Periodicity

Periodic table

Periodic Trends

Ms. Thompson - SL Chemistry
Wooster High School

Topic 3.1
Periodic table

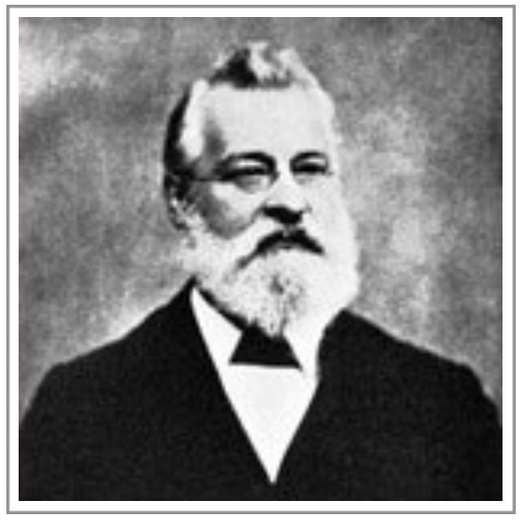
- The periodic table is arranged into four blocks associated with the four sublevels– s, p, d, and f.
- The periodic table consist of groups [vertical columns] and periods [horizontal rows].
- The period number [*n*] is the outer energy level that is occupied by electrons.
- The number of the principal energy level and the number of the valence electrons in an atom can be deduced from its position on the periodic table.
- The periodic table shows the positions of metals, nonmetals and metalloids.

Periodic table

The development of the periodic table

- Based on structure and function of the elements
- Created and updated over years by scientists from various countries
- Four key scientists contributed to the development of the modern periodic table:

Johann Döbereiner - Discovered elements such as calcium, strontium, and barium had similar properties. Developed the **law of triads** based on findings.



John Newlands - Discovered when elements were arranged in order of atomic weight, there appeared to be evidence of a pattern with the properties of the elements repeated in **octaves** consisting of seven elements. Developed the **law of octaves**.

Periodic table

The development of the periodic table

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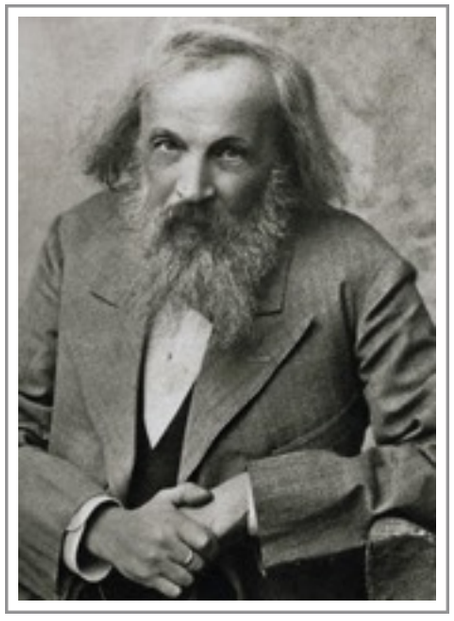
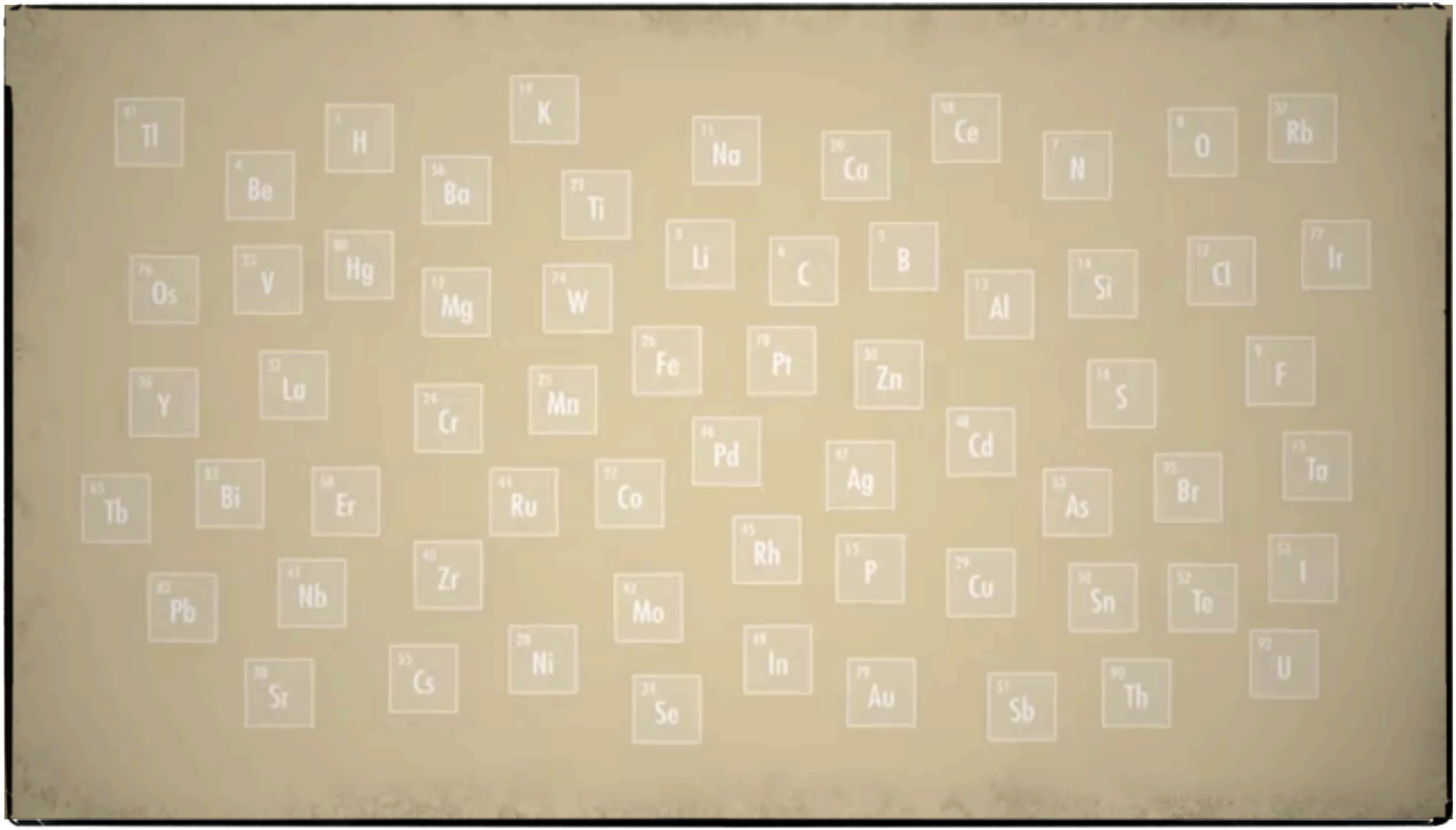


Dmitri Mendeleev - Found similar findings as Newlands but carefully considered the properties of the elements and further grouped them accordingly. Left space for predicted elements that haven't been discovered at the time.

Henry Moseley - Realized organizing elements based on weight was problematic so he arranged them based on atomic number, Z.


Tl
H
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Tb
Bi
Er
Ru
Co
As
Br
Ta
Rh
P
Cu
I
Pb
Nb
Zr
Mo
Sn
Te
Ni
In
U
Sr
Cs
Au
Th
Se
Sb

Periodic table

Class discussion

In modern science do you think that theoretical research has a much greater chance of acceptance by the scientific community if it supported by empirical evidence?

Periodic table

The periodic table today

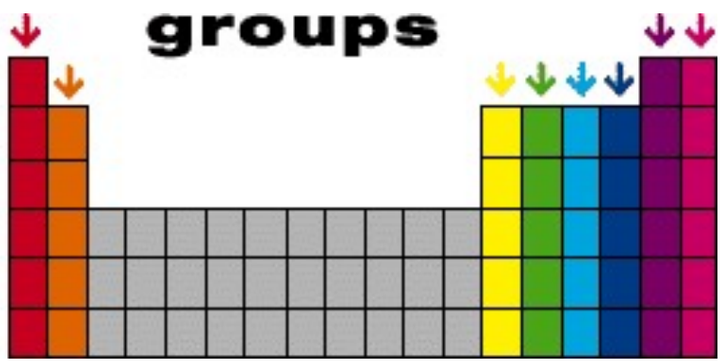
- Arranged by increasing atomic number, Z.
- Elements with similar chemical and physical properties are place under one another in vertical columns called **groups**.

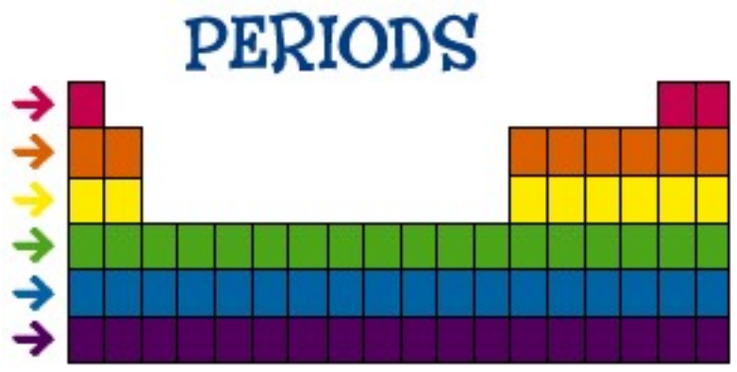
Group number	Recommended name
1	alkali metals
2	alkaline earth metals
15	pnictogens
16	chalcogens
17	halogens
18	noble gases

Periodic table

The periodic table today

- Currently 118 elements
- **Groups** (vertical columns) have distinct characteristics
  - i.e. group 18 (noble gases) are very unreactive
- **Periods** (horizontal rows) 1-7 is equal to the principle quantum number, *n*, of the highest occupied energy level
  - i.e. Ca Z=20 is in period 4 and has four energy levels with *n* = 1, 2, 3, and 4





Periodicity

Metals, non-metals, and metalloids

- Split into **metals** and **non-metals**; separated by stepped diagonal line.
- Elements to left of line are metals (except hydrogen) and the non-metals are to the right of the line.
  - ***Metals*:**
    - Good **conductors** of heat and electricity
    - **Malleable** (capable of being hammered into thin sheets)
      - i.e. aluminum foil
    - **Ductile** (capable of being drawn into wires)
      - i.e. copper wire
    - **Lustre** (they are shiny)

Periodicity

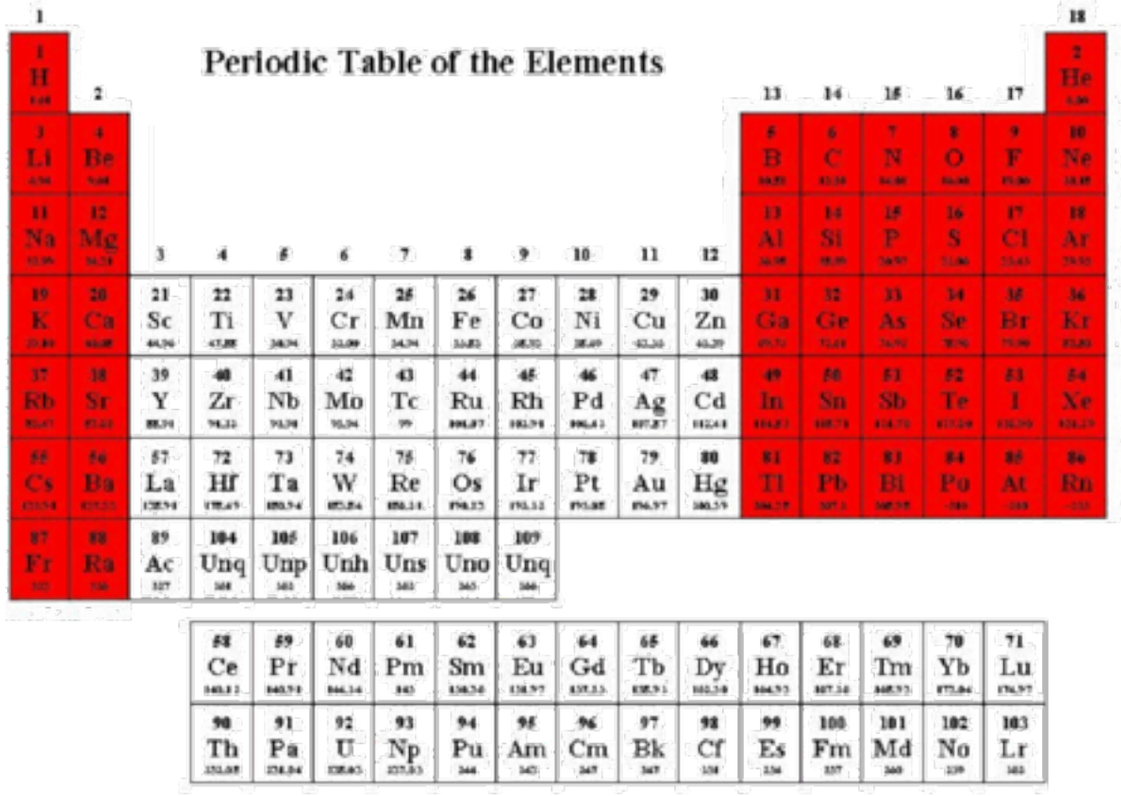
Metals, non-metals, and metalloids

- ***Non-metals*:**
  - Poor conductors of heat and electricity
  - Typically gain electrons in chemical reactions (they are **reduced**), whereas metals lose electrons (they are **oxidized**).
- ***Metalloids:***
  - Have both metallic and non-metallic properties
  - Si, Ge, As, Sb, Te, and At are all **metalloids**.
  - Some metalloids such as silicon and germanium are good **semiconductors**.

Periodicity

Main group, transition elements, and s, p, d, and f blocks

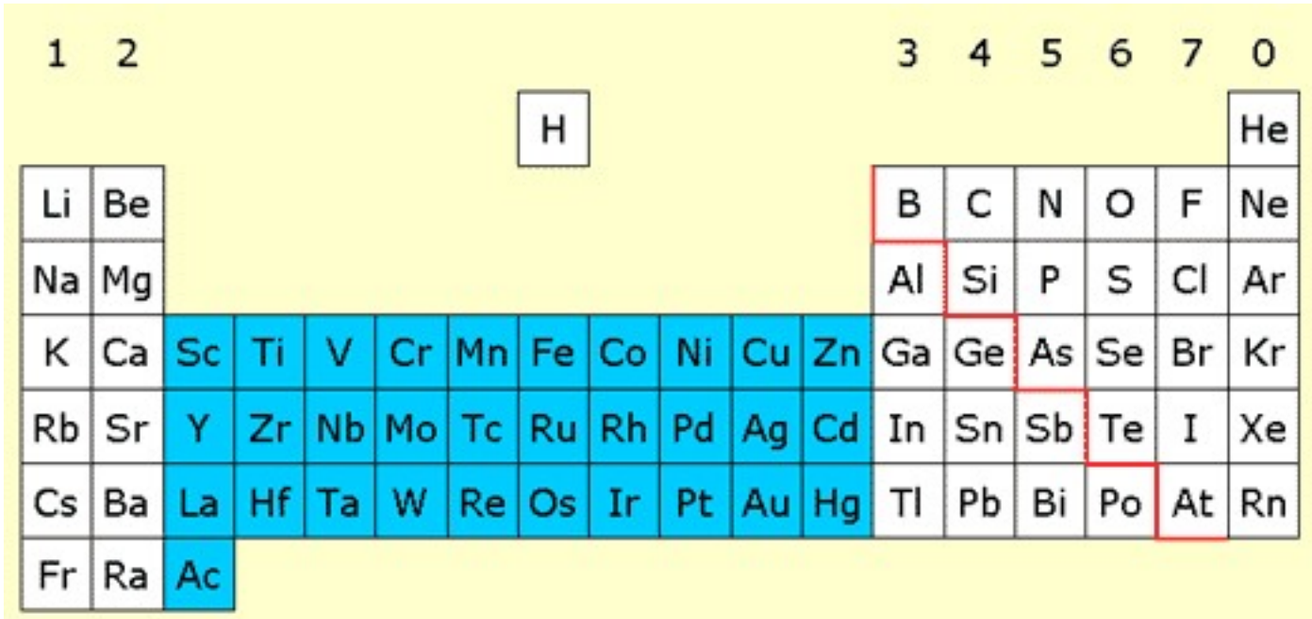
- ***Main group elements:***
  - Groups 1 (except H), 2, and 13-18
  - Properties can be deduced from their position on periodic table



Periodicity

Main group, transition elements, and s, p, d, and f blocks

- ***Transition elements:***
  - Groups 3-11



Periodicity

Main group, transition elements, and s, p, d, and f-blocks

Main-group elements	group 1 (excluding H), group 2, and groups 13-18
Transition elements	groups 3-11 (the f-block elements are sometimes described as inner transition elements)
s-block elements	groups 1and 2 and He
p-block elements	groups 13-18 (excluding He)
d-block elements	groups 3-12 (including La and Ac), but excluding Ce to Lu and Th to Lr, which are classified as f-block elements
f-block elements	elements Ce to Lu and from Th to Lr
Lanthanoids	elements La to Lu
Actinoids	elements Ac to Lr

Periodicity

Main group, transition elements, and s, p, d, and f-blocks

- The number of **valence electrons** (outer-shell electrons) can be found from group number of the s- and p-block elements.
  - i.e. Carbon, Z = 6 is in group 14 and has 4 valence electrons
    - All elements in group 14 have 4 valence electrons!! Cool!

Practice Problem

... We Do ...

Recall from topic 2.2 we showed that electron configuration of an element can be expressed in three ways:

- full electron configuration
- condensed electron configuration
- orbital diagram

For example, Fluorine, F, Z = 9:

- full electron configuration: $1s^2 2s^2 2p^5$
- condensed electron configuration: $[He]2s^2 2p^5$
- orbital diagram: [He] 

Practice Problem

... We Do ...

1. Consider the element selenium , which has the chemical symbol Se.

a. State the number of protons and electrons in an atom of Se.
b. State in which group of the periodic table selenium belongs.
c. State and number of valence electrons in an atom of Se.
d. State the number of protons and electrons in the anion, Se^{2-}.
e. Deduce the full electron configuration of Se.
f. Deduce the condensed electron configuration of Se.
g. Draw the orbital diagram for Se.

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