The Periodic Table

The Periodic table should be one of your primary tools in understanding the reasons why chemicals behave the way they do. Chemistry, in most scenarios is predictable and systematic.

The table arranges elements into a helpful framework of chemicals with recurring behaviours. If you are unfamiliar with the concept of elements and atoms, have a read of the “Atoms, Elements and Isotopes” document to get you up to speed. We’ll quickly skim over the basic definitions.

Element: Substances which are made from only *one* sort of atom.

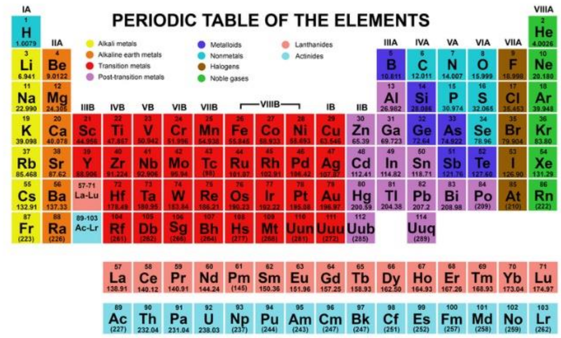
Atom: the *smallest particle* of a chemical element that can exist.

Isotope: A type of element which has a *differing number* of neutrons.

Atomic number: the number of protons an element has.

The table is in columns and rows. These columns are known as groups and they represent elements with similar properties and characteristics.

The periodic table begins with atomic number 1, hydrogen, followed by atomic number 2, helium; continuing in this fashion. This creates the order for where the elements sit in their respective groups, labelled 1 to 18.



In groups 1 and 2 (yellow and orange respectively), we have metal elements such as sodium and lithium etc... These materials are relatively water reactive. As you go down groups 1 and 2, the elements become more water reactive. Francium, at the bottom (and the most reactive element) of group 1 is so reactive that it has never been viewed in bulk. It is also very radioactive.

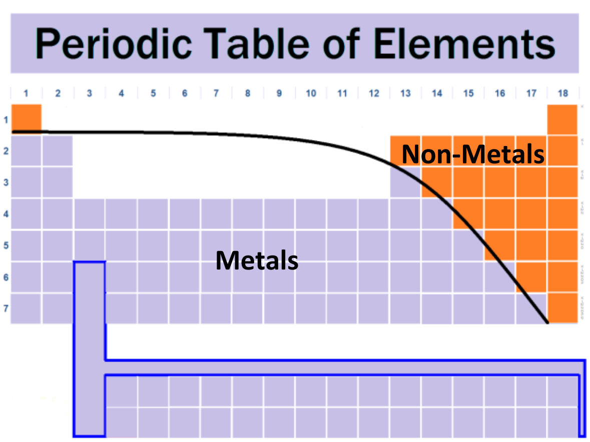
Casting your eye to the centre of the table, groups 3 to 12 (in red), you’ll find the transition metals. The transition metals have similar character to *traditional* metals, typically being shiny and conducting electricity etc. The transition metal elements are more complex in bonding than the metals in groups 1 and 2.

For example, Sodium (in group 1) can only use its single valent electron to form bonds. Iron, a transition metal can use either two or three of its valent electrons to bond. You’ll be familiar with iron rusting to the reddy/brown colour. This is iron changing its bonding structure through oxidation. You’ll also find gold and silver in the transition metals.

Further to the right in the table, we find the non-metals. Familiar gaseous elements such as oxygen, carbon and nitrogen are here. Typically the non-metals bond in a covalent way. In group 17 you'll find the halogens (in brown). These include the reactive elements fluorine, chlorine and bromine.

At the extreme right of the table in group 18 you can see the *noble gases* (in green). These are very stable gases which are not reactive. Commonly used in fluorescent lighting, Neon is an example of a noble gas.

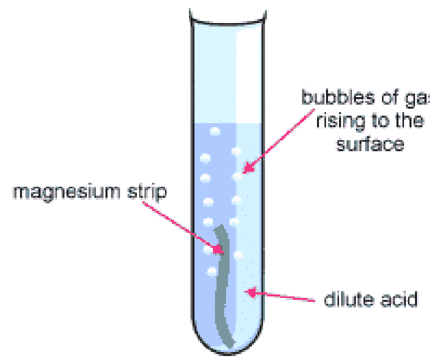
A quick rule of thumb approach to encountering a hazmat chemical element response is to split the periodic table into two. Identify the metals and non-metals. Have a look at the diagram below. Elements in orange are non-metals and the rest of the table, in mauve, are metals.



Elemental metal substances behave in a different way to non-metals. Owing to their bonding, see the Chemical Bonding infosheet, they have lower vapour pressures, reducing the risk of spreading.

From a response point of view, they are generally non-flammable and won't polymerise. In most cases, responding to a metals incident results in a scaling down of the threat level.

However, metallic substances can be highly reactive with water, releasing flammable hydrogen gas. The picture below shows what you would see if you were to place a strip of magnesium in dilute acid.



Metal + Water -> Hydrogen (gas) + Metal Oxide

Most water reactive metals are in the first two groups of the periodic table. There are some exceptions to this. Metals which have nitride, carbide, hydride or phosphide in their name could react violently with water.

Non-metals: a different kettle of fish!

Typically non-metals can exist in solid, liquid and gas forms. They also tend to have higher vapour pressures. This means that more vapours will spread over a greater distance. These vapours could potentially be flammable.

Another possible issue associated with non-metals is the possibility of a polymerisation. This could lead to a run-away reaction, with the potential for lots of energy being released. Runaway reaction example.