0
silver	47	108	47	47	61	0
gold	79	197	79	79	118	0
beryllium	4	9	4	2	5	+2
nitrogen	7	14	7	10	7	-3
sulphur	16	32	16	18	16	-2
lithium	3	7	3	2	4	+1
aluminium	13	27	13	10	14	+3
nitrogen	7	14	7	10	7	-3
oxygen	8	16	8	10	8	-2
phosphorus	15	31	15	18	16	-3
aluminium	13	27	13	10	14	+3