THE ELECTRON STRUCTURE OF IONS

Ions are particles that contain a different number of protons and electrons and so they are electrically charged.

Protons have 1+ charge Electrons have 1– charge

TASK 1 – What is the electric charge of ions containing these numbers of protons and electrons?

Protons	9	12	3	8	13
Electrons	10	10	2	10	10
Charge of ion	**1–**	**2+**	**1+**	**2–**	**3+**

TASK 2 – Complete the table about the following ions.

ion	protons	neutrons	electrons	electron structure
$^{7}_{3}Li^{+}$	**3**	**4**	**2**	**2**
$^{19}_{9}F^{-}$	**9**	**10**	**10**	**2,8**
$^{24}_{12}Mg^{2+}$	**12**	**12**	**10**	**2,8**
$^{16}_{8}O^{2-}$	**8**	**8**	**10**	**2,8**
$^{27}_{13}Al^{3+}$	**13**	**14**	**10**	**2,8**

The group 0 elements, called the noble gases, have very special electron structures.

These electron structures are very stable (their outer shell is full).

Group 0 element	**He**	**Ne**	**Ar**
electron structure	2	2,8	2,8,8

Ions have these same stable electron structure as the noble gases (group 0 elements).

TASK 3 – Complete the table about some common ions.

Ion	Li^{+}	Cl^{-}	K^{+}	O^{2-}	Mg^{2+}	F^{-}	Ca^{2+}	Al^{3+}
Number of electrons	**2**	**18**	**18**	**10**	**10**	**10**	**18**	**10**
Electron structure	**2**	**2,8,8**	**2,8,8**	**2,8**	**2,8**	**2,8**	**2,8,8**	**2,8**
Which noble gas has the same electron structure?	**He**	**Ar**	**Ar**	**Ne**	**Ne**	**Ne**	**Ar**	**Ne**

Atoms often react to gain or lose electrons. When this happens, they gain or lose electrons in order to get a stable electron structure of a noble gas.

TASK 4 – Complete the table to show what happens to atoms when they react to form ions.

Atom	Which group the atom is in	Electron structure	How many electrons it gains or loses to form an ion	Charge on the ion
Na	1	2,8,1	loses 1 e^-	1+
K	1	2,8,8,1	loses 1 e^-	1+
Be	2	2,2	loses 2 e^-	2+
Ca	2	2,8,8,2	loses 2 e^-	2+
Al	3	2,8,3	loses 3 e^-	3+
O	6	2,6	gains 2 e^-	2–
S	6	2,8,6	gains 2 e^-	2–
F	7	2,7	gains 1 e^-	1–
Cl	7	2,8,7	gains 1 e^-	1–

TASK 5 – What charge of ions do atoms from each group form?

Group	1	2	3	4	5	6	7	0
Charge on ions formed	+1	+2	+3	rarely form ions	–3	–2	–1	never form ions

TASK 6 – What charge of ions will the following atoms form?

Atom	B	Br	Mg	Li	Se	Ga	Rb	P
Charge on ions formed	+3	–1	+2	+1	–2	+3	+1	–3

Note that the only common ion that does not have the same electron structure as a noble gas is H^+

This ion has no electrons at all – but this does mean that it has no partially filled shells like all other ions.