

good morning everybody

so in this chapter we

will be talking about our coordination compounds and again there will be six

classes

so today we will basically introduce what we basically know about the different

coordination compounds and the name basically about this coordination compound because all we

know that there are chemical compounds as well

so like that of our sodium chloride magnesium

chloride all we know that they are typically metal salts and at the same time we can

consider them there as inorganic compounds

so this is one example of an inorganic compound

of sodium ion and second one is also an inorganic compound of magnesium ion

but what else to be

there which can define another group of compounds which will be calling as the coordinate compound

or the coordination compounds or the complexes

so in coordination compounds

we will have a typical coordinate bond here in this class of

compounds what we see that they are having ions in a plus c l minus and at the same time magnesium

2 plus and 2 cl minus

so they are packed in the lattices

so they are forming some ionic

bonds and these are ionic compounds and compared to that if a particular compound having some coordinate bond and coordinate bonds all we know that is particular bond is also known as a dative bond through some donation of electron charge

so very simple molecule what we can consider to our life from the very existence of all life

also and anywhere we know that this water molecule simple water molecule and the covalent structure

that means is the covalent molecule we all know and only there is partial charge separation as

we all know that this is delta plus this is delta minus and this is also delta plus and this is also delta minus

so basically what we find that dipoles are created along this o h bond and another one

is also along this o h bond now if this lone pair of electron can be utilized for some bonding

interaction to any species like say any metal ion

so it is a particular donation unlike that of

shearing or the ionic compound formation here we have the two lone pair of electrons forming a bond

between o and m that means we can have a o m bond

so what we are considering over here is

a typical o m bond

so o m bond if that particular o m bond is a coordinate bond or a

dative bond where the lone pair of electrons utilized for the formation of that particular

o m bond is coming from the oxygen atom of the water molecule
so this oxygen is from the water so
this is coming from the typical water molecule so then if we can have at least
one such interaction
with that particular metal center or the metal ion center it can be a
transition metal
ion or a non transition metal ion as well
so we can consider that we are just leading
towards something where we are able to get some coordinate compounds or
coordination
compounds
so that is there if we can see where we are able to develop a particular
chapter
which is devoted to coordination compounds and it is typically a backbone
or spine or is the main thing for modern inorganic chemistry
so the latest one because is typically developed
during the last 120 years
so this particular development is say for 120 years following
al fred noble alfred warner
so alfred werner
so alfred werner studied all these compounds
during ah 1890s
so and that particular type
so during this last period that
means we get the period where we can isolate the elements before that then when
we identified
that means the discovery of the elements we discovered the elements and
afterwards we can
put them in the periodic table their positions and their electronic
configuration structures
and everything we studied in detail but this particular concept during the
last
120 years has been
so useful that the modern days coordination chemistry is basically
devoted to typical inorganic chemistry also
so any inorganic compound if we just
consider that we have a simple metal salt m is there having a charge of m
n plus and that is a typical salt
so what type of salt we know that the from earth
crust we get something as the oxide hydroxide or carbonate or sulfide ores and
minerals
so oates and
minerals when we treat it with some mineral acid
so acids are given and those acids are providing
the corresponding anions
so these are the anions which are coming from the acids during the
treatment of these ore and minerals for isolating a typical metal salt cynical
sulphate say iron
sulfate or copper sulphate if we want to make because the copper will be
present as copper
2 plus and the corresponding anion will be present as the corresponding ionic
salt but once
we make that particular salt as i told you earlier that we can go for the
corresponding solution

that means we put that particular salt in water
so we are putting that metal ion within
water

so all these informations and all these understandings can be there how our m
n

plus will be staying inside these water molecules in the solid state as well
as in the

solution state and sometimes if these salts in terms of the corresponding
anions as isolated

as the hydrates that means dot nH_2O

so if we isolate them as the hydrate

so this how these

water molecules are interacting with these soles as well as the corresponding
metal cations also

so this is also the very important thing that

means the very backbone of our bioinorganic chemistry that means this
particular thing

that means the biologically if we have say iron we all know that iron in a
particular

oxidation state it is there in our blood where it is present it is present in
our

hemoglobin or it is present in our myoglobin

so the presence of this iron in form of a
coordination compounds is also there in biology

so that will see that how

useful they are in studying the presence of iron as coordination

compound in some biological species and it is also very useful in different
chemical

industry because chemical industry all we know that is very much dependent on
the presence

and usefulness on some good catalysts

so catalysts will be there and those catalyst

if they form some coordination compounds they can also be useful

so different types of

organic transformations the industrial chemistry is not only devoted to
inorganic

industrial chemistry but it can be for organic industrial chemistry the
medicinal

industrial chemistry or the pharmaceutical industrial chemistry where you
simply use some

of these important coordination compounds say one important thing is that
hydrogenation we all know that hydrogenation

process can be utilized or can be done utilizing some random type of
thing

where the nickel is present as nickel θ and it is activating the hydrogen gas
and that can

be hydrogenated

so what we see here that instead of that nickel as nickel θ we can have some
nickel complex or any other metal ion complex which can also be useful some
useful for some

specific hydrogenation reactions

so these compound that means the coordination compounds

will be useful for chemical industry as well then also we see that how these
can

be utilized for the different pigments this is also an application part
so pollution
blue all we know and the oriolein is also another compound and the algerian
red dye these are the
three examples again have been taken from your cbse book
so everything is there so
what is this prussian blue definitely this color is highly intense and that
prussian blue can be utilized as paint but why this is colored because of the
when we
study everything but this particular formulation because once we know the
compound and its
color and its usefulness then only we can immediately say what should be your
corresponding
formula this is $K_4Fe_6(CN)_{18}$ whole six
so what is that or this particular part that
means some part we are writing in square bracket which is $Fe(CN)_6$ whole six
so nature of
that particular thing we just try to find out similarly another yellow
compound
yellow pigment which will be there which is arioline which is also a cobalt
compound
and in this particular cobalt compound what we see that this is NO_2^- this is
 NO_2^- that means nitrite
ion is there
so nitrite can function as a ligand around covert
so typically
what i just told you that if you have the corresponding anions which are
coming from
the mineral acids you get the simple sorts that of your ferric chloride nickel
chloride or
copper chloride as cubic chloride
so chloride and ions are coming from the corresponding
mineral acid which is hydrochloric acid but if the corresponding anions are
different
here it is CN^- minus the cyanide ion here it is NO_2^- minus the nitrite ion still
we get some
coloration for the presence of those anions as well as the corresponding
central metal ion but
these are not very simple or the corresponding simplest possible example what
we know for the
corresponding metal salts these are not metal salt here we have written in
square bracket here
also we have written some part in square bracket and afterwards we will see
what is that
interpretation for writing these in terms of the corresponding square brackets
will find why
they are
so colored and how they are utilized for the pigment another example is an
algerian red dye
which is nothing but an compound of anthraquinone but the example of this red
dye is telling us
that we have something that means it is not the typical one two dihydroxy 910
and third we all
know anthracene we all know quinoan

so it is anthracene based quinone okay
so and its two and
one and two positions are also hydroxide groups
so these hydroxide oxygen and this anthraquinone
oxygen can be utilized for the formation of the coordinate bond to what to the
aluminum aluminum
as aluminum three plus
so red lake or red dye is a brilliant red coloration is only formed when it
is forming a coordinate compound or a coordination compound to aluminium only
so this can be utilized
as again a red pigment
so these are the typical example one is blue and there is yellow and
another is red
so these three useful colors we occasionally use all of them the way i have
told you earlier that means ah the lead chromate how we can use in painting
school buses
so this
is some red dye but the red dye is only obtained when you utilize this
aluminum and aluminum
is forming some coordinate compound with this
so we will define this one two dihydroxy nineteen
and aquinone as something where the oxygen atoms like our water molecules
having lone pair
of electrons can form bonds to the aluminum center and this is one more good
example that we should
not confuse ourselves that all the coordination compounds are forming from
only the transition
metal ions that means the 3d 4d and 5d elements it can be with other metal
ions where you have
filled d orbitals like zinc cadmium and mercury similarly it can be with
magnesium it can be
with calcium and it can be with aluminum also so allergen red dye which is
forming something that
means the calcium you can have the calcium dye you can have the aluminium with
the aluminum dye so
bound metal ions are important that means these are all present in the anionic
form the cyanide is
present as the anionic form that means the cyanide ion nitrite is formed as
the nitrite ion similarly
this anthraquinone hydroxy antiquinone if they go for deprotonation and hydroxy
groups are
present as o minus of the phenol unit then it can bind either calcium or
aluminum or both of
them together to give some a red dye compound
so the coloration again is due to the
formation of this coordination compound
so what we come to know from here is that
the usefulness of this coordination compound where the different color we can
generate due to
the presence of these metal ions which is forming a coordinate compound or a
complex species
what is that because this metal atoms are ions
so here iron cobalt calcium aluminium all of
them are present as metal ions but in some other cases also we will see that

we can have the metal atoms also like nickel zero the nickel zero as just now we are discussing about our handy nickel where the nickel as the fine powder having a very small size those are nickel atoms but those nickel atoms if it interact with some other species like carbon monoxide we all know that nickel can form very good compound where the nickel zero in zero oxidation state can bind to four carbon monoxide molecules so carbon dioxide molecules are gaseous compounds so is a gas is bound to the metal center where the metal is in the zero oxidation state but due to this thing that means due to this definition the metal atoms that means the nickel atoms are bound to a number of neutral molecules here the carbon monoxide is the neutral molecule so that species which is forming out of nickel 0 and the carbon monoxide is also termed as a coordination compound so it is not that the metal ions like iron in Fe^{3+} or cobalt in Co^{2+} or calcium in Ca^{2+} or aluminium in Al^{3+} but the middle in the zero oxidation state as metal atoms can give rise to the coordination compounds and in the biology that means in bioinorganic chemistry what we study is basically we all know the typical names from our school days what is chlorophyll we all know we can define we can say the function we can show is reactivity similarly just now I told you about the hemoglobin and the vitamin B12 why they are important in terms of the coordination compound because they are again a chlorophyll by definition is also a coordination compound hemoglobin as well as myoglobin which is present in our blood is also by definition a coordination compound similarly vitamin B12 is also a very interesting coordination compound where cobalt is present and not only a naturally occurring bioinorganic coordination compound but is also having some metal carbon bond is giving so it is a bioorganometallic compound also so B12 is a vitamin B12 is also a bioorganometallic compound of cobalt so you have magnesium so if we if you somebody asks you to identify the metal ions present so chlorophyll will be having magnesium hemoglobin or myoglobin will have iron and then vitamin B12 will have cobalt so we see that the typical definition a standard textbook

definition we should always keep in our mind like knowing the periodic table what is then your coordination compounds so it basically contains one or more complex ions which is very important so afterwards we will define also like just now we have seen that we can write a compound like $K_3[Fe(CN)_6]$ and from our school days we all know this is potassium ferric cyanide where iron is present in plus three oxidation state so these potassium ferric cyanide so this is the part which we write in square bracket is the complex part so this is again a compound so this is again a coordination compound it has a complex part so this part that on the right hand side we have a complex part so complex part is an anionic and the charge is balanced by the simple potassium ion because the whole charge on this complex species is three minus so for potassium ferric cyanide you require three of the potassium ions to balance this particular charge the way we write we all know that the aluminium trichloride aluminium has a tripositive charge for charge neutralization we require three such chloride ions to balance it similarly this anionic coordination compound is trianionic so we require three potassium ions to neutralize this charge overall this coordination compound is a neutral one so is a neutral coordination compound and sometime you also see that this particular part that means the cationic part can also be a complex part similarly the anionic part can also be a cationic or a complex part so these two parts so this is complex and this is also complex and together these two we call them as your coordination compounds so that tells us that one or more complex species which is important one or more complex species where we have the more complex ions that means at some time we can have both the cationic part as complex entity and the anionic part is also a complex entity where we find that a small number of molecules or ions surround a central metal atom or ion just now the examples what we are looking for is that a small number of molecules so this what are those small number of molecules that means it can be your water molecules or it can be your cyanide ions so small number of those molecules or ions surround a central metal atom or ion usually of the transition metal family it can be usually 3d 4d or 5d

metals but
it can be beyond those transition metal ions
so in a typical form either it can have
the atom like nickel tetracarbonyl, nickel hexacarbonyl, just discuss
afterwards
in detail or you can have K_3FeCl_6 where the cation is bound to
some
anions we get the coordination compounds and these coordination compounds also
by
definition they are very useful depending upon the number of groups the small
groups number of small
groups attaching to the central metal atom or ion we get different
coordination geometries so
that we will just elaborate also these are the typical definitions how we
define a coordination
compounds and will be able to get a corresponding linear tetrahedral square
planar or
octahedral geometry
so versatility is very high apart from your typical organic chemistry
where you know that the carbon center we have restricted geometries carbon can
be planar carbon
can be tetrahedral not beyond that but here we see that from a linear
arrangement to an octahedral
arrangement a metal ion a specific metal ion can extend its geometry during
the formation of
your coordination compounds and not only our application in modern day in
organic chemistry
by inorganic chemistry or industrial catalysis it has also some application in
electroplating
if we go for fine plating on some surface textile dye just now we have seen
the corresponding
dye for based on calcium or aluminium and in the medicinal chemistry some
of these metal
complexes or the metal compounds are very good as the pharmaceutical
history like our cisplatin which is a platinum based anti-cancer drug
so when we go for these that means when we go for
this processing we use a variety of metallurgical processes also that means
the identification
or the isolation of silver isolation of gold we use the cyanide as the typical
process
the cyanide process is basically based on the corresponding formation of the
coordination
entity or the coordinate species in solution then just now we discuss the
industrial
catalyst and some analytical reagents
so just now what we have discussed about
that corresponding dye which is for giving you color to your calcium or
aluminium so
that can function as a very good reagent if that particular compound the
anthraquinone
that one two dihydroxyanthraquinone compound if itself is not
so strongly colored
in the anionic form when it is bound to aluminium or calcium we find that the

color

intensity is increasing and we get basically red dye dye is all are very colored very much colored

is a pigment what you use as a pigment or the dye the intensity for those colors are very high

so what we can utilize it because it is not ah we will not be able to discuss all these in detail

so this is the right time where we can say you about this analytical reagent so

that particular reagent that anthraquinone dihydroxy anthraquinone can function as

a very good analytical reagent to detect the presence of calcium ion or the aluminium ion

in any unknown solution because the calcium ion or the aluminum ion when it is present in aqua

solution or water medium it is colorless as we put the reagent that reagent will develop some

beautiful that red lake usually we go for the in the corresponding semi micro quantitative analysis

even a spot plate the spot plate analysis is also very useful though in a drop of those reagent can

give rise to some beautiful coloration or the lake formation for identification because you can have

the sets of those two colors because when both of them are present together it has a different color

when only aluminum is present it has another color or when calcium is present though they are very

close by but we can identify those coloration by knowing the thing the color that what

particular coordination compound it is forming

so in this particular analysis

so analytical

chemistry finds is typical application during the formation of these coordination compounds

so we now take the example of some ah compound which we all know from your laboratory classes

also which is our more salt

so this more salt we consider it as a salt and we are asking

ourselves whether we can level it as a coordination compound whether some coordinate bond

is forming over there and when it is more salt we tag we definitely know that it is a ferrous

compound of iron

so more salt iron is present

so there will be some small molecules or anions

present also along with that and whether that particular anion or small molecules forming

some coordinate bond to the iron center or not that will define whether your mod

salt is a coordination compound or not and analytically also we find that this more salt

which is ferrous sulphate ammonium sulphate six water molecules since the name of this compound

is ferrous ammonium sulfate or it is a double salt of ferrous sulphate and ammonium sulphate along with six water molecules of crystallization so it separate out or it crystallize out from the medium nicely as this formulation center dot is given so that's why these are all packed in the crystal lattice so there is no such interaction with the iron center with that of your ammonia or the ammonium ion so we should be very much careful that no such coordination of ammonia as ammonium ion or ammonia as NH_3 is to that of your iron center similarly another example is that your potassium alum or potassium we call so which is potassium aluminium double salt so the potassium sulphate as well as aluminium sulfate double salt so double salts are two salts together they co-crystallize so is a coke crystallization process and in a single entity they are crystallized out and they have the typical identity that the when they dissolve it in water it can dissociate into the simpler ions so when we dissolve potassium salt of this that means the potassium alum or the more salt what we get the more salt already i told you that this more salt we have fe two plus in the system similarly in solution whether this coordinate bond is present between iron so what we are expecting this ammonium ion we are expecting that means whether we can have a typical interaction like this or when you dissolve it this can form or not so this can be derived from your ammonium ion so water can sometime be very useful to get this whether this is forming over there and the resulting some complex entity or the complex species is there which will not dissociate all together in the medium as fe as Fe^{2+} plus or ammonia as a neutral ammonia molecule or ammonium ion but in actual practice when more salt is dissolved in water we are able to detect the presence of all all the cations and all the anions what is present over there in the salt ammonium ion and the sulfate ion and large number of water molecules so will be about able to detect the ferrous ion will be able to detect sulfate ion will be able to detect ammonium ion not that will be getting something where we have the corresponding presence of these ammonia as this ammonium ion or some complex species so no complex species is there ammonium ion is also present as ammonium ion which can be detected over here as ammonium ion so is not a coordination compound it is typical an example of a double salt

so more salt like these salts are all double salt
so will not get
that but just now what we have told you that we are having potassium ferric cyanide now
then another example is potassium ferro cyanide which is instead of K_3 it is now K_4 efficient
whole six but this particular species if we take and if we try to dissolve it in water
will not be able to detect the presence of ferrous ion but the salties of ferrous will not be able to
detect ferrous and in the medium or the cyanide in the medium which is also highly poisonous
so this
particular part which is written in square bracket nowhere here we have written anything in square
bracket
so this part which under this square bracket thing we get that this particular
entity due to the formation or due to the reaction or due to the bonding between iron
and cyanide iron as ferrous and the cyanide ion forming a coordinate bond giving a typical entity
or a separate entity whose nature is completely different which is the corresponding ferrocyanide
and ion
so ferrocyanide anion is the corresponding complex species
so we will be able to generate
something which is a complex compound
so this is some typical example
so this is the anionic
part which is complex one similarly when we get this one which is the cationic
part which is six
ammonia molecules are bound to the cobalt center which is the cationic complex
species here that is
the example where we are saying that both cationic part as well as the anionic
part are the complex
pieces but we get the corresponding coordination compound where the copper
part is the cationic
part and the platinum part is the ionic part similarly this compound that the
medicinal value
just now I told you can be your cis variety where two of these groups that
means
the same groups that means the nitrogen from the ammonia are 90° degree to each
other
as we know in the definition for in the organic chemistry the cis definition
and the trans
definition if this particular coordination compound has a geometry of a square
plane
so if the cis variety is the corresponding medicine which is known as cis
platin but
the trans variety is not
so isomerism will also tell us or dictate us the very usefulness
of those compounds but here also we see that three examples this is the
cationic example of

the complex part this both cationic and ionic and this is the neutral part for this corresponding compound

so we should always be very much careful the nature of these compounds so nature of

these compounds how we identify those natures

so these are typically the different salts so

when you dissolve it in solution or water we find that this can be separated as the cationic part

and these are the anions as three chloride ions

so we can detect the number of chlorides

you can get from this particular salt similarly here we are not able to get any chloride

from these compounds whether it is present in the cationic part or the ionic part and obviously it

is present in the corresponding ionic part but this chloride you cannot take out

so this has a

typical example for the reactivity pattern or the reaction pattern if we try to immediately detect

the presence of chloride similarly this will also behave differently

so all three compounds if

we try to treat it with a dilute solution of silver nitrate which we all know that silver

nitrate is the reagent where you can detect the presence of chloride ion in sodium chloride

say in aqua solution

so if a aqua solution of silver nitrate is also added we

get the precipitation which is very sparingly soluble or also also also sometimes

we say is insoluble if the volume of the medium or volume of the reaction is very less

so in small

volume medium is basically getting precipitated and silver as the

precipitation of silver as the

silver chloride which is a white compound and you can able to detect this as the presence of the

chloride in the salt as the chloride as the anion

so similarly the hexamine covalent three chloride

when we see the systematic nomenclature also it is the name of this the naming also we should

know how you name it ok

so is this hexa amines amines are the ligands we will also define

what are those ligands

so hexamine covalent three chloride when we react with silver nitrate

it will also give rise to three AgCl molecules

so three AgCl

so amount of AgCl we can take out we

can filter it out we can take the weight of those and we can say that the quantitatively all

the chlorides can be removed from this medium that means chlorides are not bound to the metal

shelter

so the chloride ions if we consider them the species which is bound to the

metal center

as by definition will define them as the ligands why we call them ligand that we also will see

so in this particular case the chlorides are not ligands but here these are ligands

here also these are ligands

so we cannot eliminate chloride as silver chloride from

these two compounds the way we are seeing the corresponding test of ferrous ion or the

corresponding test of cyanide is missing in the ferrocyanide or the ferricyanide ions ok

so the

analytical chemistry is always very much helpful and the physical measurements also the physical

chemical measurements also will also be helpful because we all know in the physical chemistry

classes that these ions are very much helpful for giving you our the corresponding conductivity

so the corresponding molar conductivity is also will be different if we just consider that this

chloride is dissociating out and is found freely in the solution to conduct electricity or

these chlorides are very strongly bound to the metal center and not available for electrical

charge conductance ok

so it is that person what I was just telling in our first slide that it is Alfred Werner Alfred Warner during 1866 to 1919

so during 1890s basically he proposed this concept

and he basically brought at this particular time that we are only basically at the beginning of

this pm when nothing is known about the nature of the electron like the proton neutron and all these

things that the nature of these two valence one is primary valence and another is the secondary

valence of the metal ion

so what we just see that instead of cobalt chloride as the salt we all know the cobaltic chloride would be CoCl_3

so now what happens if we add some amount of ammonia to that cobalt chloride

so cobaltic chloride is the typical inorganic salt

so like all other metals

salt

so cobalt chloride

so cobaltic chloride if we can have

so C should be always capital

so CoCl_3

is the corresponding salt of cobalt chloride where we know the cobalt is present as the three plus

and the chlorides are as Cl minor then we bring something like water molecules sometime we can

also use water

so these are the species which can interact with the metal center and give rise to

the complex species

so the formula what we get we get this particular salt is they are intact but these ammonias are also strongly bound not only a single ammonia but several ammonia will be bound to this particular species that means this ammonia molecules will be some entity which is directly attached to this cobalt center and if like that of our water water having the lone pair of electron this ammonia also will have some lone pair of electron and if this lone pair of electron can be donated to our cobalt center the cobaltic center the trivalent cobalt center we get some species belongs to that corresponding coordination compounds so the primary balance will be there the charge neutralization and the secondary valence of the metal ion will be talking about when we have the complex species ok so these two things we are having so we can have several compounds like this that means the cobaltic chloride we take and we react with ammonia and if we try to crystallize it so initially we get different solutions the first how we can identify them because all these transition metal ions the most important property of all these transition metal ions will be utilized for this purpose also and is also very much useful is the corresponding formation of the different colors so when covalent three chloride is reacting with ammonia and if we consider that in a different stoichiometry or in different reaction condition the number of ammonia molecules reacting with this cobalt three chloride can be different and depending upon the nature of this color that means we can have different colors so this cobalt and these compounds with you have the n that means the n the way we say that the water of crystallizations these are not crystallization these are the molecules responsible for coordination to the central metal ion so if the n number is varying so different number of ammonia molecules attached to this cobalt chloride will be separated out from the medium so what we get we get something that means the complex ion species where this complex ion species are made up of this cobalt and ammonia so it is forming due to the presence of this cobalt and ammonia and these chlorides can be outside our coordinate sphere we call we will call them and depending upon the different number again that means it can also be x it can be three it can be two it can be one or it can be zero also so initially visually we can check these as the different color

so color

reactions will be different as the stoichiometry is changing because you are having different

complex species forming in the reaction medium

so we see that when we try to do the reverse

one that means the way we are identifying the chlorides the number of chlorides whether we

can able to detect it by use of silver nitrate

so the product of this reaction of cobalt three chloride with ammonia the presence of chlorides can be detected by the reaction of silver nitrate

in excess in solution we will see that the some of the chlorides can be precipitated out as silver

chloride others are not

so what are coming out as silver chloride those are the typical anionic chlorides which are present as the salt in cobalt chloride those can be taken out by

the reaction of silver nitrate as silver chloride but other chlorides which are bound to

the cobalt center cannot be taken out

so those can not be separated out by the use of silver nitrate for the precipitation of silver chloride from the reaction medium because this

interaction with the silver ion that means a Ag^+ plus reacting with Cl^- giving rise to

insoluble silver chloride is the ionic reaction and that ionic reaction is only giving rise to the

presence of only chloride ion and due to this very low solubility that mean the corresponding

value of the solubility product is very less

so the solubility is also very less in water medium

so they separate out as in soluble species

so this silver and silver chloride will be separated out but it is not possible if that chloride is directly attached to that cobalt center

so first what we get is a yellow compound

so very useful compound use yellow compound

and this particular stoichiometry what we get yellow and sometimes depending upon the nature

of the crystals it is a little bit of oranges also

so this orange yellow in color or

sometimes a typically orange in color depending upon the size of those crystals what is forming

so is a yellow coordination compounds as we go for a reaction of cobalt three chloride

with ammonia

so and the stoichiometry of these because we all know that the typical stoichiometry

is there because the reaction is with one of these and six of these ammonia

so one is to six

reaction product is giving us $CoCl_3 \cdot 6H_2O$

so we are not elaborating it like this we are talk taking the presence of these ammonia molecules as the corresponding presence as the corresponding solvent of crystallizations ammonia is also the ammonia in the liquid form

so it is present in the corresponding species as the corresponding solvents so if

it is ammonia solvent then it is fine

so this compound if we analyze it also for the percentage of cobalt percentage of nitrogen and percentage of chlorine also as chloride will find that this

is the corresponding typical molecular formula

so that typical molecular formula also corresponds to the corresponding this reaction what we just now told you that if the product of this that means the yellow compound dissolve it in water and react with some colorless and solution of silver nitrate

so silver nitrate in excess because we put excess silver nitrate such that all the

chlorides which are present over here can be removed

so three of these chlorides

which are present in cobalt these chloride as CoCl_3 can be removed by reaction with

a g plus as a AgCl_3 a AgCl has three chlorides of three molecules of AgCl

so what we find that

all the chlorides present in cobalt chloride as the corresponding metal salt can be removed

so these chlorides are not taking part into the corresponding valance which is utilized for

the direct cobalt chlorine bond for the complex species formation similarly the next compound will

get is a purple compound where instead of three mole of AgCl will be getting two mole of AgCl

and the stoichiometry is little bit different of one less ammonia we can have with the

same CoCl_3 and the third one is the green compound where we get or we will

able to remove one mole of silver chloride

so your stoichiometries again from six to five to four is down and there is another violet compound

so these two are pretty confusing to us right now

having the same molecular formula but the colors are different one is green another is violet

so this basically gives us some important idea that these two compounds the basic form of

the corresponding complex part that means the coordination entity or the complex entity is

same having one chloride outside the coordinate sphere and then another possibility we will also

discuss that we are not able to detect any removal of silver chloride from the compound which is a

another category of compound which will be $\text{CoCl}_3 \cdot 3\text{NH}_3$ and $\text{CoCl}_3 \cdot 3\text{S}$

so that is another possibility
what we can have and that is the possibility where all of them are attached to cobalt and we are not able to get back any silver chloride precipitation from the reaction of silver nitrate

so this is again a good thing which is the table which is taken from your textbook ncert textbook which will again explain the presence of these that means why we are getting yellow compound why you are getting purple compound why you are getting ah that a green compound and the violet compound so this formula what we just now we have seen these were the molecular formulas if we can think of the corresponding molecular formula of these as $6 \text{ n h } 3 \text{ 5}$ and $\text{h } 3 \text{ 4}$ and $\text{s } 3$ in 2 different cases will find that this can be present over here in the first case all the three that means all three chloride ions will be present over there as the corresponding anions in the typical salt

so our formula of this compound is $\text{c o n h three whole six c l three}$ that means

we have all the six ammonia is attached to this particular covalent so we can assemble we can cover it

so in a typical form we can cover by all these ammonia so this is ammonia

this is ammonia this is ammonia

so how we know that

so we will have

all of them that means all six of the bonds basically six cobalt nitrogen bonds

so we will have six covalent nitrogen bonds and obviously this is forming due to the donation of this ammonia lone pair to the cobalt orbitals and these bonds are

what type of bonds these are coordinate bonds

so if we are able to detect or if we are

able to identify those coordinate bonds the first category of compound will be these

and these chlorides like that of or any others salt like aluminium chloride the typical

example of aluminium chloride is that when you dissolve it in water it can dissociate all

the chloride ions and you can you can remove them by addition of silver as silver ion for the

formation of three silver chloride precipitate three moles of silver chloride will be

precipitated out similarly here also you get three silver chloride

so your these will be

there

so six covalent coordinate bonds are there and what about the cobalt chloride bond if we

just consider

so there is no cobalt chloride bond this chloride will be outside the coordinate sphere

so no chlora cobalt acquired bonds

so these are the two statements which are very useful and which are ah very immediately we should all know

so this is the first compound what is there the second compound which this is the yellow compound

so this is the second compound is the purple compound and the difference is only thing that you now just change or manipulate the

corresponding coordination environment

so what we do the second compound if we write down the formula because everything is there in your textbook only you sit

comfortably and write the corresponding form

so here you have one cl and this nh3 is

five in number and two of them are outside so think of the corresponding oxidation state we

should not forget the corresponding oxidation state is a trivalent one and the number

of these

so one of these one of these bond that means one of these cobalt ammonia bond will not be there

so will have five of them are nitrogens

so these five

of them are nitrogens of the ammonia and one of them is basically your chloride

so this is the compound

so that compound immediately tells

us that if you have a charge of three one will be balance

so overall charge of these

complex pieces what we write entire thing is in ah the square bracket

so entire thing

we write basically in square bracket

so if this is we write

so this charge

basically sometimes we write is this small squared part to indicate the charge because

the way we write that chloride as cl minus f e as two plus because the species is very

small but when you write a huge species like this and we required some separation and then we

write

so plus three minus one

so it is two plus

so what will be there

so you will have these

two

so the charge balance will be therefore due to the presence of two cl minus

so that is why you have two cl minus

so in terms of this cover nitrogen and cobalt

chlorine bonds now you can write it down nicely that will have five of the first

category and one of the second category and when we go for the corresponding separation these two can only be separated these two chlorides can be separated as silver chloride

so will have two AgCl from the medium this will remain as the corresponding entity

so the third one we are taking everything from your book these examples are there in the book

so the third variety is your green variety and the green variety we are moving one step forward where we have two Cl bound to cover center

so now

you have the third one where you have CoCl_2 and obviously when two of the positions are occupied by these groups when two of them are occupied by these

so obviously we will have four remaining ammonia

so sorry this is ammonia so

four remaining ammonia groups are there and that's why the stoichiometry of all these

products in one case we have seen that the stoichiometry for ammonia was six the next one

it is five and the third case it is four

so what basically we try to understand over here is that the number of cobalt-chlorine bonds are increasing

so the overall charge of this particular species two and three

so it is one minus so outside you will have one chloride only and that chloride basically we can take it out

so we can take it out as the corresponding one as the reaction of these with a g^+ plus

so we will get one AgCl

so that clearly

differentiate depending upon the number of AgCl coming out number of moles of AgCl coming out from

the reaction in water medium

so it is very is all of them are we are lucky enough to see that all of them all of these compounds are water soluble so ah these things are there and the ammonia

solution what we are using for the preparation are very dilute solutions

because this ammonia

we know that the ammonia in the laboratory is available as ammonium hydroxide which is also a

weak base

so that can also be available for the production of HO^-

so if more amount

of hydroxide ions are there

so the side reaction for all these reactions for all these

complexation reaction can be the precipitation of cobalt hydroxide but which we should avoid

so precipitation of this hydroxide and in fact also sometimes the removal of this hydroxides how

we can manipulate this that will see afterwards that what is the corresponding product if we

simply use ammonium hydroxide instead of some reaction where cobalt chloride is reacting with

dilute ammonia
so this is there
so one is coming
so your difference is there three difference
is two and the difference is one and this is also changing now you have four
of them the
cobalt nitrogen bonds and two of them are cobalt chlorine bonds
so this quartz sphere and all these things are changing then
the fourth one what we will just discuss in our next class that how we can go
for the
next one is the color is different this is green but all other things are same
that means is
corresponding formula this reactivity with silver chloride and its the
corresponding
conductivity measurement that i will see afterwards in the next class that how
your the
corresponding solution electrical conductivity ah how it can also detect the
presence of
chloride corresponding to the quadrosphere so what we see that the last two
compounds having
the same molecular formula but the colors are different that means what we
should guess
and the type of the electrolyte is also same is one is to one electrolyte and
second one is
also one is two electrolyte only possibility is that you have four ammonium
groups and they are
also four ammonia groups and the chlorides
so what is the corresponding geometry until and unless
we define this as the corresponding coordination number what is the typical
coordination number
we call and how the different number of these groups can be assembled around
all these this will
find it out then the corresponding positioning of these two groups
so if we can have two different
positions for the placement of these chlorides along with these ammonia groups
also will
find that this will be responsible for one typical coloration and the second
one is
also responsible another different coloration but the nature of this
electrolyte type is
same but their corresponding positions will tell us something which is or
another type
of thing which will consider in terms of the corresponding isomerism ok
so everything will
see again in our next class thank you very much you