TRENDS in the Periodic Table

Full Name: _____

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The different kinds of elements can be arranged in a pattern, according to the structure of their atoms and the way in which they behave.

(1) Elements can be arranged into groups

Each element behaves in a different way from every other element. We say that their properties are different. But there are also similarities in the way that some elements behave.

For example,

lithium, sodium and potassium have very similar properties. They are all reactive metals. They are often called the alkali metals.

Fluorine, chlorine, bromine and iodine also show great similarities in the way they behave. They are often known as the halogens.

(2) The Periodic Table shows all the elements arranged in groups

You can see these groups in the Periodic Table. The elements in each group are arranged vertically. The element with the smallest atomic number is at the top of the group, and the one with the largest atomic number at the bottom.

The horizontal rows in the Periodic Table are called periods. Look at Period 2. It begins with lithium, then beryllium, then boron. These elements are arranged in increasing atomic number. (Remember – the atomic number is the number of protons in an atom.)

(3) Elements with a similar arrangement of electrons in their outer orbit behave in a similar way

When chemists first arranged elements into groups, they did not know why some elements showed similarities in the way they behaved. Now we know that it is to do with the number of electrons they have in their outer orbit. Elements with the same number of electrons in their outer orbit behave in a similar way.

For example, lithium, sodium and potassium all have one electron in their outer orbit. Fluorine, chlorine, bromine and iodine all have seven electrons in their outer orbit. Lithium, sodium and potassium belong to Group 1, because their outer orbit contains one electron. Fluorine, chlorine, bromine and iodine belong to Group 17, because their outer orbit contains seven electrons.

(4) The Periodic Table can suggest how reactive an element will be

Atoms are most stable when their outer electron orbit is full. The Group 18 elements have eight electrons in their outer orbit. The orbit is full. So Group 18 elements are very unreactive. They are sometimes called the noble gases.

Group VII elements have seven electrons in their outer orbit. They only need one more electron to fill this orbit. So they readily take electrons from other atoms, to fill up their outer orbit and become stable. This makes them very reactive elements.

Group 16 elements have six electrons in their outer orbit. They need two more electrons to fill this orbit. Like Group 17 elements, they will take electrons from other atoms. But they do this less readily, so they are less reactive than Group 17 elements.

At the other end of the Periodic Table, Group I elements have only one electron in their outer orbit. They can have a full outer orbit by losing this electron. They do this very easily, giving up their electron to other atoms. So Group 1 elements are very reactive.

Apart from the noble gases, the most reactive elements are near the left- and right-hand sides of the Periodic Table.

(5) Metals are on the left-hand side of the Periodic Table

The zig-zag line separates metals from non-metals. All the elements on the left-hand side of the line are metals. All the elements on the right-hand side of the line are non-metals.

Metals are elements which tend to lose electrons. The metals have atoms which can most easily end up with full electron orbits by losing electrons.

(6) Transition elements have more complex electron arrangements

The middle of the Periodic Table is taken up with the transition elements.

These elements do not fit into one of the eight groups. They have more complex electron arrangements.

A chemical family is used to describe a bunch of related elements

Also: Stable Octet
→ 8 electrons in the outer shell
∴ a full outer shell

Group VIII / 18
8 electrons in the outer atomic shell (except He)
Do not react.
Why: they have a STABLE OCTET
Name: NOBLE GASES or INERT GASES

(Elements near this zig-zag line show both metallic and non-metallic properties)

GROUPS (Vertical columns)
Elements with similar chemical properties

METALS ← → NON-METALS

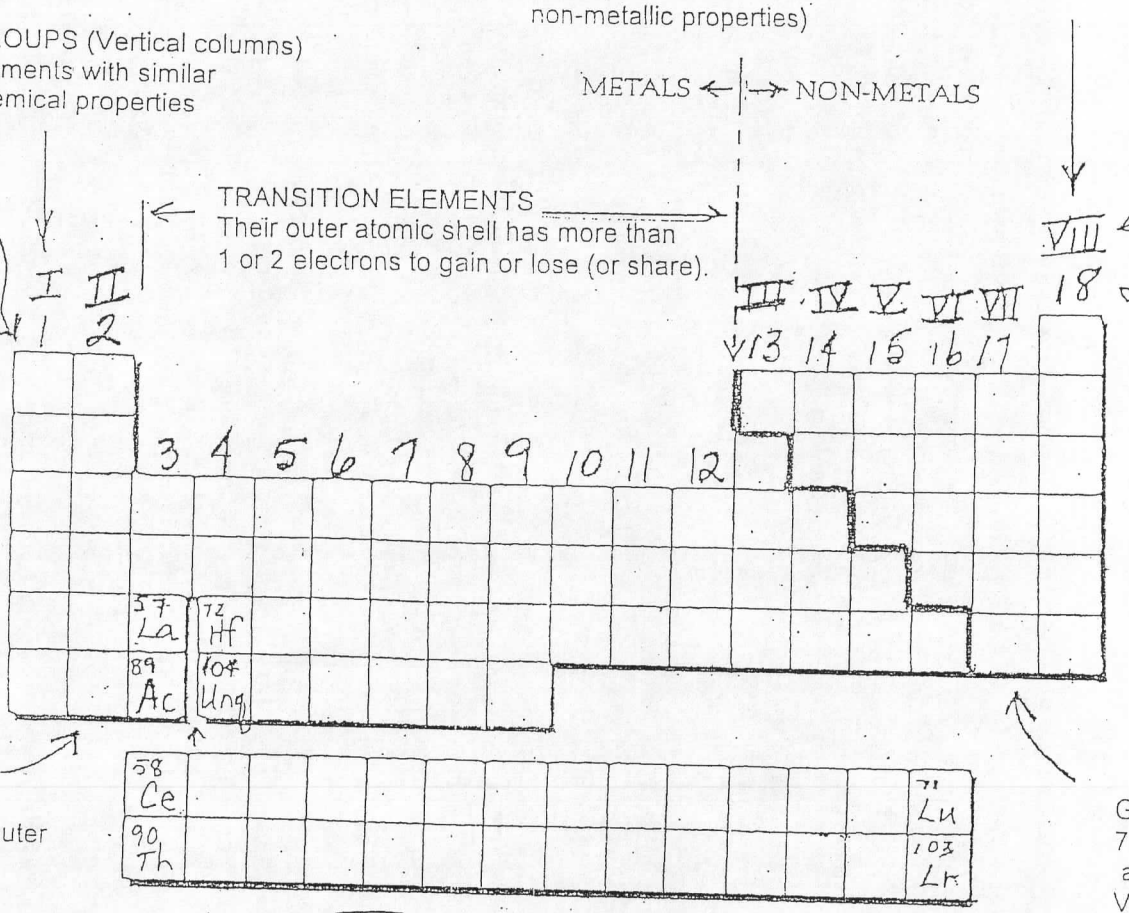
Group I / 1
1 electron in the outer atomic shell.
Very reactive.
Why: They have 1 electron more than a stable octet.
Name: THE ALKALI METALS

TRANSITION ELEMENTS
Their outer atomic shell has more than 1 or 2 electrons to gain or lose (or share).

The older way of numbering groups.

The newer way of numbering groups.

PERIODS (Horizontal rows)
An arrangement with increasing atomic numbers



Group II / 2
2 electrons in the outer atomic shell
Fairly reactive.
Why: they have 2 electrons more than a stable octet
Name: THE ALKALINE EARTH METALS

These elements fit into the gap in the upper table
Name: LANTHANIDES or RARE-EARTH elements.

Group VII / 17
7 electrons in outer atomic shell
Very reactive
Why: They are 1 electron short of a stable octet
Name: the HALOGENS

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Chemical Groups:

Use the information in the note and in your periodic table to complete the questions.

1.) a) Elements with the same number of electrons in their outer orbit _____ in a similar way.

b) Elements with the same number of electrons in their outer shell belong to the same _____ on the periodic table.

c) Atoms are most stable when their outer electron shell is _____.

2.) a) List all of the elements that belong in Group I/1:

b) What is the other name that is given to these elements? _____

c) Why do all these elements belong to Group I/1?

d) Why are these elements reactive?

3.) a) List all of the elements that belong in Group VII/17

b) What is the other name that is given to these elements? _____

c) Why do all these elements belong to Group VII/17?

d) Why are these elements reactive?

4.) a) List all of the elements that belong in Group VIII/18

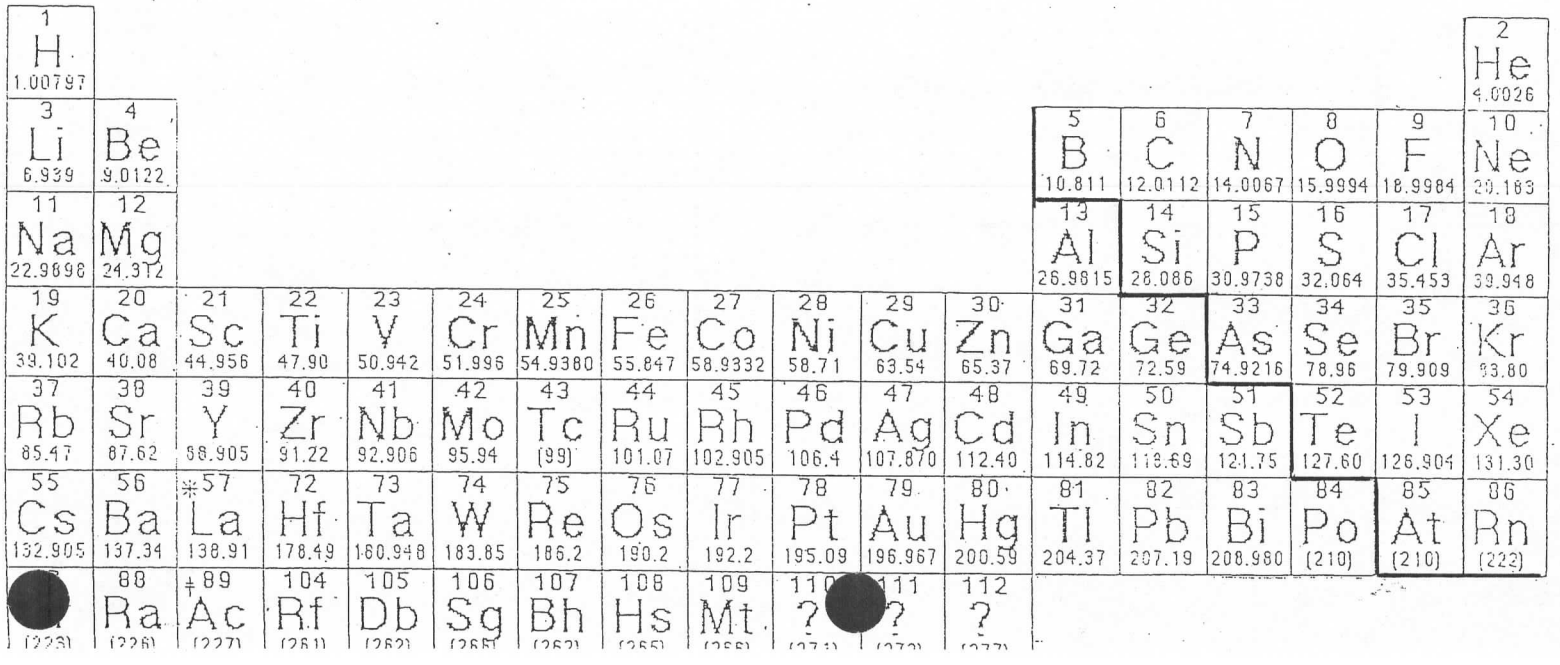
b) What is the other name that is given to these elements? _____

c) Why do all these elements belong to Group VIII/18?

d) Why are these elements unreactive?

On the Periodic Table below, locate and colour in those elements that are in the same group and therefore have very similar chemical properties. Select a different colour for each group and fill in the chart.

Name of Group	Group Number	Colour	Example of Chemical Properties	Number of Outer Shell Electrons	Explanation of Chemical Behaviour (Hint: Read pg 1-2!!)
Halogens		GREEN	very reactive non-metals; react with H to form an acid		
Alkali Metals		RED	very reactive metals; react violently with water		
Noble Gases		BLUE	extremely unreactive non-metals (do not normally form compounds)		
Alkaline Earth Metals		ORANGE	reactive metals (but less reactive than alkali metals)		



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The Outer Electrons

Shell diagrams are a way of representing atoms based on the Bohr-Rutherford model, and they are helpful in understanding how substances react **chemically**.

1. Periods (HORIZONTAL ROWS) An arrangement with increasing atomic _____.

Period 1

Element	Atomic Number
Hydrogen	
Helium	

Period 2.
Begins with lithium and ends with _____.

Period 3
Begins with _____ and ends with argon.

a) What did you Discover?

How many electrons will the outer electron shell hold in the first period = _____
How many electrons will the outer electron shell hold in the second period = _____
How many electrons will the outer electron shell hold in the third period = _____

Outer Electrons and Groups of Elements

A chemical family is used to describe a bunch of related elements.

As you go down a group their atomic number and their atomic _____ increase.

Also the number of electron _____ increases.

Electron arrangements of four families (complete the table)

Alkali Metals (very reactive)	Alkaline Earth Metals (fairly reactive)	Halogens (very reactive)	Noble Gases (highly unreactive)
			He
		F	
			Ar
K		Br	
		I	
	Ba		

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Noble Gases (group number _____)

Noble gases do not like to combine with other elements, they are _____.

Based on numerous laboratory experiments and other observed properties, what have chemists reasoned about the electron arrangement? Give an example:

_____

_____

_____

The electron arrangement for noble gases is extremely stable. It is called a _____

Halogens (group number _____)

Halogens have _____ outer electron(s). They are _____ below a stable octet. Halogens react vigorously with nearly everything. They are extremely corrosive and _____.

Alkali metals (group number _____)

Alkali metals have _____ outer electrons. They are _____ beyond a stable octet.

They also react vigorously with other substances.

The Alkaline Earth metals (group number _____)

Alkaline Earth metals have _____ electrons in the outer shell and are said to be _____

Electrons beyond a _____ _____.

They react fairly vigorously but not as vigorously as the _____ metals.

* NOTE:

"Stable octet" → a full or complete valence shell

e.g. 1st shell = 2
2nd shell = 8
3rd shell = 8

eg: Helium