good morning everybody in this last class of
d and a block elements will just today discuss about the features the electronic configurations
the oxidation states of the f block elements and basically what we will be seeing here is
how we can locate the a block elements and there will be two different a block elements
one is four f and another is five f
so fourteen plus fourteen because we know that the maximum
capacity of f or vitals is fourteen electrons
so there are seven orbitals each of them are
occupying two electrons
so 7 into 2 that means 14 electrons will be fitting in the periodic
table for 5 f as well as 4a
so basically what is our intention that how we can identify these
elements because we do not have any scope to study the reactivity pattern the reactions and all
these but there are some examples which are very well found in the nature
so basically when we get
all these elements from the minerals and the ore
so these can also be related to some amount
of the corresponding geochemistry which is a very important subject and a huge subject where
people can handle the different ores and all and this geochemistry study for these periodic
tables because if we locate these elements in the periodic table and how ah we can place them
depending upon their properties
so initially we will see that how we can locate or find out these
four f elements and those four f elements whether they are interesting for their oxidation state
and the reactivity or in some other type of ac applications
so geochemistry is basically dealing
with the nature because the nature is the typical source for getting all these elements and in the
nature occasionally we say some of them are not very common on the earth crust like iron like zinc
like nickel etcetera
so they are basically called as rare earth elements or the real earth but they
when they found they are combined together they are found together in the nature and that's why
they are all called as the rare earth elements
so if we just see these two groups
so we
have seen that different properties of three d four d and five d elements and
side by side what we will be getting those four f and five f elements one is the
corresponding lanthanoids starting from lanthanum and other is the actinoids after actinium
so as we are dealing with 3d and the 4d on the 5d we have seen that the other orbitals
which are involved along with the they are very nearby energetically they are also very close

so in case of this five f and four f will see that several d and s or vitals will also be there
so we
should also consider particularly the occupancy of this d and s orbitals along with 4 f and this
d and s orbitals along with 5 f because for getting the different oxidation states these are
initially from the elemental state that means the ah lengthen arm the the series starting from the
zero oxidation state that means the metallic or the elemental form it can go to lanthanum 3 plus
with the loss of 3 electrons
so those 3 electrons can be lost from s and d levels
so let us see how
these groups can be considered
so since they are inside the transition elements that are called
as inner transition elements because when we reach the transition elements ah such as
that of our 5d or the 4d they are filling beforehand
so these inner transition elements
so transition elements they are of inner type they are having two series as just now i
told you they are lanthanoids and actinoids having 14 elements in each series but what about
their electronic configurations the electronic configurations are always important because the
reactivity patterns what we are just discussed in our previous class is that the d block elements so
d block elements are there where we see that the 10 electrons can be introduced in the different d
levels or the d orbitals starting from a situation which is also very much useful and characteristic
is the d 0 state but in the elemental state it is not d 0 but also in the ionic state it can be
a d zero situation like that of our manganese seven plus seven
so this electronic configuration
can be very useful to know and what are the different oxidation state particularly the most
stable oxidation state is important to know
so mostly they are all try positive
bio
so try positive point which was not common for the transition element
the d block elements because in case of d block element mostly we find that the plus
two and the plus three oxidation states are very much prevalent but in this particular case
it is the tripositive ions which are very much stable
so if we can knock out the s electron two
of the s electrons and one d electron without touching the f level we get a situation where
the element will be in the try positive state and we can have a particular configuration for the
four f m level since for the d level we are using is n is the number similarly for this inner

transition elements or f block elements will be using m for the number of electrons occupying
this particular ionic state or the elemental state
so we can have f that means 4 f 0 to up to 4 f 14
and like that of our d block elements it can have some extra stability corresponding to those
oxidation states or the elemental state okay
so in terms of these general features which are
very important to know because this is there in your book also very nicely collected over there
because the general features will tell us that how these can be known first and what are
the positions in the periodic table and any reactivity pattern particularly any application
so if we know some reactivity pattern like that of our d elements or the 3d elements we can see
that they can be very useful also along with the 3d elements
so 3d elements along with the 4 f
elements can be very useful for particular type of properties like that of our catalysis then
sometime we know that which is not there in your syllabus this is organometallic compounds
organometallic compounds
so nothing there the name will tell you that if you have a organic part and a metallic part like that of your very well known thing which you study in organic chemistry is the
grignard reagent
so methyl magnesium bromide or phenyl magnesium bromide
so you have the methyl or
the phenyl which is attached to the magnesium so the carbon attached to the metal that
means the metal carbon bond if you have
so organometallic properties or the organometallic compounds we can get from there also
so what are the general features for in the elemental
state what we get from the different ores and we will also see very useful and well known ah
ores like monazite will see what is this monazite like that of our pyrulocyte and hematite magnetite
like of ores
so these all lanthanoids are silvery white soft metal and which are tarnished if we
keep in air because some oxide layer is forming some oxidation can take place over there if the
they are reacting slowly with air sometimes it can also react with ah carbon dioxide and moisture
and as we move from left to right the elemental condition or the elements their hardness basically
increasing as we move from left to right and when we reach to samariam is not that at the end of the
series we reach samaria and samariam is still like still hard metal
so melting points is also will
be increasing for summarium case it will be 1623 k kelvin
so which is way above to that of our

thousand and 1200 degree k for the other species or the other metals
so this can be
compared to their metallic state what we get that this melting point and hardness and all these
because sometimes we have to use these as material because the material characteristics apart from
the catalytic and all other behavior which is also important
so material wise if we want to use that
for some to increase the hardness or to increase some other property we can use these species
so this particular one from following this ah lanthanum
so this lanthanide series
so from lanthanum to lutetium we get all these elements
so basic feature is that
you there is no need to ah remember all the name of these because it is sometimes very difficult
to remember all these things
so you should not try to remember all these medals but at least you should know that some of them are very useful and what is their electronic configuration and what
is their position particularly the atomic number and if your atomic number is given to you like
that of a cerium because cerium we all know is a very common ah metal salt what we use in
the lavatory which is a ceric ammonium sulphate or ammonium silic sulfate
so which can also
be like your more salt which is a double salt
so which is a very useful oxidizing
agent also because later on we will see that along with potassium permanganate
and potassium dichromate we can use this particular cellic sulphate the sulfate form is
very useful because if you use sulfuric acid for the redox titration can also be a very
useful oxidizing agent using a particular species or the metals salt which belongs to
a four f category over which is a lanthanoid
so this one where in the species is all
the elements ah elemental form of cerium we are having electrons in s level we are having
electron in the d level and we are having electron in the f level
so this has a particular electronic
configuration that we also remember that one one two electrons are there in all three levels
and they are very close to each other in terms of their energy differences similarly if we move
to gadolinium
so gadolinium when we reach to the f7 condition
so it is also instead of f1 it is f7
d1 and s2 and lutetium which is also a 14 d 1 and s 2.

so in all these cases what will be getting
there that if we remove all these electrons from the 5 d level and the 6 s level you get a

corresponding tripositive species
so try positive species is the cerium three plus
so cerium
three plus will have electronic configuration of four f one
so this electronic configuration
is very useful because still you have one electron in the f level and in terms of its redox
potential value whether we can still take out this particular electron from the f level we can reach
up to an oxidation state of plus four force area and in ah true sense the cerium can go for a
condition where the cerium can reach up to a oxidation state of plus four similarly for this
particular one the promethium promethium we if we can remove one more electron from here and for
the terbium if we can remove one more electron from here
so this gives you a f zero situation
so it is ah not filled basically which will have some stability like this four f zero
so this four
f zero uh situation we get that there and in this particular case also for uh promethium and terbium
that if we take out one more extra electron from this four f eight situation it will again be four
f seven like that of your gadolinium in plus three oxidation state
so they have some extra stability
for the half build cell as we all know for d5 situation in the transition elements similarly
for ah this particular one for the terbium as well we get this particular oxidation state as
four f seven
so these are the positions without memorizing the positions of all the entire series
we can have some idea about the positioning of the cerium and why will be getting some half filled
situation like this because in this particular situation when we get the bivalent state we
still have a d electron in it
so instead of f 8 situation we have a d 1 situation
so d 1 f
7 situation for gadolinium in bivalent state so one condition is that how good they are for the
corresponding highest possible oxidation state
so in case of this highest possible
oxidation states we have written down only five of those elements
so cerium promethium
and neodymium and terbium and disposium
so these can have some extra stability as we move
for in f zero situation or f seven situation and along with this f seven we can have also
f eight
so this basically gives us some idea about the corresponding ah the size
so radius
or the ionic size as well as the atomic size

so if we just consider that they are ionic sizes

so atomic sizes also are important why they are important we should ask yourself that since we have four f level instead of the corresponding d levels

so we have four wave levels and we all know that these are having some ah orbitals involved if and they are if they are more diffused in space whether we can have some bigger size compared to the transition element

so when we consider the atomic sizes we should consider the size differences between the transition element and the inner transition element and we should also consider the situation where we all know that is another process which is very useful for the 3d element is the alloying that brass we get the bronze we get due to the alloying formation and during that particular alloying formation the size plays some important role there and if the sizes are matching particularly from the idea what we get for the size effect in solid state structure

so if we can have this solid state structure the size basically the size is bigger

so atomic sizes as we see that along the series how it is changing starting from the initial point whether it is bigger or smaller than that of our three d or the five d element we get for the transition element

so the solid solid state structure how it can affect as we move for the atomic sizes as well as if we move for the corresponding ah ionic species that means lanthanum in the trivalent or the bivalent state

so these are the when we get these ionic species so the ionic condition that means the ionic sizes also like that of our atomic sizes we can also think of about those ionic sizes and how they are different how much they are different from the corresponding atomic sizes

so these sizes are also typically related definitely to their radius because your book will tell you about the corresponding ionic radius

so there is some role to play for their size

so they basically involved in their solid state structure they can change the corresponding solid state structure if they are big enough then if you know all know that we are considering a species like very simple species when we dissolve the corresponding ferric ion in water spheric chloride or ferric nitrate in water we know that the hexa aquapheric ion is formed in the solution that means the aqua solution so in aqua solution we all know that this is the condition that means if once we go for any aqua solution of any metal salt it is equated

in terms of its corresponding metal ligand interaction that means complex species is forming
so in all cases we get basically the complex ions
so how the size can also affect the corresponding
stability of the complexes in solution
so this is the lanthanum species and we have we can have
the stability in plus two plus three and plus four oxidation state and also sometime this
value is also changing
so if this x is varying we do not know the exact value like that of
your iron we can typically say the number is six but depending upon the different lanthanides
we can have a different values of this x
so also the corresponding charge which can m plus
if we write depending upon the fm configuration for this species but one thing we can consider
over here is that as the size is changing and the corresponding in decrease in size if there
is any decrease in size that will see effectively because of that particular thing that means
it is decreases
so ionic size basically decreases along the series
so as the electrons
are feeding into the different orbitals we are having some nuclear charge increase but
that is not contributing to the corresponding atomic or ionic radius of that particular element
or the ionic condition of that particular element
so as the size is decreasing from left to right
so the interaction between this ah lanthanum
lone pair and ah sorry lanthanum orbitals to that of the lone pairs on the water molecules will
be strong enough
so which will be responsible for their increase in the stability of the complexes
so there is a increase in the stability of the complexes that means the echo ions which are forming in the solution
so this is one case and the third case what
we can consider along with the effect for the different sizes is that if we find some
organometallic compound that means if we have some lanthanum which is bound to some carbon center and
if we compare that we can have a transition metal ion
so instead of that was a thing that we can
have a transition metal ion and the carbon bond in this particular case for the lanthanum series
we can have the compound which are more ionic then the d block elements then the d block element
so if this particular
bond that means the metal carbon bond is important for any other property particularly the catalysis
so that will also affect the
corresponding catalytic behavior of the corresponding metal carbon bond
so we can

substitute these corresponding catalyst which are   having a transition metal and carbon bond to that
of our ah corresponding lanthanoid and the carbon   bond
so what we see here therefore that as we see
that from left to right the size is decreasing so   you see that from lanthanum which is 187 picometer
to eterbium or luteacium basically we go up to   that particular point where the size is basically
decreasing up to 173 picometer similarly for uh   the sizes of the two other species that means for
the lanthanum three plus
so lanthanum three plus which is 106 picometer and towards the end if we get it is the lutetium
so if we get is lutricium   which is also similar to that of eterbium which is 86 picometer
so this what i am saying is that is a   typical data that the size of these ions and as we
just simply compare when we have f e three plus or   a l three plus and we all know that
the bound water molecule over here with this lone pair another lone pair is not involved in coordination similarly for o h hhh
so depending upon the charge and
the size which is also important so   the charge is there
so ionic charge
we don't know three plus but the size
so charge by size ratio already consider for the
solid state chemistry but here also the charge   and size also play some important in modulating
the pka value of these bound water molecules
so this particular one
so it is this one is
aluminum
so aluminium compared to we should have   some rough idea which is a non transition element
is a transition element which is a lanthanoid and   if we just follow up our study for actinoids
will find that in all these cases how the size   is changing and how the corresponding reactivity
pattern and all these things are changing   and aluminum is very small which is 53 picometer
so this binding is very strong and as a
result we most of the cases we get that   aluminum is separating out from the medium as the aluminum hydroxide aloh   hole three
so aloh hole three is thing and in some
other water molecule can also be attached to it   is not that it is only tri coordinated
or bound to three ah hydroxide groups   like that of our water molecule bound to
f e three plus
so this basically gives   immediately that idea that what is
the pka value and pk value is also   dependent on the size this particular size when
size is very small and the number of ligands we   discussed several times in our previous classes

that the number of ligands which are bound to this particular center that means the metal ion the central metal ion and the geometry whether it is octahedral or some distorted one that will also contribute to the corresponding p k values or the acidity so this is one aspect that if we have a smaller size of the ion definitely your p k value is less and this particular proton is acidic and it can go out as h plus but what about this lutetium or lanthanum in three plus oxidation state and obviously if they are forming the same equated species it is ok you can apply the same rule or you can extend the same justification for knowing the corresponding p k values but once the size is increasing it will have a natural tendency to bind more and more ligands because in our next class for studying the coordination compounds we will find that is like the sphere so if we have a sphere like arrangement for the corresponding metal ion so if it is say lanthanum ln 3 plus so it is there and why this particular one is forming a octahedral complex of iron because you do not have any others space available depending upon the size because the size is the most crucial one you can go for another bond this is some kind of the corresponding pin cushion and these are say these different pins how many of these pins we can attach to that particular pin cushion so that will tell you the coordination number of that particular central metal ion so in this particular case what we see that since the size is very much different you see that in this particular case the size is almost double so doubling of the size will definitely not allow you to go for a coordination number of six so they will all have a very high coordination number so that is another feature for knowing the corresponding chemistry of these lanthanoids is they are having high coordination number so they can go for a coordination number of up to twelve so one sometime we ask for that give an example of a metal complex having a very high coordination number of say coordination number of twelve so seric ammonium nitrate and all these cases will see that cerium center is there and the corresponding nitrate is there if it is six and if it is in the plus four oxidation state so overall charge for this serie ammonium nitrate will be two minus so how these six ah nitrate groups are surrounding this cerium so if we can go for a coordination number of twelve that means all the oxygens

so all the oxygens that means the oxygens for
this nitrogen
so this oxygen and this oxygen and another is way out
so this can form a chelation to
the cerium center
so six into two
so six into two of such nitrate groups giving rise
to a coordination number of twelve and this all is due to ah the
corresponding
size
so the cerium size is very big enough and this particular thing also allow
you
to go for a gelation of the nitrate group which is forming a four member drink
which
is not possible in case of other transition metal ions of 3d 4d and 5d
elements
so all
together what we see that if we have these centers and the size is changing
so not only the corresponding size of the ah elemental state that means the
length
arm from here to here that is the corresponding sizes of the trivalent species
from 106 picometer
to 686 picometer which is also affecting the solid state structure to the
corresponding
coordination number coordination behavior and obviously that particular type
of thing what we
can expect the catalysis
so if we just simply plot it is there in your book also
so if we just simply
plot the corresponding one
so we just typically there is a decrease in the size
so decrease in
the size in the picometer scale what we have seen that it is in the 86 and it
is 106.

so 106 to 86
is the corresponding
so is a monotonous decrease basically
so monotonically it is decreasing from
la3 plus to lu3 plus and what about the react connectivity because we have
also assigned
that these two have some stability
so we just now what we are discussing that cerium and
the four plus
so cerium four plus is they say around 92 picometer
so this as the 92 picometer
size will also have some ah effect for that particular one which we are not
getting for ah
aluminium or iron that it can interact with the nitrate groups giving rise to
a coordination
of a very high coordination number of twelve
so which is a very useful compound the ammonium
seric nitrate is a useful compound which is the material which can be used
alongside that of our

ah potassium permanganate and potassium dichromate
so these ah these are basically we can consider
these are the typical stability for the different metal ions in the tetravalent state or the
bivalent state
so they are present in a typical islands
so as we move from eurapium
so europium
three plus here
so as we go from here to here that means one electron change for their oxidation
so it is the trivalent strain and in the bivalent state and you see the corresponding one the
change in the size is
so much similarly for samarium it is here and this samarium is here so that particular change from the trivalent state to the bivalent state will also tell us that whether
in terms of the coordination behavior it will give some important characteristics or they are only
stable in the solid state as oxides or some other useful compounds
so they are basically stable
when they are present in the trivalent state and since some cases only they are stable in
the bivalent state
so this decrease a very useful term always we ask that what do you know about lanthanide contraction
so this decrease is basically as we move from left to right
we are feeding electrons to the system but we are not getting the change what we are
expecting because of the poor shielding effect of the 4 f electrons in the 4a orbitals so
the size is not changing much
so can be explained by poor seedling
so these are the things the
lanthanide contraction how you can explain
so lanthanide contraction can be explained only
due to the poor shielding effect of the four f electrons
so four f electrons are not shielding
much of the nuclear charge
so the electrons outside they feel more attractive force from the
higher nuclear charge
so they basically contract
so that contraction is also leading towards
something where we can have some stabilization for the different oxidation states
so mostly what
we have discussed
so far that this is dominated by the plus three oxidation state and the uh lanthanods or the lanthanum three plus compounds the six s electrons and one photoelectrons
are lost and the ions have the configuration of this that means they are following zenon so
we are having the stable zenon configuration and some electrons in the four f level as four

fm
so four fm is if it is not there that means if it is four f zero like that upwards
area
so cerium zero will have a xenon like configuration and that is why it is very
much stable in its tetravalent oxidation state and when we exhibit the corresponding oxidation
state as plus 3 like that of hard cerium
so cerium is in plus three oxidation state we are
still have one electron
so which has a electronic configuration of four f one m value is equal to one
so we can knock out this electron to cerium four plus
so how good this thing is that how
easily we can remove that thing and how good this seric ion
so this is seric ion and this
is serous ion
so cerium in plus four and cerium in plus three how good they are as oxidizing
agent that we can also check depending upon the corresponding amount of this particular
electron transfer that how quickly we can go for the reduction of that steric ion to the
that of our seracion
so one electron we can remove from there but most of these cases these are the
very stable species and they are mostly stable in the plus three oxidation state
so once we see that
they are there and is important this contraction what we see that the lanthanide contraction
is important for the transition elements which are filling off due to the corresponding
electrons putting in the d levels of the ah 5 5 d
so putting these electrons after that
particular contraction
so it will also add up some size
so again some size is increasing
due to addition of electrons to this but this contraction is also some play important role to
the properties of these five d block elements
so along with cerium
so cerium we can get as
the cerium four plus promethium we can get as the promethium four plus and terbium we can get as
starvium four plus that we have just discussed so these things
so once we get if this is the most
common oxidation state like that of our thing what we get for iron the hematite and magnetite
we know that either two and three oxidase plus two or plus three oxidation state is
stable
so naturally we also obtained that particular species as the corresponding

oxidation state for the oxide for the sulphide and all this thing but for these rare earth
elements it is one such case where ln will be attached to some anion which is not typically
found for the d block elements which is phosphate having a charge of three minus
so l n p
o four which is the common formula for the monagite we know that india is
also very rich in monarchied sand the monazite we know from in south india the
monastic sand is there we get from managed other rare earth elements are also sometimes
the actinides also the thorium is also available
so this is one thing that means the ah
monazite ah ore and another is bustnessite
so burstnessite there basically if we have some
lanthanoids and we all know that like that of our ah d block elements we are not restricting our
metal as the salt of the bivalent species
so it is not a typical carbonate but it can also
a carbonate salt along with some fluoride
so is two plus one three
so again it is three plus
this is again three plus
so this is another salt
so we get this per particular one and most of the
elements when we just treat it for their isolation
so isolation of these elements for their
corresponding compounds we basically get that as the corresponding halides is very easy to get
like your ferric chloride and oxides
so this can be treated for oxides
so these are the most common
for all the ah inner transition elements of the corresponding series for the lanthanides and this
basically give you some idea that this when we get ah for the species like ah fluoride the fluoride
is we have a definitely the fluoride is a small ligand or the small anion which is attaching
to the center which is bigger or big enough so your coordination number will be definitely
higher
so its coordination number is nine when it is oxide its coordination number is
also higher but it is not nine it is seven
so this particular one for the formation of
these and for the cerium basically when cerium is forming
so the ionization enthalpy which
is for the fourth electron transfer that means if we can consider is the corresponding one for
the i 4 after i three the third electron transfer is the fourth electron transfer
so for the fourth
electron transfer if we see that this value is low

so you can have this because the extra
stabilization of the xenon electronic configuration cerium can be stabilized
as cerium four plus and that's why you can for this particular species you can have
the corresponding oxide as silicoxide ceo2
so in other cases also the europium we have
seen that europium can gain an electron to form europium 2 plus
so that gives us the
stabilization for the plot to oxidation state having a d5 electronic configuration and
these two that means one is in the bivalent state another is the tetravalent state most of
the lanthanoids have stable oxidation states in the plus three in aqueous solution
so if we
try to get that in aqua solution
so it is the cerium four plus and europium two plus which can
be stabilized in these two oxidation state and now you see the corresponding ah e zero value
the redox potential
so the redox potential is
so important to consider over here that
the e 0 value for the cerrix serous couple is 1.
74 and that basically give us some idea
that how strong they are compared to that of our k menu 4 that means the potassium
permanganate which is one point five one volt
so this particular oxidation is very close and
close to that of our water oxidation potential of one point eight
so we can immediately say that
it can have some ability that it can oxidize water
so if we can generate or if we can get something
that means the catalyst if we want to develop some catalyst or the water oxidation catalyst
because water oxidation is a very important area of study or the research we all know that
this particular cerium
so cerium based compound involving the ceric and the seras ion for this
e0 value which can be able to oxidize the water molecule
so which is there and the formation of
cerium 4 is therefore is favored by its noble gas configuration that means it has only the xenon
configuration
so fourth plus we are going
so is basically the zenon configuration the most
stable one
so cerium we get that thing but this particular reduction as we know for their
corresponding elemental state the other other way around we go for plus three to plus four but
if we go in the reverse direction that means if we transfer three electrons to the lanthanoids in
the trivalent state and mostly it is in aqua state we get the lanthanoids in the solid state how

good they are for their corresponding reductions
so basically this will give you a negative
potential a negative potential in the range of minus 2.
2 to 2.
4
so it is all of them are
very similar redox activity
so redox activity is not very much different unlike your chromium or
unlike your manganese what we see in the 3d series only little bit different
is europium europium
having some potential of minus 2.
0 volt
so these potential range
so very these
are very simple idea for that and we can have some good idea that why we are
moving from ah the the d elements to the f elements the f block elements the
f block elements are very interesting to study and they have some good
applications
also because the spectroscopically what we have seen the spectra for the three
d
elements in solution in aqueous solution but in these cases the spectroscopic
properties
when we are having some f electrons they are having f electrons
so the f block elements
and if they are having something that means not absorption if they can go for
some emission
pattern
so emission if we can get like that of our atomic spectra atomic emission for
the sodium
flame test
so emission pattern if it is different that can be useful for some practical
purposes
so that is why we know that the general knowledge type of thing is that the
neodymium
so neodymium
are very much useful or used much for the lasers and samaria because of their
presence
of more number of d electrons because you see that you can have seven orbitals
to
accommodate the electrons and we can have if all the seven orbitals are ah
singly occupied
we can get a electronic configuration where seven unpaired electrons are there
so more number
of unpaired electrons
so more number of unpaired electrons we can put that means the
ground state ah magnetic moment we are not considered
so far the magnetic properties but
the magnetic properties of the 3d elements we know how we calculate the
magnetic properties
by knowing the n values
so the more number of unpaired electrons the n value is very high
so the
corresponding magnetic moment the board magneton will also be very high and
this magnetic

property
so can be useful
so this magnetic properties out of this samarium can be useful
for different magnetic application
so magnetic application making of some
permanent magnets and all this ok
so is this that means starting from is
the aqueous chemistry to that of thing and this is also taken from your book
that how
quickly we can remember all the reactivity pattern in a single slide that how
good they are
in terms of their reactivity pattern so chemical reactions of the lanthanoids
will tell
us that it can also because already we have seen that they can form very good
ah very nicely the
fluorides they can give rise to the hydroxides
so this elemental form basically can react with
water can react with carbon at high temperature can be heated with nitrogen
can be heated
with sulphur and bonds in oxygen so all these species along with the
elimination of hydrogen like that of our 3d metals it can also give you oxide
sulphide
nitrite carbide hydroxide and the halides
so at one end we can have the ionic compounds
and other end we can have the solid compounds
so the application is pretty wide if we
can have some useful application of the corresponding carbide compounds
nitrite compounds
or the sulphide compounds we should all know how we can make these compounds
very easily using
the corresponding elements because they have some availability on the art
crust and we get
this compound and we have the corresponding elemental form and those elemental
form can
be converted to their corresponding compounds and some of them are very useful
as solid
compound or the solid state properties are useful and in some other cases the
ionic compounds
are useful that means the ionic states are also important for those then we
move to the
actinoids
so the other one
so is a very simple direct correlation of the actinium and its
corresponding actinoids
so the position of the actinium in the periodic table is important and
following
actinium we get the corresponding actinoids
so actinoids we get and the positioning of all
these due to the presence of the corresponding electrons in the level which is
five f
so the five
s level is important like that of our four f which we get for the
corresponding lanthanoids
so the

when we talk about the 5 f electrons or the levels or the electrons occupying the 5 wave level
we should also consider the presence of the electrons in the 7s and the presence of the
electron in the 6d
so not only knowing the names basically from the series basically because
they are also very important elements and they are having some important applications also and this
particular series the four f series what we see they are mostly important in terms of
energy nowadays because they are radioactive and it gives why it is radioactive because it can
give rise to the corresponding elimination of some radiations the rays it can give
so rays it can
give rise
so in terms of studying this actinium or the actinoids what we can study
also side by side the nuclear chemistry
so the field which is nuclear plus
sometimes we call the nuclear and analytical
so nuclear and analytical chemistry is enriched by
studying the corresponding properties of all these element because they are giving rise to radiation
so alpha beta gamma rays they can produce
so these are also useful for the medical practice that the
rays are useful the gamma rays can be useful for some treatment then the treatment of the
cancer presents
so these sometimes these rays are useful
so these rays are also useful for
the corresponding transformations and since these are radioactive
so most this whole series are
radioactive only some of them that means some of them that means like that of a thorium and
europium euro uranium
so thorium and uranium where they are
so we should have some idea about
the positioning of these two elements in the ah corresponding periodic table and this
thorium and europium are only long lived and they occur therefore in minerals if they
are not long lived it is very difficult to get as the natural source
so geochemists will not
help us in getting thorium and europium from the minerals as thorium i told you just now that it
is there in the monastery sand
so in the in the monastery sand the thorium is there and if they
are very long leave otherwise what they we find that they they are not there
so other elements
basically ah they will be radioactive in nature and when they are there that means if they are
long lived that means they are available in nature in the materials but they have some half life so
these half lifes are also important

so depending upon the nature of their half lifes we just
basically decay
so some of these uranium we all know that as the nuclear fuel because they
are very good nuclear fuel uranium and plutonium are nuclear fuel
so this uranium and uh plutonium
will have some t half values and the corresponding isotopes we know that for
uranium it is the 235
uranium or 238 uranium
so 235 uranium and 230 uranium will have some particular t half values
so this particular t half values will also tell us that after some time they
will go down that
means the radioactivity is a chapter where we see that for the nuclear
chemistry chapter we
also know that we can have some thing where it can go to its corresponding
decay products
so within the minerals we can also have some decay products within this
particular mineral
so this t half what we see for that uranium 235 and uranium 238 which is
pretty high which is
pretty big that means for uranium 235 it is 7.
04 into 10 to the power 8 years and for uranium 238
it is 4.
47 into 10 to the power 9 years which is stable enough and these two are very
much useful
and a corresponding species is also useful for our nuclear fuel
so along with plutonium uranium
can be useful for our nuclear fuels purpose
so the positioning in the periodic table their
electronic configuration will tell us something related to their useful
application which is not
in the purview of the corresponding chemistry that means the solution
chemistry or the solid state
chemistry but in terms of their corresponding application as their reactivity
in terms of the
radioactivity
so their activity is different which is a radioactive element and they give
rise to the
corresponding energies for their nuclear energy or the electricity what we can
make from those
wells
so earlier members have relatively long half life
so just now we are discussing about this ah
uranium and all other
so we have the actinium we have thorium ah then we have actinium thorium
and uranium
so along with that ah this other ah four f elements this can also be having
that electronic configuration and have the similar type of stabilization
pattern that means
the half field level is stable and all these
so this basically give rise to the some idea that
we can have ah metal in the trivalent state so metal in the trivalent state
for the corium it is
five f seven
so it will have some extra stability

so this zero is the actinium
so like that
of our lanthanum actinium also will have a extra stabilization
so that extra stabilization
also we get the there but along with that thing that means if we just consider the corresponding
change in the corresponding radii whether we can have like lanthanide ah lanthanide contraction
whether we have some similar or the parallel actinide contraction also but in case of
actinides we see that the change is coming from say 111 or 103 to 98 for the trivalent state and
for the tetravalent state it is 99 picometer to 86 picometer which is not much
so the trend is there
that means it is going down but the trend is not much ah compared to that of our ah lanthanides
so electronic configuration again we can similarly involving the s f and d sub cells and
they have having the variable occupancy because all three will have very close
energy values they are very close by
so either you can kick out the electron from
s level or the d level or finally from the five f level
so it is look like four f orbitals
in their angular part of the wave function if we consider the corresponding angular part
because both of them are of f or vitals they are not
so much hidden as four f orbitals
and his photo electrons can take part in bonding to a far greater accent
so this is the only
difference between the four f orbitals and the five wave orbitals
so these compounds
basically can take part in bonding to a far greater extent thats why if we get some gate the
uranium
so uranium can give rise to some compound and mostly we all know that the uranium is a the
corresponding uranium in the hexa valence state so it is uranium six which is a corresponding uranil
ion
so uranil ion is there
so iranian ion can give rise to some compound in the solid state
we can ah isolate as the cesium salt which is u o two c l four where uranium which is a
dioxo compound
so this particular species is there which is forming as the corresponding compound as the dioxo compound
so they can take part in bonding
so if we just consider that you
can have some sufficient thing that means you can have the chlorides over here this chloride over
here this chloride over here similarly these two can be replaced by some other ligands
so that we

will find when we study the coordination compounds
so if we have some o type of ligand like acetyl acetone
so these two can be attached to these and giving rise to the some acetyl acetone compounds and since the chlorides are all for them giving the charge
so that's why
we know the cationic charge but here if this is one negative charge acetyl acetone
this is one negative charge of acetyl acetone
so this is basically a compound which is having
a neutral compound
so zero oxidation ah the zero charge on this particular compound
so this particular one compared to that other ah species what we have seen for the ah lanthanides what about their oxidation states
so there is a greater range of oxidation states
which in take part in for the involving the five f sixty and seven s levels compare comparable energy
so all together we can remove electron from five f level we can remove electron from 6d level or we can remove also electrons from the 7s level and towards the left hand side that means as we start from the group we can get a more and more different oxidation state that means the variable oxidation states are possible to get on the left
so if we go for that uranium the
neptunium then ah plutonium and all these cases and americium we see that they are having some variable oxidation states and the stability of these oxidation state from ah thorium to berkelium ah
so these are all four
so these are in bold later
so this plus four and plus six these
two are mostly stable but as you move towards the right their stability is very less and as we move towards lr the larynxian or the nobelium
so what we are comparing we are comparing
that them with respect to the t half values
so uranium we have seen then another
isotope of uranium also we have seen their t t half values in terms of the decay product for the nuclear disintegration then if we can move down to that of our nobelium and lawrencium
so 259 nobelium if we know if we consider
and 256 laurencium if we consider having atomic number of 102 and atomic number of 103 and their t half values are very less it is only one hour and another case it is 28 second
so that immediately tells us that these species even if you can make in the nanogram level or a picogram level
so they are all synthetically made they are not naturally available
so these

compounds
so most of them that means the all elements beyond this uranium
so all trans
uranium elements what we consider that if you are asked to comment on the stabilization or the
stability of these then all transuranium element they do not occur naturally on the earth that
means beyond uranium will not get there
so they are artificially made
so they are very useful
for their property studies and whether there is some application
so that's why we get all
and beyond that also that considered under the super heavy elements
so these basically gives
that you already have seen that uranium is there
so one more thing that means like
pitch monoxide we have pitch blend that is another natural source which is uranium
compound
so uranium oxide
so that also tells us that in the nature like that of our m n o two we have seen earlier that as pyrulocyte m n o two was our pyrulocyte which is in the plus 4 oxidation
state
so what about this this definitely are stabilizing
so we have to balance 8 into 2 that
means 16 negative charges
so 16 negative charges how we can balance we can balance it by presence of uranium hexavalent and uranium tetravalent
so two of them is as the uranium hexavalent and
one of them as the tetravalent
so always we get that as the in the pitch blend
so pitch blend is
our source for that nuclear fuel isolation
so they are non-stoichiometric
so stoichiometrically that
means the oxidation state then in the mix valid oxidation state like that of our fe3o4 we all
know that the magnetite what we get that means we have both iron two and iron three similarly for
uranium also that u308 will have both hexavalent and the tetravalent and hexavalent condition
what we have seen that it has much more stability compared to the other species
so this plus
six oxidation state
so we can also correlate this immediately with that that means what we have studied earlier that the chromium we have studied molybdenum we have studied tungsten and in some
cases also the molybdenum can dioxoform tungsten can dioxoform similarly we can include this also
in terms of their chemical reactivity that uranium is also forming because molybdenum is also forming
similar type of metal complexes that will see when we study the different

coordination compounds ok
so knowing these elements from the periodic table   their isolation their identification will give us
something which we get these as the regular salts
so whether we get these as the regular salts for
their further reactivity particularly in terms of   some metal complexes like that of our uf6
so this
we can consider also as a metal salt hexavalent   uranium compound uranium hexafluoride or you
can consider as a corresponding coordination   compound that will start from our next class
that the coordination compounds of uranium   because the fluoride can be considered as a good
ligand as fluoride ion ok thank you very much you