good morning everybody

so in this class of redox reactions today we will be basically discussing about three things first one is the corresponding disproportionation reaction second one would be the different redox reactions how we can balance because the balancing is always very important in relation to the number of electron getting transferred and lastly will be discussing on the analytical aspect or the application of this redox reaction is the corresponding redox titrations

so the first thing what we will be seeing today is that disproportionation reaction is a very simple and unique definition we can have for a typical disproportionation reaction is like this which tells us that disproportionation in a definite type of redox reaction

so we'll be talking something where we are concerned about a particular redox reaction in which the species species species is simultaneously reduced and oxidized to form two different products

so if we are talking about the disproportionation reaction of a particular species we have to think about its corresponding potential in terms of its reduction as well as its oxidation such as one such simple example what we know particularly when we go for heating some inorganic salts in last two classes what we have seen that some oxides some carbonates we can heat it with the liberation of oxygen with the liberation of carbon dioxide but if we can take the example of a species which is simply a salt of metal is mercury which is mercurous chloride where mercury is present in plus one oxidation state

so one positive oxidation state of mercury giving rise to the mercurous chloride and a typical reaction condition because sometimes we have to say it or we have to put some interesting reaction condition such that this reaction goes which is the uv driven photolysis reaction that means the photons are passed through the solid sample and some lysis reaction this is means the degradation of the species is taking place and at a particular wavelength which is in the uv region that means below 350 nanometer because at this particular energy where the uv energy we are talking about is a high energy which is energy is higher than that of the visible range

so that will basically degrade or giving us two products from the degradation of mercury one chloride is the mercury which is zero mercury elemental mercury in the liquid form and mercuric chloride

so how we can talk about this particular reaction is that if we think that ok we have from the left hand side to the right hand side we have basically mercury is present in three different oxidation states one is in mercury which is in plus one oxidation state it is mercurous mercury and on the right hand side after this photolysis reaction we get this mercury as the mercury in the elemental form that means mercury in the zero oxidation state and the oxidized version oxidized form of mercurous chloride which is mercury two chloride or we call it as a mercuric chloride

so what do we get that that's the typical nomenclature of these ions is that mercurus us like ferrous

so the nomenclature for mercurus tells us that it will be in the lower oxidation state that means mercury is in one

so if we get something that means if we have some species having some intermediate oxidation state

so that particular species can simultaneously reduced according to this particular definition what is written above that it can simultaneously be reduced and oxidized

so one of these mercury in the mercury one plus can be reduced to mercury zero and other mercury which will be taking that particular ah electron is giving to the other species will be oxidized to mercury chloride so thus we call this as a typical disproportionation reaction

so this is coming from a metal salt

so other metal salts also we can have

so we just simply write that if we have metal salts

so metal salts we can see that h g two c l two is a mercurous chloride having intermediate oxidation state

so another example will be talking about you see that if you have a copper in again plus one oxidation state which is q plus chloride

so like that of the thing that means it can have some other thing it can also happen in aqua solution or in water medium that it can go up to copper 0 or it can go down to copper 2 plus which is also a typical dispersion reaction what we can follow

so stabilization of this as copper chloride and if we think that this is there as q plus ion in solution which is aquas

so in aqueous medium if we have the acupress ion we have to stabilize by some special condition and sometimes we can take in some non aqueous medium that means some solvent which can be ch3cn which is a commonly known solvent is acetonitrile like ch3oh we know ch3oh is methanol

so in acetonitrile medium

so this particular ion can be stabilized by forming a complex species which is c h three c n whole four plus

so four such solvent molecules with nitrogen lone pairs forming coordinate bond to the copper center stabilizing this particular species

so in non aqueous medium this can be stabilized and if we can isolate like isolating the solid salt in organic salt this can be also isolated in the solid state as a white solid compound because it is q plus copper copper in plus one oxidation state having a electronic configuration of three d ten

so it is not colored unlike copper two

so this is there but if this particular one is not stable enough in aqueous medium it can go for disproportionation between copper zero that means metallic copper

so fifty percent of the species can be deposited at metallic copper as copper zero and other half will be going to cubric copper as copper 2 plus

so these are the relative examples the typical examples for the disproportionation of metal salts similarly we can have something that means the states some species which are in elemental state say p four the elemental phosphorus then s eight that elemental sulphur and elemental chlorine the chlorine gas

so what we see that whether these pieces can undergo the reaction which we can term as the typical thing what we are talking about here is the typical disproportionation reaction

so if that can undergo we should be able to identify something that if i say that in a particular reaction condition because we know that the reaction condition according to the environment of that particular reaction where we are doing if we are doing that reaction at room temperature in air and in condition of the that means it is in presence of the air and the moisture

so this is one particular condition

so there is a possibility that oxygen is also available and this o2 present in the air can oxidize this particular species this elemental phosphorus but if we talk in terms of the corresponding disproportionation reaction some things should also be available which can in turn reduce the species to some other form

so the products also we should know very precisely that is the important thing for knowing this disproportionation reaction

so from elemental phosphorus if we get phosphine gas is a gaseous product so is a phosphine gas like that of our formation of ammonia from nitrogen

so phosphine which is therefore a reduced form or the reduction product of the elemental phosphorus to phosphine

so what about the other species the other species can be the corresponding oxidized form and this can be some phosphate or phosphide based species

so is h2po2 minus

so is basically the phosphite ion species

so where you have the phosphorus in the oxidized form from the zero con state

so this particular reaction can take place in basic medium

so this particular dispersion reaction

so things are becoming much more complicated compared to that of our u v photolysis of mercurous chloride where we have seen that simple heating of mercury chloride can give you two products but here we should know the corresponding or the typical reaction condition and also sometimes we do not know one which is also not very much obvious that you have the product of ph 3 and h2po2 minus

so if two products are given we should be able to write down the second thing that we will be seeing today which are interrelated in a manner that you should be able to a balanced redox reaction for the reaction of this elemental phosphorus in basic medium to give rise your ph 3 and h2po2 minus

so that will see how we can get that similarly for this particular elemental sulphur

so obviously we should know all that elemental sulphur is in zero oxidation state when it goes for the corresponding reduced form it can also give rise to the corresponding species like h2s that hydrogen sulfide

so hydrogen sulfide will have a sulphide ion

so the reduced form is your sulfide ion and the oxidized form again we just attach oxygen because you have the available oxygen from the reaction medium in presence of the moisture like water

so the species containing sulphur oxygen bonds and in this particular example will be having s two o three two minus which is the thio sulfate anion

so thiosulfate and iron what will be getting is the corresponding oxidized form of the elemental sulphur while producing the reduced version as sulfide ion

so these two things again will be producing in the medium by the reaction of again in presence of hydroxide ion or strong alkaline medium giving rise to another example of your disproportionation reaction similarly the cl2 also will give rise to two sorts products again like that of your reduced form of l we all know this will be giving rise to the chloride ion and again like that of your phosphorous and sulfur you simply attach oxygen to the other species

so will be the oxidized form

so the electro negative ion which is ah the electronegative element which will be attached to chlorine will be c l o and that c l o minus will be there and that c l o minus will be again forming from the hydroxide ion medium

so one will be the reduced form and another will be the oxidized form

so let us see how these example these three examples from the elemental form can be balanced nicely with the help of the balancing terminology what we just want to say about this corresponding p four

so you have p four you have s eight and you have c l two

so which can be reacting with hydroxide ion in presence of some more water and we need three hydrogen

so three hydrogens will be there from this hydroxide and three water molecules will be there

so because three hydrogens will be required for formation of the ph three minus where phosphorus is in minus three oxidation state here it is in zero oxidation state and the other species the number is also twice of that h two p o two minus where phosphorous is in plus one oxidation state similarly for this s eight we can have just simply we just look at the number of electron transfer between these pieces if it is one is to one we are fine but sometimes it is also not one is to one such as it is accepting three electrons it is going to ph three

so it is accepting three electrons going from zero to minus three

so this is not always one is to one type of reaction

so in the second case where s eight is reacting with hydroxide ion giving rise to four s two minus plus twice of s two o three two minus and six molecules of water and in case of this chloride the reaction is very simple only in the basic medium we all know that will be forming the reduced version which is minus one oxidation state this is minus two oxidation state and this is also plus two

so this is the chloride ion will be forming along with c l o minus where this as one plus and some amount of water

so this is typically the hyperchloride solution or is the common bleach we call or the lundi bridge what can be formed from the reaction medium by reacting this chlorine

so all other halogens also like that of our chlorine we can also go for the reaction with bromine we can go for the reaction with iodine also

so similar type of reaction we can follow with that of your bromine elemental bromine but elemental iodine but the tendency for a different type of reaction can be very easily seen from a another example what we have discussed earlier that what about f 2 whether f 2 can also go for this sort of disproportionation reaction what the cl2 then br 2 and i2 is following but it is not that

so the f2 the fluorine molecule does not therefore show up this typical disproportionation reaction

so this fluorine which is f to zero which is in the gaseous form when it reacts with the same reagent the alkali present in the reaction condition which is in the aqueous form giving rise to this fluoride will be definitely forming

so will be giving rise to two f minus

so this is twice f two and this is the unique species what we have discussed earlier which is a gas also

so this fluoride will be in the aqueous medium plus h2o

so this is the typical reaction where we get the fluoride will react in a different form and this of 2 already we have discussed that you have the f and f like that of r o h h

so this species will be forming

so this is 1 minus this is 1 minus this is 2 plus

so what is basically we are getting

so we are here we are getting phosphorus in the positive oxidation state sulphur in the positive oxidation state chlorine bromine and iodine all in positive oxidation state but this particular thing that means this particular element your fluoride will resist that particular formation that means it is not forming a plus

so a plus is not forming in any such reaction

so it is not a typical dispersion reaction

so whatever f minus is forming in the aqueous medium in the gaseous phase it is again forming of2 where f is present in the negative oxidation state of one minus one minus

so these are the things

so that means always we know that these f two molecules f t molecule is the odd element out from this group of halogens from fluorine chlorine bromine and iodine

so it will definitely react in a different manner so if we just see from a very simple example of this mercurus chloride what we have seen and if we just go beyond that means if we just go beyond for this chlorine that this particular chlorine what we can see now is the chlorine can assume all other oxidation states in one case also we have seen that it is assuming ah this one minus and one one minus and one plus

so this particular one can also give you the other oxidation state because the chlorine can have the oxidation states like plus three plus five and plus seven

so other species containing c l o bond can be available for us which are like that of our c l o minus c l o two minus c l o three minus and c l o four minus

so for assuming all these oxidation states which are not the sometimes typically the outcome of a simple disproportionation reaction of chlorine gas between chloride and hyperchloride ion but it can also go further or go beyond that means the formation of these as the corresponding chloride ion cl o2 minus the chlorate ion the cl o3 minus and perchlorate ion cl o4 minus where the number of electron transfer will be more than one

so while handling this

so basically when we choose this particular reaction or particular aspects of these where we see that this particular thing is happening where chlorine oxygen bonds are giving rise to more number of oxygen attaching to the central chlorine atom

so that basically give rise to the different oxidation states of plus three plus five and plus seven

so we get that way that this particular one will have when we handle the chlorine gas this particular chlorine gas this just take it out ok

so ah this one will give you something where when we handle the chlorine bearing some other reagent such as the chlorine gas itself or hydrochloric acid when we use hydrochloric acid as gas or in aqueous medium we find that this particular one will give you that something

so we therefore see that the getting these other oxidation states is very difficult to find out if we do not know the what is the product of that particular reaction when the other species like chlorate and perchlorates are forming

so the multiple number of electron transfer will be taking place there and the perchlorate ion we all know when we go for a typical reaction because this is the corresponding version which is commonly available from acid form which is your perchloric acid which is hclo4

so that perchloric acid containing this chlorine in plus seven oxidation state will be highly oxidizing also

so this particular case also we see that in another example

so if we just now we have seen that this particular disproportionation reaction is taking place with only a moderately concentrated sodium hydroxide solution but if we go for a solution which is dilute one and in that particular case the reactions to isometry is different

so you see the reaction condition basically changing the reaction stoichiometry in the previous case our chlorine is to hydroxide stoichiometry was one is to two one cl2 was reacting with two hydroxide ion but simply the condition the condition of the reaction we move from a moderately strong sodium hydroxide solution to a dilute solution the reaction stoichiometry is still the particular one is forming again is one is to two but in this particular case the number of electron transfer was of different type because only one species is forming for a highly oxidized form that means c l o three minus the chlorate ion where you have chlorine is in the plus five oxidation state similarly you can have zero to plus five

so you require five such chloride ions to be formed over there from this reaction as the corresponding chloride ion

so this also is all true for a typical reaction in terms of the corresponding inter halogen compound

so we are talking about the metal salt the corresponding elemental form of the compound and some other compound which are the inter halogen compound

so these inter halogen compounds what we see is the brf

so when brf is getting basically in some form when one b r is attached to f and the stoichiometry is b r and f but it can go for this proportionation reaction between bromine trifluoride and elemental bromine

so again we see that is that b are plus and f minus

so the bromine is present

so if we think or if we talk in terms of the bromine as the intermediate oxidation state

so plus one it will go to zero and b are two and two plus three in b are f three

so which is also true for typical example of some other compounds which are typical inter halogen compounds

so similarly we see that simple other gas compounds

so gases also have some tendency if we know that these gases this is most of these gases which are oxides the nitrogen oxides the sulphur oxides we all know that these oxides are basically anhydrides of the corresponding acids or the mineral acids

so nitrogen dioxide is also a corresponding anhydride of the corresponding acids but this no2 which has a typical oxidation state of plus 4 and it can react with water going for a typical disproportionation reaction that means the flash 4 oxidation state of nitrogen dioxide is not very much stable in this particular form

so it is not very much stable to give us some other species or the corresponding ah compound that means the corresponding ah hydrated form

so that hydrated form we are not getting at the corresponding acid and that acid basically we are getting when we react this no2 to h2o is the corresponding nitrous acid

so nitrous acid is if we just to quickly look at the corresponding oxidation state of this nitrogen over here

so is o2 is 2 to 4 and hydrogen is 1

so 4 minus 1 is 3

so negative 3 is there

so nitrogen is plus three similarly this nitrogen is also three into two six plus one is five

so it is plus five

so this plus five and plus three

so the plus four oxidation state of nitrogen in nitrogen dioxide will prone to this proportionation reaction between plus 3 and plus 5

so when it reacts with water because it will be disproportionated for different oxide or the oxygen ions it is not that it will disproportionate into two other gases because we all know the nitrogen can give rise to other oxygen gases like nitrous oxide then n2o3 and n2o5 all like this but since the reaction is taking place in presence of water

so it will be forming two acids one is nitric acid and another is your nitrous acid

so before going to this redox titration reactions

so will be just quickly see the corresponding thing that means how the different redox reactions because will be utilizing those rocks reactions for those redox titration is the balancing so if we just simply consider that the balancing and one such example because always we take the direct laboratory examples of the experimental chemistry is always in nice in knowing all these things

so laboratory chemistry will also help us into knowing a species which is oxidant

so which is typically labeled as oxidant which is your dichromate ion cr2o72 minus and will give you some condition for this particular reaction which is the acidic condition that we give acid to it or the medium is acidic such that will prevent in reacting with water itself or hydroxide ion formed from this water molecule

so it will be friendly acidic or fibrilly acidic or slightly acidic which reacts with so3 2 minus the sulfite ion

so this is your oxidant this is your reductant what is happening and what sort of reaction we can expect

so we should also know

so these are the reagents

so if this is a and this is b we get this reaction to c plus d

so identification of all these are important that means we should know what is a we should know what is b

so the correct assignment of the formula of each compound that means which are reacting a and b and the products also c and d

so since this is oxidant since this is reductant

so this oxidant will be reduced

so if this is your oxidant and this is your reductant

so this oxidant will be reduced

so what are the reduced form of this chromium is present in plus six which is hexavalent chromium in dichromate

so hexabalan chromium will be reduced down it can go to plus five it can go to plus four it can go to plus three but which is most stable one and which is very much stable in this particular reaction condition which is slightly acidic

so in this particular condition c will be your chromium three plus the chromium three ion

so it will be reduced to chromium three plus ion what about this reductant that means the reducing agent which is responsible for the reduction of this dichromate species

so any other chromium anion or chromium species based on the plus six oxidation state will be reduced by this reagent which is nothing but the corresponding species which is this is oxidizing as oxides the sulphur trioxide but sulphur dioxide is the reducing gas when it reacts with water we get sulphurous acid and that sulfurous acid when it is ionized we get the corresponding ion as the sulphide ion

so sulfide and which can also be produced from the metabisulfite which is the anhydride of this sulphate

so this is the reducing agent

so this species will be reducing

so if we just simply have a solution

so orange colored solution you can have aqua solution which is slightly acidic and you pass sulphur dioxide gas the same reaction can happen over there

so this thing is there

so the reductant that means these species should be oxidized

so a

so three two minus should be oxidized that means in other way if we consider it that s o three two minus will be oxidized by this oxidizing agent which is your dichromate because the commonly used salt we use in the laboratory is the potassium dichromate solution

so a solution of potassium dichromate can be able to oxidize your solution which is containing sulphide and sulfide we know that this is in plus four oxidation state will be oxidized to sulphate which is in plus six oxidation state

so that gives rise to the assignment of this thing

so the correct assignment of the reagents and the product that means the assigning a assigning b assigning c and assigning d is also important then next step the assignment of the corresponding oxidation states what we have seen that the species what is forming where it is

so it is in plus three oxidation state plus six it was in plus four and it was in plus six

so then the total number of electron transfer what is taking place over there that we also try to find out

so here the number of electron transfer is basically what we get if you have chromium in the hexa balance state to a trivalent state transfer is giving to for three electron acceptance

so three electron reduction step since we have two chromium centers present itself in the same species that means the dichromate and ion

so total number of electron transfer will be three plus three will be six

so we have six electron transfer for this step what about this for the sulphide to sulfate conversion

so sulphide to sulphate conversion is two electron transfer reaction

so this is the thing that means the imbalance in the number of electron transfer between oxidant and reductant that has to be matched

so the increase in decrease in oxidation number

so the third step would be the calculation of the increase and decrease in the corresponding oxidation number per element species or per atom of chromium or per atom of sulphur then we just go for the total ionic charge balance because ionic charge balance is also important because what we should use that if the medium is alkaline we should use water if the charge is not required but if the corresponding charge is required we should be using hydroxide ion but if we require the cationic charge we will be using it as h plus and the product of this because these two we combination of this reaction or elimination of this o minus or addition of o to this sulfur center will just either com consume water molecule or produce water molecules

so addition of water molecules will also be there and balancing the hydrogen atoms from the left hand side to the right hand side will give rise to this particular reaction

so what in a sense

so if we sum up this particular reaction what will be getting over there for summing up this reaction simply that c r two o seven two minus will be there for balancing the total number of electrons

so it will be three into two

so we have three s o three two minus forming two c r three plus and three of the sulfate ions

so that basically and critically matching the number of electron transfer reaction for this

so more number of examples we can have and we can have several others

so quickly we should see some of these examples of this balancing reactions because we see for the redox titration

so if we have the nitric acid which is the most common reagents which we deal with in the laboratory in your general chemistry textbook as well as in the experimental part so when nitric acid is getting reduced by h2s we have the nitric oxide and the elemental sulphur

so this is a very precise example of sulphur is going from minus two to zero

so you have a change of plus two and this nitrogen is changing from plus five in nitric acid to plus two in nitrogen

so it is minus three

so the multiplication will be in terms of this two is to three

so the reaction will go like this twice of hno3 plus thrice of h2s will be giving rise to the liberation of nitric oxide which is a very interesting molecule we should also study when we study the nitrogen chemistry in the group that the oxide of nitrogen or when you study oxygen in the group that oxides because it is a very interesting molecule and is a very biological it is also very important and is for the detection purpose also the identification of the nitrates and nitrites will also be detected by the presence of or the liberation of this n o

so this n o and the elemental sulphur the sulphur is in elemental form is the corresponding powder form is very small particles will be forming and that is in the zero oxidation state and that will be floating around

so elemental sulphur liberation will also can take place and that is also an interesting observation in the laboratory chemistry or experimental chemistry or practical chemistry is that you can see this elimination of sulfur from that particular reaction

so another interesting species or the reagent is like that of your potassium dichromate is your potassium permanganate kmno4 where manganese is present in plus seven oxidation state and if that particular one is reacting with simple a chloride salt because the chloride salt all we know how we can identify

so if any of them can be your unknown species in the laboratory experiments also how we can identify this

so will be taking the help of again a particular redox reaction and that redox reaction if we know that it will be going for some reaction where c l two is forming that means chlorine is in one minus oxidation state will be going to chlorine zero

so that chlorine zero formation is basically is corresponding oxidation reaction

so any chloride salt this is potassium chloride salt even for hydrochloric acid which is hcl in aqueous medium which has also chloride as one minus

so that can be oxidized and this is our oxidizing agent

so k menopause may be in solution we should know the corresponding reaction condition or in the powder form if we add dropwise this kcl to this particular powderic form of this k mno4 will be able to get chlorine and this gas once it is formed we take out from the corresponding flux the reaction flux we can have

so the reaction flux we get

so from that we get and collect this particular c l two

so c l two will be forming

so this is also a typical example for c l two preparation

so this c l two is giving

so what about this manganese then

so this is very simple that chlorine is going from this to this that means it is minus one to zero

so once level of oxidation change that means plus one change but the manganese in this particular condition which is not alkaline and which is not neutral if it is slightly acidic because this reaction can take place in slightly acidic or almost very close to neutral condition that it will form manganese in the manganous ion so it will be forming the corresponding salt as mangano sulfate

so if we add some acid to maintain the reaction condition acid of our choice would be therefore since the sulphate we are writing here will be your h2so4

so in presence of that sulfuric acid kcl will be oxidized to give rise to some reaction where this k amino 4 will be utilized for its oxidizing power for the production of chlorine gas

so the balanced equation

so the balance redox reaction

so balance redox reactions what we can have for this is this therefore k m n o four

so twice of k m n of four because this balance is that is seven to plus two

so this is plus two

so this will be the change in minus five and here this change in is also plus one

so the reaction stoichiometry will be one is two five and since this is the corresponding doubling of this c l two is there for the chlorine gas elimination it will be again doubled

so it will be twice of k m n of four instead of one k minor four twice of k minor four because we will be taking there 5 into 2 of 10 of kcl in presence of 8 molecules of sulfuric acid which is typically balanced because the balancing the proton balancing the sulfate anion all these things in the different steps like one two three four five what we just discussed will be following for the formation of the corresponding m n s o four which will be forming five times of that chlorine and along with that because this cation is there and this anion is there which is in excess and some other thing is also in excess is the corresponding hydrogen ions and the oxygen which is coming from this permanganate is the formation of water

so these are the byproducts or the side products of the reaction is your k2 so4 potassium sulfate and water molecule and balancing this thing will be giving you eight water molecules will be forming along with six k two s o four

so we get something where we can see that the balancing is important and we can have some typical other examples we can work out and we can also down this reactions for typical other species where we get and i will just give you some examples where we can have some species like c u s the reactions of c o s with h o three we should follow the reaction we should know the reaction and how the reaction goes and ultimately the balance redox reactions we should be able to write in terms of the number of electron transfer between the oxidants and the reductant

so cubric sulphide we know that it can be precipitated in the group separation table in analytical chemistry or then organic chemistry practical classes and is just can be dissolved in nitric acid similarly one typical example of a s 2 s 5 which can also be oxidized by this oxidizing agent which can also fulfill something else that it is oxidizing agent at as well as it is maintaining the corresponding proton concentration in the medium

so what is forming over there from this particular one case that means whether we are getting some arsenic ion or not that is important and whether we are getting sulphate ions from there or not that is important

so these reactions will tell us these products we should know the follow up of these reactions in a fashion like this similarly we can have c a three p o four hole two which can be reduced by coke or charcoal or carbon that means carbon reduction process which is a typical industrial process we know that charcoal or carbon reduction process

so that is the reduction process and it is also the reductant and in presence of sio2 which will be forming something where we get that is the corresponding formation of the species like that that means the silica which it can be converted to the silicate to take out some species from this reaction condition

so this basically give us something which we can consider this as the corresponding preparation of p four the elemental phosphorus from phosphate rocks

so this is the rock species rock species can be reduced to form some value added species or value added product is the preparation of the elemental phosphorus

so these are some examples

so one such example is that the handling some more complex inorganic compound is potassium ferric cyanide handling potassium ferric cyanide and how the redox chemistry goes with potassium ferry cyanide we should also know and this when react with c r two o three the chromium and the chromium oxide in plus three oxidation state

so assigning this and assigning the corresponding oxidation state of this iron center and if we know the corresponding products which will be k four f e c n whole six which is this is ferris cyanide this is ferrocyanide which is iron in the plus three oxidation state this is iron in the plus two oxidation state and that ferry cyanide is behaving as an oxidizing agent for the chromium oxide ah oxide which is in the lower oxidation state of plastics and which will be oxidized to chromate

so this will be forming cro4 2 minus and this particular species we all know is stable in alkaline medium

so the reaction will go in presence of hydroxide ion

so we know a b c d we know the reaction medium

so we know the number of electron transfer we can follow the number of electron transfer for this reaction

so we can write the balanced redox reactions out of this

so now quickly we should see that how this balanced redox reactions can be helpful for our redox titrations

so redox titrations are utilization of the corresponding ah redox reactions basically for this particular thing that means how we can handle a particular redox reaction for titration purpose titration means how you can understand how we can find out the unknown concentration is not only in the domain of chemistry it can go to biochemistry or any other area that where we can quantitatively utilize the redox titration of the redox reaction to understand or to find out any unknown quantity in any sample

so is the another branch of chemistry is opened up using this particular one is the analytical chemistry branch

so what this will be utilizing the redox reactions and for quantitative analysis because we know that something we call as a qualitative analysis that means the identification of the species such that chromium in any unknown sample chromium in steel chromium in ore or chromium in any other material can be identified first that means whether chromium is present or not that is the aspect what we call as the qualitative analysis now the next stage of knowledge or next stage of understanding or next stage of information what we can have is that how much chromium is present in that particular species

so the amount present will be known by knowing the corresponding methodology where we find or where we analyze the sample quantitatively and one such procedure is by doing redox titrations

so these titrations also involve therefore the reactions between oxidizing and reducing the way we are just now we have seen while balancing the redox reactions which will help in understanding or knowing or estimating the amount of unknown substance this is important this term is important unknown substance in any solid sample any biological sample any biochemistry sample any geochemistry sample any other sample in this universe which can be having some composition element wise that means same chromium is present it can be in your pressure stone also in gem

so that chromium can be identified one thing is that since we do all these redox titrations in the solution medium the substance the material can be taken into the solution that the solution preparation would be very much important for all these cases

so these are the techniques

so the techniques are very important and therefore since we are utilizing for this redox titrations the reagents that reagent what is we are talking as that since we are talking that oxidizing and the reducing agent

so we can use oxidizing and reducing agent

so definitely if we use some oxidizing agent say some reagent will be utilizing is as oxidizing agent

so potassium permanganate will be utilizing

so just now we have written some reaction that potassium permanganate can be useful for the generation of chlorine gas

so the same potassium permanganate can be utilized as oxidant in redox titration to analyze the other unknown species the unknown species which we call as analyte the analyte will be identified or the amount of these unknown species can be identified by knowing its reaction with k amino 4 which is your oxidant

so this particular analyte should be your reducing agent

so which can be oxidized by k mno4

so utilization of this k mno4 as oxidant for redox titrations has a special meaning

so any other species which can be oxidized by k mno4 will be utilized for this particular titration

so the name of this thing is therefore your redox titration based on k menopause that means the permanganometry the permanganate potassium permanganate we are using for some tritometric analysis which is therefore a permanganometrimetry is therefore the metric arrangement the metric analysis

so there are other examples of oxidizing agents

so one we just now we have seen the corresponding balanced equation based on the dichromate ion which is k2 cr2o7

so when you use k2 cr2o7 which is nothing but your potassium dichromate

so the inherent species which is they are already in that particular compound two chromium centers are present which is bridged by one oxygen

so chromium chromium centers we cannot take out from there

so is the dichromate itself can be utilizing for that particular oxidizing agent because it has a specific e0 value and once we know that the amount of its oxidizing ability we can choose the corresponding reducing agents or the reducing analyte which is getting reduced by doing the titration whether we do it by permanganatory or dichromametry similarly we can have the seric ammonium sulphate or ceric sulphate which is a double solid like more salt

so we call it as a sedimentary

so this cerium sulphate can be utilized and this iodine can be utilized in two such titration two such redox titrations are well known and one is therefore the corresponding iodometry where iodine can be liberated from the medium from say potassium iodide and that iodine can be the corresponding amount of iodine can be estimated by the corresponding titrometric method which is known as iodometry and iodometry iodimetry is a different type of thing where you have a standard solution of iodine in the buret we take that in buret and we go for that particular iodine as the oxidizing agent to titrate the corresponding reducing substrate in the conical flask

so why we are taking we are having these examples that means one two three four examples for these redox titrations why you are taking

so many of them because their e0 values are different one of them can be highly oxidizing and the other is not the k mno4 is the strongest possible oxidizing agent among all these and if we consider this as having a e0 value of 1.

51 volt

so this e 0 value will immediately tell us where the i 2 value is 0.

0.

51 only

so this particular one is weakly oxidizing and k amino 4 is strongly oxidizing

so we can have under the category of k n m 4 we have series of compounds which can be analyzed similarly using potassium dichromate we can analyze some other compounds from there

so this is therefore a powerful oxidant k amino food will be a powerful oxidant and which is used quite often and in acidic condition

so in acidic condition this particular e0 value for the half cell reaction between mno4 minus and mn2 plus that means manganese in plus 7 oxidation state and manganese in the by valence state and giving rise to a 0 value of 0.

514 and which is highly colored because the permanganate we know because of this charge transfer transitions manganese though it has no d electron is the d zero systems manganese is in plus seven oxidation state but due to charge transfer transition it is violet in color

so this violet color will disappear during titration that means the disappearance of the color during the titration we can follow this reaction from the corresponding reduction of mno4 minus to mn 2 plus which is a colorless one therefore we do not use any indicator to indicate the end point of that particular titration

so to indicate the redox titration where the reaction is completed that means the reaction has gone hundred percent almost hundred percent towards right where no more this reducta this reducing agent is present because all these five electrons will be transferred to the other species which will be accepting these five electrons quantitatively for its oxidation by mno4 minus this particular potassium permanent is not a primary standard

so it has another problem because it has stress amount of mno2 because it can go undergo some self decomposition reaction because this mno4 is stable in acidic condition but when we preserve in the neutral condition in water solution some amount of this mno2 is forming where manganese is reduced only to manganese in the plus four oxidation state and if the water is not very much pure it has some organic impurity and that organic impurity can function as the item which can be nicely oxidized by k amino 4 and that k amino 4 will be degraded to forming some mno4 in the medium

so invariably some amount of mno2 is present that means some amount of k menopause will be lost and some amount of mno2 will be formed in the reaction medium

so this particular one we call it as the primary standard and that primary standard thing can be titrated by some ah other primary this is not a primary standard therefore it is a secondary standard solution and which can be standardized by titrating with standard solution of either oxalic acid or sodium oxide

so this is sodium oxalate which can be nicely oxidized by k amino 4 and this is the corresponding balanced equation for that redox reaction between k amino 4 and oxalic acid and that camino for oxalic acid because oxalic acid after oxidation giving rise to formation of this only carbon dioxide and this manganese will be again like that of the previous example of the half cell reaction is that reduced to manganese sulfate only and this particular reaction

so quantitatively if we know since this sodium oxalate solution is a primary standard solution

so knowing the strength of this sodium auxiliary solution will be knowing the corresponding strength of the secondary standard of k mno4 and immediately before performing the actual titration we find out this strength and we use it for estimating some other species

so this is the standardization process

so this standardization process can be utilized for the formation of different thing that means if we have some unknown strength of hydrogen peroxide often we use from any other any laboratory we use because this is a not a very stable quantity even if we preserve in solution in under refrigerated condition but when we use it we should know the actual strength of hydrogen peroxide what we can have

so knowing of this actual strength of hydrogen peroxide we have to use the corresponding balanced redox reaction of k amino 4 with hydrogen peroxide and that amino 4 and hydrogen peroxide reaction will definitely be giving rise to the again the manganese sulfate and this hydrogen peroxide will be oxidized now the same example what we are knowing from the very first day of these classes that we will be going to the production of dioxygen molecule similarly the determination of sodium nitrite we all know that sodium nitrite when we dissolve it any acid such as sulfuric acid forming nitrous acid

so the identification of the amount of sodium nitrite or the amount of nitrous acid in the reaction medium can again be found out by quantitative titration the redox titration by means of potassium permanganate and this nitrous acid will be oxidized to nitric acid and the third one is a very nice example where the iron in the ferrous sample that is very important because the ferrous sample is not always very easy to get because ferrous sulphate itself is not stable in the laboratory condition only in the highly pure form in the crystalline form and it is stabilized in a double salt which is known as ferrous ammonium sulphate or ferrous sulphate ammonium sulphate double salt which is known as more salt

so when more salt is dissolved in water we get the active species which can be oxidized by k mno4 is your ferrous sulphate

so that ferrous sulphate can also be estimated by permanganometry by titrating it with k mno4 solution standard camino force solution which has been standardized by standard sodium oxalate solution in presence of sulfuric acid to give this particular one and the unknown concentration of this that means the ferrous sulfate solution can be found out from this reaction stoichiometry and the balance reaction and the mole reactions

so this particular case the ferrous sulphate the amount of ferrous sulphate

so any other sample of iron also the simple thing is that any iron sample if you transform this because we know that from iron nail to iron seed we know how to convert that iron seed or iron nail to ferrous sulphate

so that can be converted to ferrous sulphate and that ferrous sulphate can be titrated or estimated by knowing its titration with potassium permanganate

so lastly we will just conclude over here that how we get this the reverse reaction because potassium permanganate we are utilizing for the formation of the corresponding k amino 4 but how the reverse reaction that means the oxidation of mn 2 plus can be achieved for the formation of mno4 minus and this is a typical introduction of another oxidizing agent which is your sodium bismuth

so you have 2 step of reaction that means the oxidation of mn two plus and reduction of bismuth ion bio3 minus two bismuth three plus giving rise to two

half cell reactions and those two reactions when we sum up in this form where mn2 plus is available
so any manganese two plus we can have
so any manganese to salt whether it is a manganese ion in as chloride salts or manganese chloride or manganese sulfate
so what we get sodium bismuth is the standard reducing agent oxidizing agent in the laboratory which can immediately oxidize this manganese quantitatively to the permanganate
so one this permanganate ion mno4 minus ion is formed in the medium we see by the color change simply because it is the pile violet coloration will take place over there that means the mn 2 plus has been converted to mno4 minus 1 this is giving rise to some identification of mn2 plus
so how you identify mn2 plus in any unknown sample
so this is the test that you use sodium bismuth and sodium bismuth oxidation will convert it to this and you can identify by knowing the color then how much it is forming you get that quantitative transformation these and you estimate the the particular potassium permanganate or mno4 minus what is formed over there by titrating with sodium oxalate and all these reactions are taking place in acidic medium and hydrogen ions and water are added to these hop reactions to balance the corresponding overall reaction
so this overall reaction we have to balance because we are utilizing fourteen h plus and forming seven h two o
so like that of our reaction of mno4 because mno4 minus is very much stable in acidic condition
so the formation of mno4 minus is also in the acidic condition
so that is an another example of this that mno4 minus and mn 2 plus whatever we are handling for this quantitative estimation that means the laboratory chemistry or the theoretical chemistry what we can understand by knowing the reaction the balancing of all this reaction is in acidic medium
so this is purely we are having in the acidic medium but what we get in that corresponding one in the reaction what we can have for the sulfate what we have discussed earlier
so this is basically a reaction where we can utilize in basic medium
so this potassium permanent is directly going to mn2 plus this is due to the corresponding medium the acidic medium
so acidic medium is therefore very important if we go for a corresponding redox titration reactions but if we are able to get some reaction in basic medium
so basic medium in that way is not very much helpful when you use this simple reaction we are not writing any h o minus for its basic medium but we are writing simply h 2 also because this h2 will be consumed for the formation of more amount of koh
so the medium is basic in that way by formation of koh from left to right
so this is getting converted to mno2 and that mno2 what we are getting is not soluble in the aqueous medium this will be insoluble in aqueous medium
so that will be liberated out
so this reaction is therefore not helpful for any such permanganometric titans
so all permangometric titration likewise the dichromatometry also is helpful to doing it in the acidic medium only
so in the basic medium this will be precipitated out and we cannot do or we cannot perform the corresponding redox titration reaction
so as a result what we can state that in basic medium the hydroxide and and waters will be added for the balancing the reaction and the half reactions will be there to balance the overall reaction and this overall reaction is very important and this overall reaction once we get and once we have the

understanding where we use
 so this reaction we cannot use for the corresponding titrometric method of redox titration utilizing k menopause it will be only utilized for the oxidation of sulphide similarly some other species will also be available over there which can be utilized for the use of this k you know for this oxidation reaction
 so this is some example only based on k menophone likewise we can use silic sulphate we can use iodine
 so these are the techniques where we can use
 so one such example we have discussed that camino 4 can be utilized for typical redox titrations in analytical chemistry ok thank you very much you