Hello everybody I am miss Varsha K. Sail, Associate Professor,

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The title of unit today is

Periodicity of element.

The model name is factors

affecting Ionization Energy Part

2, model number is 08. Outlines-.

Factors affecting ionization energy-
Atomic size, Type of orbitals.

and electronic confirmation.

The learning outcomes of

this particular module-

The student acquired understanding of.

different factors affecting

ionization energy.

The reason shown for this particular effect.

and the trend shown in the periodic property.

The student can apply this knowledge

to predict or understand the trend

shown in the period or

the group in the periodic table.

They can understand other chemical

properties related to the ionization energy.

Thus they can predict the trend in the

reactivity or the chemical property

of the elements in the periodic table.

Now let's go to the different factors

affecting ionization energy.

The different factors are Net nuclear

charge or Effective nuclear charge.

The second factor is the Shielding

or the screening effect.

Third one is Atomic Size.

And the fourth is electronic configuration.

Now in today's module we will be discussing factor #3 onwars that is Atomic size,

Type of orbital and Electron configuration.

Now all these factors are found to be

usually interrelated to each other.

Now we will see the first factor that

is Atomic size.

We have seen that Atomic size goes on

increasing down the group with increase in the number of shells. As we go down the group

in the periodic table and the number

of shells goes on increasing,

so does the size of atom.

Also,

it is seen that across the period

the atomic size goes on decreasing,

from left to right with increasing the nuclear charge.

Now.

The force of attraction between

the charged particle is inversely

proportional to the square root

of the distance between them.

The force of attraction is also an

increasing as the distance

between the charged particle goes

on decreasing.

In case of atom,

the attractive forces is between

the protons in nucleus and the electron.

So in a smaller atom there are few

Electron and fewer number of electron shells.

As a result,

the valence electrons are closer

to the nucleus.

Now since they are closer to the nucleus,

they experience a stronger

coulombic attraction.

The electrons are more tightly held,

so it is difficult to remove

the valence electron.

Now in case of a larger atom,

there are more number of electrons and

there are many electron shell.

As a result, the valence electrons are

more shielded from the nuclear attraction.

Hence it is easy to knock off the

loosely held electron from the

outer most orbital or the valence shell.

Thus, as the size goes on,

increasing the energy required

to remove the valence electron,

that is ionization energy goes on decreasing

That is larger the atomic size

smaller is ionization energy.

This can be seen from the first ionization

energy of the elements which goes

on decreasing down the group with the

increase in the atomic size. We can see that in the

first group that is alkali metals

lithium, sodium, Potassium, Rubidium   cesium

As the size goes on increasing downward the

Ionization energy, which is given in terms

of electron Volt goes on decreasing.

Lithium is the smallest

atom whereas cesium is the biggest one.

The energy required to remove electrons

from the valence electron from

lithium requires more energy because

the electron is much closer to the

nucleus whereas in case of cesium,

since the size of the atom is big,

the electron is far away and

the energy required is lower.

similar trend is seen in all

the groups in the periodic table.

Thus as we go down the

group the size goes on,

increasing and ionization energy

goes on decreasing.

Now let's do the second factor.

That is, a type of orbital.

Now different orbitals have varying

radial distribution of electron.

This is given by the shape of the orbital

And the radial distribution of electron.

is different for different orbital.

Accordingly they have different shapes

of orbital and electron density also

around the nucleus is different means

different orbitals have different shape.

Now electrons penetrate to different extent

towards the nucleus in different orbital.

This is because of the electron density,

When the electron density is lesser.

The electrons are pulled

strongly towards the nucleus,

so the electron gets more pulled

towards the nucleus

Now,

for a given principle quantum number and

the electron density near the nucleus

decreases as Azimuthal or

Subsidiary Quantum number

L goes on increasing.

Now, the L value for S orbital is O, P,

orbital is 1and for D

it is 2 and for the F orbital it is3.

So for given principal quantum

number n,
the electron density near

the nucleus decreases as the
Azimuthal quantum number goes on

Increasing, that is the penetrating

effect of the electron towards the

nucleus decreases in the order **s> p>d>f**

so the electron in the S orbitals are

experience more attraction from the nucleus

then in P orbital and which in turn

is most strongly held or pulled

towards the nucleus.

Then the DS electrons are very

much more strongly held

compared to P and they are in term

health strongly then D. And then if.

Therefore, for a given principle,

quantum number ends the energy required

to pull out a S electronics maximum as it

penetrates most closer to the nucleus.

Those greater than penetration of electron,

there more strongly held in the new

health and higher is the actual image.

Thus, the energy required to remove

the electron from the different

orbital decreases in the order SPDF.

Thus keeping all

other factors and the principle

quantum number (n) constant,

it is seen that Ionization energy goes on

decreasing as a subsidary quantum number

L of the electron goes on increases,

Now following table shows the

decrease in the first Ionization

energy due to the type of orbital

occupied by the valence electron

despite the increase

in the nuclear charge.

Now let's consider elements from the

second period beryllium and boom,

the atomic number is 4 and 5.

Electronic configuration in case of

beryllium electron is occupying the valence

electrons is in S orbital and in Boran the valence electron occupy

the P orbital.

Though these are increasing

the nuclear charge,

the energy required to remove the last

valence electron in case of boron is lesser

compared to that required in case of beryllium.

Similarly in case of management

Aluminium the atomic number of

aluminium is more than Mangnesium,

so the nuclear force has to be stronger.

But still the energy required to remove

the electron from the P orbital is lesser.

compared to that,

in case of Boron

This is because the electron

is occupying S orbital,

Now let's consider third factor

It is electronic configuration.

Now elements have higher stability

due to fully fill or exactly half filled

electronic configuration and they

show higher Ionization energy.

So all those elements which have

either completely or exactly half

electronic configuration

show higher ionization energy.

Now half electronic configuration

are found to be stable.
because of the even distribution

of electron and minimum into electronic.

repulsion.

Thus,

when electron is added to half

filled orbitals,

the repulsion between electron

and the extra electrons just added

offsets the attraction due to

the increase in the new proton.

As soon as one electron is

added into one of the orbital,

there's a repulsion between the electrons,

and though the nuclear charge is increasing.

Usually with increase in nuclear charge Ionization energy is increasing,

but due to the repulsion between

electron, repulsion is more compared

to the attraction in the nucleus.

As a result,

the electronic configration

becomes less stable.

And it is thus easier to remove

the last valence electron.

Now lets see noble Gas electronic configuration

They have a filled orbital and

are most stable and
show the highest ionization energy.

This is again due to the close shell

and it has ns^2 np^6 electronic configuration

And due to this,
electronic configuration there

there is even distribution of

the electron and hence they resist

any disruption in the electronic configuration

and their resist formation of any bond.

They don't allow any electron to

get out of it and they don't

go into any chemical bond formation.

Thus,it is the most stable electronic configuration.

and more is energy required to remove electrons.

So more stable the electronic configuration

higher is the Ionization Energy.

For example, let's compare the initial energy

of elements with half electron confession

to that of the next element in the period,

and this is shown in the given table.

Let's consider two elements from the

second period, nitrogen and oxygen.

Nitrogen has atomic numbers.

seven where as oxygen is eight.

There is increase in the nuclear charge.

So the electrons should be

pulled more strongly.

But if you see the electronic

configuration of nitrogen,

it is an $2s^2$ $2p^1$ $2p^1 2p^1$ that

is exactly half filled orbital and

their 1st ionization energy is 14.534 electron

volts and then we going to oxygen.

One electron is added to the P orbitals

and there's a repulsion between the two electron

in the p orbital and thus this

electronic configuration is less stable

compared to nitrogen,

that is where it is exactly half filled.

As a result the energy required

to remove this last electron from Oxygen

i.e the valence electron

is less,

and thus the ionization energy of Oxygen is lesser.

This give a more stable configuration

It does not like to change or

resist change from a more

stable half filled electronic configuration to a configuration

where it is less stable.

So it would like to go to the more stable half filled

electronic configuration.

Similar thing is seen for the third period

for phosphorus and sulfur. Atomic number of phosphorus 15.

Sulfur is 16.

Again,

In case of sulfur.

The p shell is exactly half filled.
.
In P one electron which is added to p orbital.

Now this one electron in the P results

in interelectronic repulsion

between these two electron and this

offsets the attractive force due

to the nuclear charge which

is increased. Again this is leading to instability

of the electronic configuration,

The energy required to

remove that last electron is less
compared to that required to remove

the electron form a more stable electronic configuration.

Now following table shows the high

initial energy of noble gas due to

stable electron or completely filled

electronic confusion where in the

last shell is completely full

$ns^2\ np^6$. If you see all the

noble gases they all show a

very high initial IE because

they it is very difficult to disrupt

a very stable configuration.They resist removal

of electron because they're completely

filled electronic configuration

You see even electronic distribution.

However, you can see as we go down,

the IE goes on decreasing. Again.

this is because of the increase in the

atomic size as we go down the group,

the size goes on,

increasing the energy required

to remove the last electron is less,

so IE goes on decreasing,

Thus in general.

Noble Gas has the highest Ionization

energy in the full periodic table

The references for this particular

module are

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Thank you.