hello welcome back to the series of lectures on organic chemistry the fundamental aspects of organic chemistry the basic principles of organic chemistry is what is being discussed in this module we will discuss two important aspects in organic chemistry one is purification of organic compounds the second one is identification of elements present in organic compound lets say for example a scientist synthesizes an organic molecule in the laboratory a new organic molecule in the laboratory it is important that the scientist purifies the organic compound to the highest purity that is possible
So purification methods are extremely important in the practice of organic chemistry now having synthesized the molecule he has the reason to identify the compound in terms of its elemental composition in terms of its structure and
So on what we will deal with in this particular module is some processes which are used in the purification of organic compounds unless otherwise the organic compound is pure one cannot determine the elemental composition of an impure substance
So it is necessary to purify the compounds after purification it is essential to identify the presence of various elements and elemental composition in an organic compound and that is usually carried out by various chemical tests carried out on the organic compound let us start with the purification of organic compounds this is going to be fairly descriptive in nature because of the fact that many of these procedures are discussed in the textbook and the diagrams related to the various methodology you can refer to the textbook also one is sublimation sublimation is a phase transformation when a solid compound is heated even before it melts it goes into the gas phase and sublimes
So if you take something like naphthalene for example if we heat naphthalene naphthalene does not melt even before it melts the vapor pressure of the solid itself is sufficiently high for it to undergo vaporization to go to the vapor compound vapor phase and the vapor phase can be conduct condensed on a cold surface
So what is normally done is to take in a stand a petri dish containing naphthalene and the petri dish is covered with a funnel by inverting the funnel upside down onto the petri dish and the compound is gently heated from the below using a bunsen burner or a heater for example when the substance is heated if it is a sublimable substance the substance is sublimable provided it goes from the solid phase to the directly to the vapor phase without melting in other words the vapor pressure of the solid is sufficiently high at this particular temperature to which is it heated
So it directly goes into the vapor phase before it becomes a liquid phase for example when the vapors reach the colder surfaces of the funnel the crystallization process will take place essentially
So the funnel stem and the funnel surface is going to be now covered with crystals of naphthalene
So this is a process by which some of the organic substances are benzoic acid naphthalene they all can be sublimed for example using the sublimator that is shown here often time it may not be enough if you just leave a inverted funnel like this there are other sublimation apparatus which are let us say an outer jar is there and this is covered and then you have a inner tube that is inserted into the jar all the way down to the bottom the substance to be sublimed is taken in the outer jar like this and the inner jar has a water circulating unit all the way down here
So cold water is sent here and it comes out of here
So the surface of the glass in the inner tube is continuously cooled by means of water circulation or chilled water circulation this is a sublimation tube that is normally used for example
So sublimation is essentially going from solid to vapor and the condensation of the vapor back to solid
So the typical example that is shown is if naphthalene is contaminated with a little bit of silica or sand or some such substance sand and silica are not supply mobile they are high melting solids
So when you heat a mixture of sand and naphthalene only naphthalene will sublime and you get pure naphthalene deposited on the funnel surface or in the inner tube surface here the vapor will essentially condense on the outside of the inner tube inner tube can be removed and this material can be scrapped off after the sublimation is over the second process is crystallization this is the most popular methodology to purify solids organic solids crystallization is a process in which the substance which is a solid substance is dissolved in a suitable solvent it could be water or an organic solvent such that it is not highly soluble in that particular solvent it should be highly soluble at a high

temperature ideally and when it is cooled it should be insoluble in nature and typically the impurities should be highly soluble in the solvent of choice
So if you take for example something like benzoic acid benzoic acid can be dissolved in boiling water
So when you boil water and add solid material of benzoic acid to it initially it will be floating around slowly it will go into solution and it will dissolve in the water and when the water is cooled it will reappear as crystalline solid
So what is normally done is under the hot condition the solution of benzoic acid in water is quickly filtered to remove any suspended impurities and once the filtrate is collected filtrate is the one that is filtered through a funnel for example with the filter paper it is filtered through the funnel into a beaker and the solution that you get here is what is known as filtrate when the filtrate is cooled to room temperature crystals of benzoic acid appears again
So if you take impure benzoic acid one can easily purify it by crystallization by far crystallization is one of the best methods of purifying an organic solvent solid only problem is one needs to identify a suitable solvent in which it is soluble at high temperature but insoluble at lower temperature
So that one can effectively do this picric acid for example can be crystallized from water
So these are some methods of purification of organic compounds the third methodology is distillation methodology distillation essentially involves boiling a liquid this is a methodology for purification of liquids when the liquid is heated to its boiling point in other words when the vapor pressure of the on the surface of the liquid equals to the atmospheric pressure liquid starts to boil and produce vapor and the vapor is condensed again using a cold condenser and this process is what is known as distillation
distillation there are several different types of distillation known one is a normal pressure distillation that means the liquid is heated in the atmospheric pressure itself until it reaches its boiling point the vapors are condensed using a condenser and that is a normal pressure distillation or ordinary distillation the second distillation is vacuum distillation here using a vacuum pump a low pressure is applied on to the reaction distillation unit let us say for example you have a distillation unit which is consisting of the flaws containing the liquid and having a condenser attached to it and you have a receiver flask here for example in this portion you apply vacuum in other words connected to a vacuum pump
So that the air inside the flask is sucked out and there is a low pressure that is created here why do we need to do a vacuum distillation some of the organic compounds when it reaches its boiling point it undergoes decomposition even before it reaches its boiling point it can undergo decomposition and some of the organic compounds may be dangerous to heat to high temperature because it may catch fire and
So on
So for these two reasons if the pressure in the reaction still or the distillation still is kept at a lower level then the vapor pressure is reached to the applied pressure of the applied vacuum of the system even at a lower temperature in other words the liquid boils at a lower temperature at reduced pressure let us say for example i have a vessel here like this and this is maintained at atmospheric pressure when will the liquid boil the liquid will boil when the vapor pressure at the surface of the liquid is equal to the atmospheric pressure at that particular temperature the liquid would start boiling in other words the temperature at which the vapor pressure is equal to the atmospheric pressure the liquid will start boiling suppose if it is not atmospheric pressure it is less than atmospheric pressure then the temperature will also be lower because at a lower temperature itself it will reach the pressure that is being applied or the vacuum that is being applied
So that is a basic principle of the vacuum distillation otherwise distillation of an organic compound which normally will decompose at its boiling point to make it distill at a lower temperature we apply vacuum and reduce the pressure distillation is what is known as the vacuum distillation the third distillation is known as fractional distillation let us say for example we have a mixture of two compounds let us say mixture of benzene which is has a boiling point of 80 degrees or
So and xylene which has a boiling point of about hundred and ten or hundred and twenty is centigrade or
So now these two liquids are miscible let us say accidentally you have mixed it or you

have a mixture of these two compounds you want to separate them one can distill this compound under fractional distillation condition such that the low boiling liquid is obtained first as a fraction and then you heat it to a higher temperature and get the high boiling liquid as a second fraction in other words based on the boiling point difference if they are very widely different in their boiling point then it is easy to do a fractional distillation even if they are closely closed in terms of their boiling points it is possible to do a fractional distillation provided you have a fractionating column what is a fractionating column a fractionating column is nothing but a tube that is filled with beads glass beads of this kind and this is connected to the flask distillation flask where the liquid is taken for example this is completely filled with the glass beads this is open here put some cotton plug or something and fill it up with the glass beads in this particular way
So there is a lot of obstruction for the vapor to pass through this this is connected to a condenser as usual
So what happens the liquid starts to boil the vapor pressure of the lower boiling liquid is going to be higher in the vapor phase compared to the vapor pressure of the low higher boiling liquid for example because there is a differential in their boiling point
So the one that is boiling at a lower temperature that vapor will rise it will keep condensing until it rises to this level and then the distillation of that lower boiling fraction will take place in other words based on the boiling point difference you are selectively distilling off the more volatile compound in this particular instance benzene and compared to the less volatile compound which is xylene in this particular case
So this is the basic principle of the fractional distillation setup finally you also have steam distillation steam distillation is a very favorite method for isolation of terpenoid compounds from plant materials for example i want to distill of limonene from lemon peels of lemon has what is known as lemon in sorry and suppose i want to isolate the lemon in from the peels of lemon or peels of orange it's ideal to do a stream distillation unit steam distillation is also useful when a compound is steam volatile in nature in other words at the steam temperature it has sufficient vapor pressure to form the vapors and the vapors are condensed to using a condenser during the process of distillation
So there are several organic compounds which are steam distillable as usual if it is applied pressure then a pressure corresponding to the water vapor and the partial pressure corresponding to the organic
So so this is water vapor pressure and this is the organic compound vapor pressure this will be the total pressure in a steam distillation unit
So when the molecule when the temperature reaches the applied pressure it will contains both the vapor of the water as well as the vapor of the organic molecule and it is being condensed organic molecule of course in invisible with water
So at the receiver you will receive a mixture of water as well as the organic compound and that is to be separated by means of a separating funnel in the process of separation is done at the at the using a separating funnel in the process of isolating the pure organic compound from the water fraction that is being solid created the fourth methodology is an extraction methodology this is useful if two organic compounds are let us say mixed together and based on their chemical property one can separate one from the other by selective extraction process i will give you a example of let us say benzene and benzoic acid are mixed together in other words a solution of benzene is given one can do simply removal of the benzene by distillation and get the benzoic acid
So that is by means of distillation of benzene one can get the benzoic acid alternatively one can also extract the benzoic acid out of the mixture in this mixture exploit the acidic property of benzoic acid
So what is done is normally a separating funnel is taken for example the solution containing benzene and benzoic acid is taken here to which now you add aqueous sodium bicarbonate the ecosodium bicarbonate when it adds it will form another layer this will form the lower layer water is heavier than benzene
So the upper layer will be benzene containing the benzoic acid and the lower layer will be aqueous bicarbonate solution what will happen when you mix this together and shake it up and mix it together the benzoic acid will essentially react with aqueous bicarbonate sodium bicarbonate to form sodium benzoate which is water soluble because it is a sodium salt
So you will start extracting the benzoic acid from the benzene solution into the aqueous

layer solution and then allow you to settle the echoes layer will separate in the lower layer
So it will contain the sodium benzoate the upper layer will have benzene for example and if you just drain off the lower layer by separating the layer corresponding to the lower portion of the two layers you will get in the beaker the lower layer containing sodium benzoate now if you add hydrochloric acid benzoic acid will come out of the aqueous phase
So this when you add hydrochloric acid after separation of the two layers it will regenerate benzoic acid sodium chloride of course water soluble
So the upper layer will be in the flask itself in the separating funnel itself that will contain benzene the lower layer which is the aqueous layer contains the sodium salt of benzoic acid which on acidification gives you benzoic acid if you have a mixture of aniline and benzoic acid the same methodology can be used aniline is basic benzoic acid is acidic
So you can either extract it with the hydrochloric acid to selectively remove aniline or you can extract it with benz sodium bicarbonate to selectively extract the benzoic acid out
So selective extraction is the methodology that is used for this type of separation the last but the most important technique is chromatography chromatography essentially operates on a principle of having two phases one is a solid stationary phase the other one is a mobile phase we are talking about column chromatography for the separation of mixture of organic compounds now if a methodology cannot be adopted based on sublimation crystallization distillation or extraction the final point is that you can separate them using chromatography this is there are two types column chromatography and paper chromatography and thin layer chromatography let us say for example we do an organic reaction we end up with a mixture of compounds and that is not easily separable by any one of this methodology what is normally done is in a long burette kind of a apparatus which is known as the column this is plugged with some kind of a cotton or glass wool here to close the not permanently close it but make it permeable only to the liquid but not to the solids and fill it up with silica gel or alumina silica gel is sio2 alumina is al2o3 these are most commonly used stationary phase material in a other words these are immobile phase that you have here then a solution of the organic compound which is the mixture of organic compounds is applied to the top of the silica gel
So this now essentially contains a mixture of organic compounds let us say the mixture of organic compounds are mixture of dyes
So that you have a red colored dye mixed with for example a blue colored dye in this particular instance now a suitable solvent is chosen and it is these compounds are eluted through the column using this now there is a chemical absorption of the organic molecule onto the silica silica surface is full of hydroxy functional group similarly alumina surface is also full of hydroxy functional group
So there is a hydrogen bonding interaction and weak interaction between the organic compound and this solid phase or the stationary phase and when the solvent passes through these compounds are eluted because these compounds have certain solubility in the
So you are essentially partitioning the organic compound between the mobile phase which is the liquid phase that is passing through and the solid phase in the absence of any mobile phase this will be permanently adhered to the solid surface now you are partitioning because of the solubility of the organic compound in the mobile phase you are partitioning it through the mobile phase
So over a period of time the two molecules may have different polarity to start with and the one that is more polar is going to strongly stick to the silica gel the other one that is going to be less polar is going to be eluted faster
So let us assume the red compound is the one that is less polar in nature
So that is going to be eluted first in the form of a band like this and the blue compound which is more polar is going to be eluted slower
So you are going to see two bands corresponding to the red compound and the blue compound separating like this
So if you elude it with more and more solvent the first compound that is going to come out is the red compound followed by the second compound
So if you have a mixture of n number of compounds you can still separate it by means of a column chromatography the basic principle is essentially same in the paper chromatography except paper cellulose is used as a solid stationary phase
So you have a beaker and in the beaker you suspend a piece of paper and you spot the

organic compound mixture on the bottom of the paper and then fill this with a little bit of solvent that to be eluted and the solvent essentially goes up because of the capillary action on the paper and that is a mobile phase and when it moves for example it eludes the organic compound
So if you have a mixture of let us say a blue spot and a red spot spotted together let us assume that the blues part is a less polar spot that will move faster and the reds part is a more polar spot that will elude slower in this particular case
So as a result of that the two spots can be seen very clearly by means of as paper chromatography
So when you are doing an organic reaction if you want to follow the organic reaction this is for bulk separation one can do gram quantities of separation of organic compounds using column chromatography it only depends on what size of the buret you take or what size of the tube you take the diameter of the tube that you take you can pack as much of silica gel as possible and load the compound and elude the compound to separate them properly in this manner now on a glass plate or on a aluminum sheet if a thin layer of silica gel or alumina is coated then it would constitute the thin layer chromatography
So thin layer chromatography essentially you have a strip of paper sorry not paper a strip of glass or an aluminium sheet on which a millimeter thickness of the silica or alumina is coated and this is kept inside a jar and let us say it is close the bottom of the jar like this and a small amount of solvent is taken the solvent essentially moves upwards because of the capillary action again and if the compounds are spotted here essentially you can move the solvent all the way up to here let us say for example
So this is a solvent front and this is the origin where the compound is spotted and during the elusion the molecule let us say moves up to this point here
So this distance here is let us say l and this solvent distance is about m in other words the solvent has moved up to m millimeters whereas the compound has moved only up to l millimeter the retention factor is defined as the length to which the compound has moved divided by the length to which the solvent has moved for example this would correspond to the thin layer chromatography basic principle is essentially same you have a differential absorption of the compound onto the solid surface which is a thin layer of silica or alumina on an aluminium plate or a glass plate and the solvent is eluted from the bottom up in this particular case compared to top down in the column chromatography the solvent is poured from the top and the collector in the bottom in the column chromatography whereas solvent is taken in the bottom and it is eluted to give the chromatographic pattern of organic compounds and the retention factor is essentially a parameter which identifies for a given solvent system how much is the distance that is travelled by the compound in comparison to the distance travelled by the solvent itself up to the solvent front
So these are some methodologies by which compounds can be purified in organic chemistry now let us move on to determination of elemental composition of organic compounds using simple methodology let us say for example organic compounds generally contain carbon and hydrogen
So one does not want to test for carbon and hydrogen one can indeed test for carbon and hydrogen in an organic compound but it is not necessary because when you say organic compound invariably it will have carbon and hydrogen in its composition however if you take an organic compound containing carbon and hydrogen if you mix it with cupric oxide in the presence of oxygen and heat it strongly it will form carbon dioxide and water in other words you completely oxidize the organic compound at a high temperature the corresponding oxidized product the hydrogen present in the organic compound becomes water during oxidation and the carbon present in the organic compound becomes carbon dioxide this can be tested with lime water and this can be tested with calcium chloride anhydrous anhydrous collagen chloride absorbs water
So the weight of the calcium chloride will essentially increase during the process what if the organic compound also has other elements namely nitrogen sulphur phosphorus and halogen let us take for example a compound has both carbon hydrogen and the nitrogen how do we identify the presence of nitrogen is the test what is known as lessons test this is also known as sodium fusion test let us take a compound like this this has nitrogen there are two nitrogens present in this compound let us say carbon hydrogen is there nitrogen is also there but then the nitrogen is in the form of an organic nitrogen in this particular compound it is not an ionic substance it is a neutrals nitrogen is what is being present in this particular system

So when an organic compound containing nitrogen is strongly heated with sodium it turns the nitrogenous content into cyanide because of the presence of carbon and nitrogen
So sodium cyanide is what is produced during the course of this in other words the sodium fusion test essentially allows you to convert the nitrogen content of the organic compound into an inorganic nitrogen compound namely the sodium cyanide sodium cyanide can be easily tested by
So with the excess of sodium you heat it to high temperature and diffuse it in other words you melt the sodium in a small tube along with the organic compound to high temperature and suddenly plunge the tube test tube into water
So that you form sodium hydroxide and sodium cyanide in the process now this is called the sodium fusion extract sodium fusion extract is always alkaline because of the excess of self sodium that is being taken which will react with water
So first it is fused with sodium secondly water is added or it is added to water the sodium fusion tube is plunged into water and the tube red hot tube essentially breaks and the excess sodium reacts with water to go to sodium hydroxide and the organic nitrogen content becomes turns into sodium cyanide
So now what is done is ferrous sulphate is added and boiled under alkaline condition if you boil ferrous sulphate with sodium cyanide it will form ferrocyanide as the species now the boiling ferrous sulphate also under aerial condition gets oxidized to ferric sulphate
So a small amount of ferric hydroxide will also be formed
So the ferrous and the ferric they combine together forming a ferric ferro cyanide is being formed and this is deep blue in color it is called the prussian blue
So after the sodium fusion extract is over it is boiled with ferrous sulphate and then it is acidified with dilute sulfuric acid dilute sulfuric acid is necessary to get rid of the sodium hydroxide in this particular extraction process
So the sodium fusion extract is first boiled with sodium sulfurous sulfate and neutralized the excess sodium hydroxide with the dilute sulfuric acid upon neutralization one produces a deep blue color or what is known as the prussian blue colour which is an indication the presence of the prussian blue colour is an indication of the
So the overall reaction is carbon and nitrogen in the presence of sodium forms sodium cyanide sodium cyanide with ferrous sulphate essentially produces ferrocyanide you can balance these equations yourself ferrous sulphate gets oxidized to ferric sulphate the ferric sulphate that is formed reacts with ferrocyanide forming the ferric ferrocyanide as the final product and this is blue in color all the equations needs to be balanced which you can do it yourself
So the prussian blue color is the appearance of the pressing blue color is indication of the presence of nitrogen in an organic compound the basic principle is simple the you know organic nitrogen is converted into inorganic cyanide and the cyanide is essentially tested by the iron complex which is shown there suppose sulphur is also present in the organic compound in the sodium fusion extraction it will not give cyanide it will give sodium thiocyanate the thodium thiocyanate on reaction with ferric sulphate produces a blood red color of this particular species hexathosinodo ferrite is what is being formed and this has blood red colour the presence of a blood red colour in the lesson stress is an indication that you not only have nitrogen but also sulfur that is present in the system suppose if only sulphur is present in the system then the carbon sulfur using sodium fusion test will produce sodium sulphide
So organic sulfur compound is converted into inorganic system a good example sulfur compound will be let us say this three sulfur containing compound when it is heated with sodium sulphide sodium metal when it is fused with sodium metal it produces a sodium sulphide as the inorganic sulfur containing compound the inorganic sulfur containing compound can be tested by means of sodium nitro procedure sodium nitro procide is essentially n a two f e c n five n o
So this is sodium nitro proside when it reacts with the sodium sulphide it essentially produces na2 fpcn5 nso nos and this is supposed to be purple or violet in color
So the sodium nitroproside test gives a very violet color in the presence of indicating the presence of sulphide sodium sulphide can also be tested by lead acetate in other words the sodium fusion extract is taken and it is neutralized with acetic acid and then lead acetate is added if you add lead acidity directly let the hydroxide will precipitate
So it should not happen this is neutralized with acetic acid to generate the sodium sulphide and sodium acetate then if lead acetate is added the black precipitate of let

sulphide is an indication of the presence of sulfur in the organic compound
So we have seen the detection of nitrogen we have seen the detection of both nitrogen and sulfur being present together and we have seen the detection of sulphur itself in the organic compound now what is left is halogen now in the sodium fusion extract in the sodium fusion test if halogen like chlorine bromine iodine are also present in the organic compound let us say bromobenzene or chlorobenzene is the compound that we are dealing with
So let us call this as x x is equal to bromine chlorine or iodine as the case may be during the course of the sodium fusion extract it will form sodium halide
So one has to test now for halogen the simplest test one can do is this is of course in the process of sodium hydroxide because of the excess sodium that is present in the sodium fusion extract
So neutralize it with dilute nitric acid
So that all the sodium hydroxide is converted into sodium nitrite and then add silver nitrate this is important to neutralize with nitric acid otherwise if you add silver nitrate directly to the sodium fusion extract silver hydroxide and silver oxide will precipitate itself
So that would be problematic situation in this
So the silver halide precipitate is obtained if we get a white precipitate that is soluble in ammonia then it is called the silver chloride test x is equal to chlorine x is equal to bromine you get a pale yellow precipitate partially soluble ammonia finally x is equal to iodine dark yellow precipitate which is insoluble in ammonia this is an indication
So if it is a chloride that is present you get a white precipitate which is soluble in ammonia if it is bromide you get a yellow precipitate of silver bromide which is partially soluble in ammonia if it is an iodide you get a dark yellow precipitate of silver iodide which is completely insoluble in ammonia for example
So one can determine the presence of any halogen that is present in the organic compound by means of a sodium fusion test only thing one needs to remember is before adding silver nitrate to a sodium fusion extract one needs to neutralize it with nitric acid
So that the sodium hydroxide excess does not react with the silver nitrate and it is completely neutralized to sodium nitrate in the process of treating with dilute nitric acid phosphorus is not a very common element in organic compounds but it can be present in organic compound phosphorous is essentially tested by the sodium fusion extract if phosphorus is present in the form of an organic phosphine let us say for example this is a organic phosphorus compound several pesticides and insecticides have organic phosphorus compound this is triphenylphosphine this is triethyl phosphate for example these are all examples of organophosphorous compounds if phosphorus is present in the system this is first treated with sodium peroxide
So that one produces sodium phosphate which is an inorganic phosphate the phosphorus is completely oxidized in its organic state to the ionizable phosphate state and sodium phosphate can be detected by means of ammonium molybdate this is treated with nitric acid to produce phosphoric acid and the phosphoric acid is what is detected by means of a this is ammonium molybdate ammonium olive blade gives a nice yellow precipitate of ammonium phosphor molybdate ammonium phosphor molybdenum has the molecular formula which is this twelve m o o o three its a fairly complex molecule important point is that it gives a yellow coloration or yellow precipitate when ammonium molybdate is added to phosphoric acid solution ammonium phosphor molybdate is what is formed which is responsible for the yellow color that we see in this kind of a situation now having found out a methodology for the detection of carbon hydrogen nitrogen sulfur halogen phosphorus and
So on in organic compound one can have an idea of what class of an organic compound it is whether it is a nitrogenous compound whether it is a sulfur compound whether it is a halogenated compound or a phosphorous containing compound but then more important thing is to estimate the amount of this elements that are present in an organic compound for example this is extremely important this is carried out by what is known as elemental analysis elemental analysis of organic compounds let us say for example the lemonade which is present in lemon as well as in orange is isolated by steam distillation and we have a very pure lemon in we want to find out what is its elemental composition the elemental composition of limonene is c 10 h 16
So we do not know to start with what is the elemental composition of limonene but from the sodium fusion test we know that nitrogen is absent sulfur is absent halogen is absent

as well as phosphorus is absent oxygen is generally not detected by means of elemental test because the total percentage of other elements minus 100 essentially gives the percentage of oxygen if at all oxygen is present in the compound let us say for example this is the elemental composition of limonene which we do not know we need to find out what is x and what is y what is done is the organic compound is treated with copper oxide in the presence of dry oxygen in the process you essentially catalytically convert all of the carbon into carbon dioxide all of the hydrogen into water in the process of decomposition or the process of elemental composition determination is absorbed onto anhydrous calcium chloride
So you take a certain weight of calcium chloride after the all the water that is produced is passed through the calcium chloride tube you weigh it again it will tell you the difference will tell you the weight difference will tell you the amount of water that is being generated in this particular case this is passed through the solution of sodium hydroxide
So that the carbon dioxide essentially reacts with sodium hydroxide to produce sodium carbonate which is estimated
So one can estimate the amount of carbon dioxide that is produced as well as the amount of water that is produced in this let us say for example x grams of co2 is produced and y grams of water is produced from m grams of the substance initial weight of the substance taken is m grams let us say now we know that carbon dioxide molecular weight is 44 and it has one carbon
So it corresponds to 12.
So 44 grams of carbon dioxide if it is formed it corresponds to 12 grams of carbon if x grams of carbon dioxide is formed in the reaction then it would correspond to this much amount of the carbon that is present in the system this amount of carbon is present in the m grams of the starting material
So from how many if you want to calculate the percentage of carbon in the organic compound one has to use this formula its very simple carbon dioxide has one carbon which is 44 molecular weight out of which 12 is corresponding to the carbon and 32 corresponds to the oxygen we are not concerned about oxygen at this point of time it is a carbon amount that we need to find out if you want to find out out of 44 grams of carb carbon dioxide 12 grams corresponds to the carbon
So if x grams of carbon dioxide is formed how much will would have been the carbon amount in the carbon dioxide that is produced that is produced from m grams of the starting material initial amount of the substance that is taken
So in m grams of the starting material this much amount of carbon is present
So hundred grams of carbon 100 grams of the material how much amount of the carbon is present this would correspond to the percentage content of carbon in the system similarly if you have water eighteen grams of water has two grams of
So the percentage of hydrogen in the molecule would correspond to for 18 grams you have 2 grams of water y gram is actually formed the water amount that is formed is y grams and that is formed from m grams of the initial starting material
So for hundred grams of initial starting material what would be the presence of hydrogen in the system
So this would correspond to essentially the percentage of hydrogen that is formed in this reaction let me illustrate it with one example of let us say for example we burnt butane or we catalytically convert butane into carbon dioxide and let us say 0.5 grams of s e n h m is burnt we do not know what is m and m we need to find out the but we know it is hydrocarbon molecule if it gives for example one point five one seven grams of c o two and 0.77 6 grams of water is produced in the process now what will be the percentage of the carbon and hydrogen is the question that we are asking the percentage of carbon will be out of 44 grams it is 12 grams carbon
So out of 1.517 grams how much is the carbon that we produce in this system this is for coming from point five grams of the substance
So from hundred grams of the substance how much is going to be formed if you work out this detail this would correspond to eighty two point seven six percent of carbon hydrogen you can simply subtract it from hundred but one can calculate the hydrogen also because the water content is known percentage of hydrogen out of eighteen two grams of hydrogen is there from the molecular formula this is present in point seven seven six how much is present in hydrogen is present in the system this is coming from 0.5 grams
So out of 100 grams how much is the this corresponds to 17.24 percent

So the carbon content is eighty two percent the hydrogen content is equal to seventeen point two four percent now we need to find out what is m and n the ratio of the carbon to hydrogen is what we need to find out
So if one divides this by twelve this would correspond to six point eight nine in terms of the number of carbons that is present we divide this by one that is the molecular weight of atomic weight of hydrogen and atomic weight of carbon if you decide divide it from the percentage you can calculate what would be the ratio of these two
So the carbon hydrogen ratio is what is needed in this particular case 6.89 is to 17.24 is the ratio of carbon and hydrogen that is present here
So if you normalize it by dividing it by six point eight nine this would correspond to one is to two point five you cannot have a fractional stoichiometry
So you multiply this by four this would correspond to four is to ten
So the m is n is equal to four m is equal to ten
So the compound corresponds to c4 h10
So this is an illustrative example of how elemental composition or if the molecular weight is known for example from the molecular weight you can calculate what would be the this is the empirical formula that you have if the molecular weight is four times the empirical weight then it also corresponds to four is to ten corresponding to butane as the
So the elemental composition from the combustion experiment by calculating the carbon and hydrogen amount is given here we will stop it at this stage will continue in the next session about estimation of nitrogen and other elements in organic compound hope this illustration was useful to you
So in this module essentially we looked at the types of purification methods sublimation crystallization distillation extraction and chromatography and then this detection of elements that are present in the organic compound using the sodium fusion test and a few other tests that are discussed here thank you very much for your attention you