Electronic Waste Management - Issues and Challenges
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Lecture - 22
Tutorial – 2
Health Risk Assessment

Welcome back. So, this is the continuation of tutorial one. So, we have already discussed in the tutorial one about e waste quantification and its economic assessment, now we will discuss about the health risk assessment. So, what is the health risk assessment? Why there is a health risk in the in the management of the e waste.

So, in India if will see about 80 to 95 percent, 80 to 90 percent e waste goes in to the informal sector, they use burning, they use acid leaching, which is very unscientific and as a result people unknowingly consume major amount of hazardous metals or any hazardous waste through 3 different types of, 2 different modes of consumption, like one is while you are calculating health risk you should keep in mind that there are 3 different modes of consumption.

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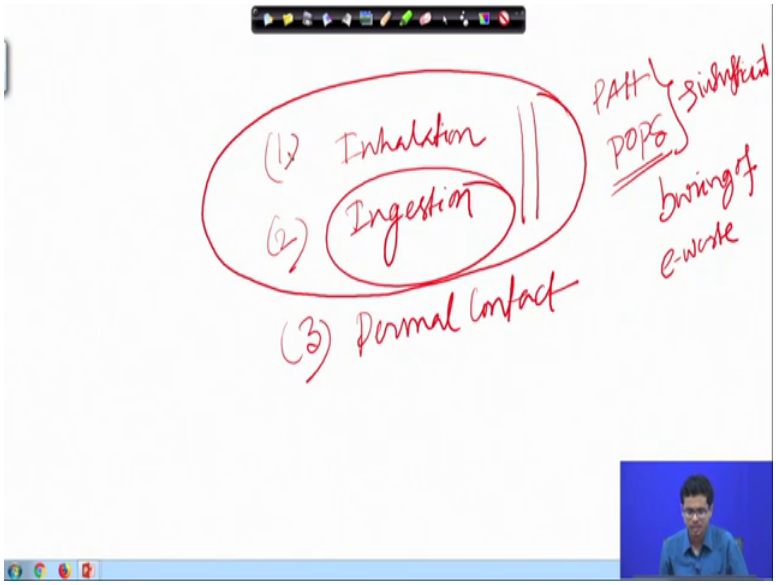

One is you can consume pollutant or heavy metals or any other polyaromatic hydro carbon or poly persistent organic pollutant which is generated due to insufficient burning of e waste, insufficient burning of e waste through inhalation ok.

So, you through inhalation everyday we can consume or actual through inhalation we are consuming lot of pollutant. Second is ingestion, what is ingestion? Through overall intake we are taking drinking water we are taking food. So, through ingestion, through food, through water we are consuming also pollutant, third is dermal contact through our dermal contact we are also getting the effect of pollutant basically principle mode is inhalation ingestion. Most of the disease in India happens because of this two mode inhalation and ingestion.

So, now will come to the our topic, so for.

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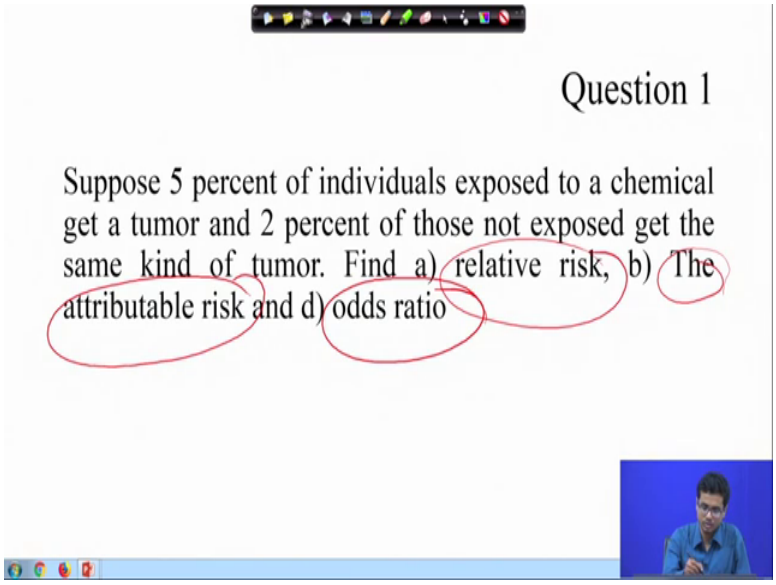

So, first problem say for example, this is a typical problem suppose 5 percent of individuals exposed to a chemical get a tumour and 2 percent of those not exposed get the same kind of tumour sometimes it happens that you even we will not you are not exposed to certain kind of pollutant, but accidentally you got the tumour. So, what is the relative risk, you have to determine what is the relative risk? what is the relative risk. So, what is the relative risk, what is the attributable risk and what is the odds ratio? So, how to calculate this one, this is the very simple problem.

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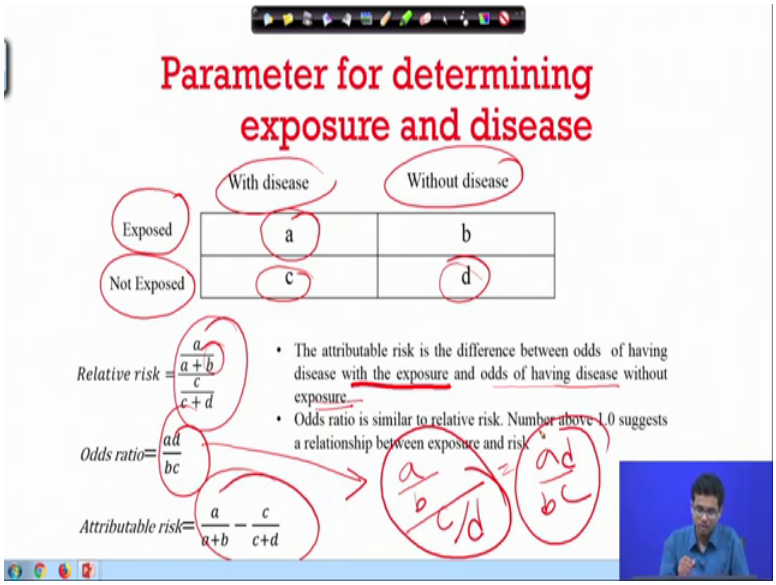

So, these are the parameters for determining at relative risk odd ratio and relative risk odd ratio is attributable risk. As already we have discussed in the video lecture this attributable risk is the difference between odds of having disease with exposure and odds of having disease without exposure. This is not odds of having disease with exposure like a by a plus b minus odds of having disease without exposure c by c plus D relative risk is the a.

So, people exposed with disease divided by total number of the population, those who are exposed with disease plus without disease divided by c people not exposed, but get the disease divided by total number of the population those who are not exposed with disease and without disease c and D and odds ratio similar kind is similar the relative risk see if will rearrange this formula. So, a by b divided by c plus d, it will come a D by b c. So, it is nothing, but a relative risk this similar kind of a by b means with disease compare to without disease and c means people not exposed, but get the disease c by d. So, it is a D by b c. So, these why you have to formulate 2 by 2 matrix and then you have to calculate the relative risk odds ratio and attributable risk.

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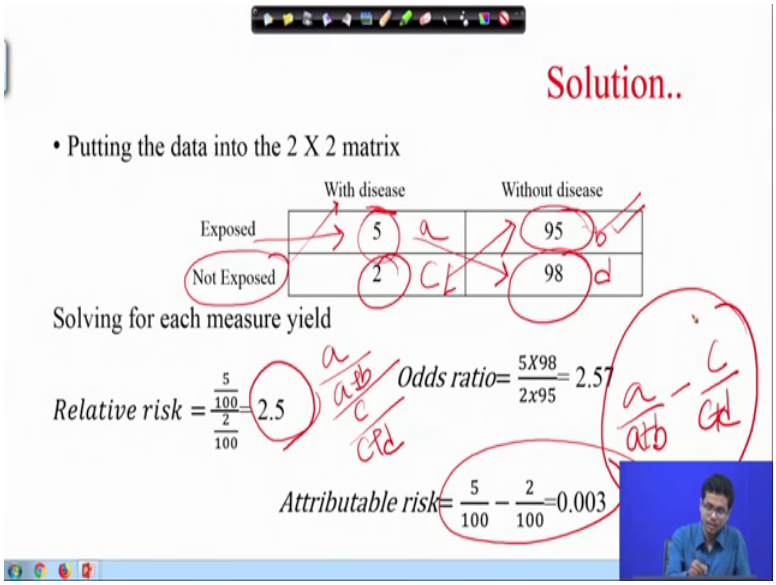

So, 5 percent people exposed get the tumour. So, remaining 90 we were assuming 100 percent. So, remaining we were assuming population has 100 percent. So, remaining 95 percent without disease, similarly people not exposed, but get the tumour is 2 percent. So, remaining is 98 percent. So, this is you're a, this is your b, this is your c, this is your d. So, you prepared a 2 by 2 matrix nicely and you mark all the notation along with the values. So, what is the relative risk what I told you already a, what is the relative risk a by a plus b divided by c by c plus d, a by a plus b divided by c by c plus d. So, you got 2.5 this is the high relative risk what is the odd ratio a into D divided by b into c ok.

Now, what is the attributable risk a by difference of odds having diseases minus not having diseases, c by c plus D these way this is the very simple calculation you can calculate the relative risk odds ratio and attributable risk, next we are going to a another kind of problem.

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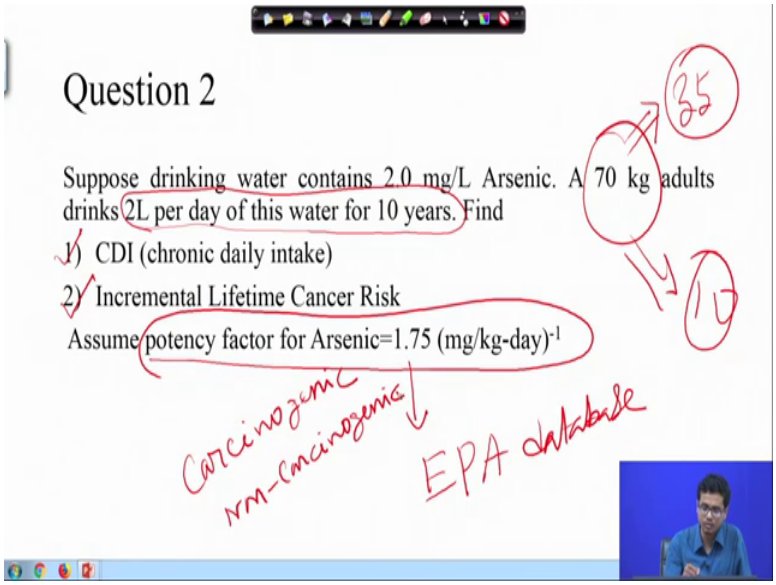

So, in the question two suppose drinking water contains two milligram per litre of arsenic we are consuming drinking water if will see go to the in west Bengal area if will go to the Nadia district Murshidabad district there are lot of problem in the arsenic, they are facing lot of health problems due to arsenic content in the water. So, suppose drinking water contains 2 milligram per litre arsenic a 70 kg adults we have assumed the weight of the adults is 70 k g it can vary also, for me say for your case it could be 35 for child it could be 10, sorry drinks 2 litre per day of this water for 10 years.

So, how much time how many years they are consumed, for 10 years they are consumed 2 litre per day what is the chronic daily intake you have to determine and what is the incremental lifetime cancer risk and assume potency factor for arsenic is this one this data we collected through EPA database environmental protection agency database. They have made certain database for carcinogenic as well as non carcinogenic substance, carcinogenic as well as non carcinogenic substance.

Now, one thing you should know before start starting of the solution.

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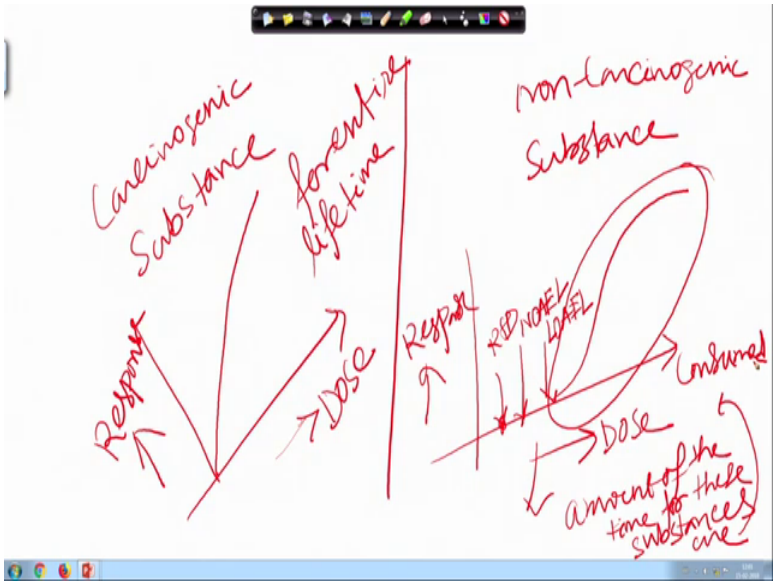

What is carcinogenic substance, what is non carcinogenic substance? What is the difference between these 2, what is the difference? For carcinogenic substance if will go through the dose response curve sorry, dose response curve you will see it will start from the origin. Why? For carcinogenic substances it is assumed that once you consume this material or metal or any kind this pollutant your reaction starts, reaction start means there is no threshold value for carcinogenic. So, it will start from the origin; that means, we are assuming once you consume this carcinogenic substance your cancer is going to be happen in you, in your body.

So, cancer is going to be a whereas, for non carcinogenic substance if we draw dose response curve it will be like this, means there are will be a reference dose, there will be NOAEL, no observe adverse effect level then LOAEL observe adversing this things are already discussed during the video lecture. So, I am not discussing again. So, basically there is a threshold value for non carcinogenic substance; that means, when you are consuming carcinogenic substance and if you want to determine the health risk you have to do the averaging for entire life time, for entire life time. So, if someone lives for 70 years we have to do the averaging over the 70 years, but whereas, non carcinogenic substance what will be the, what will be the averaging time, it is the amount of the time someone consume this non carcinogenic substance, amount of the time or amount of the time for this substance substances are consumed, substances are consumed.

So, it will be averaged over the conjunction time not the entire life time. So, now, we will start the problem. So, you have to determine the chronic daily intake and incremental lifetime cancer risk is the.

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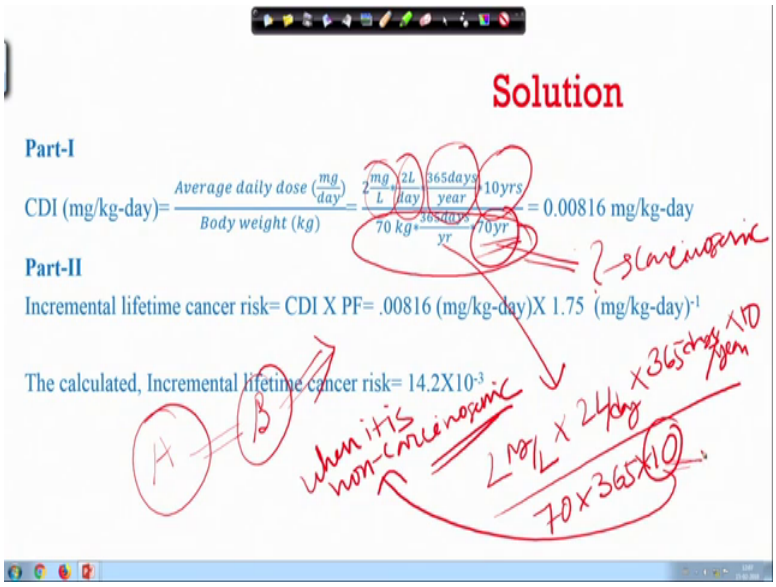

So, as we have already knows these are the formula I want to show you.

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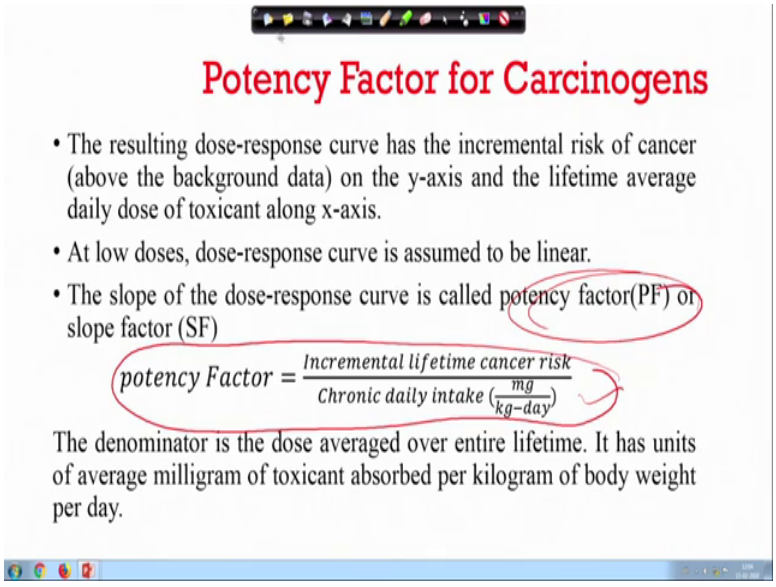

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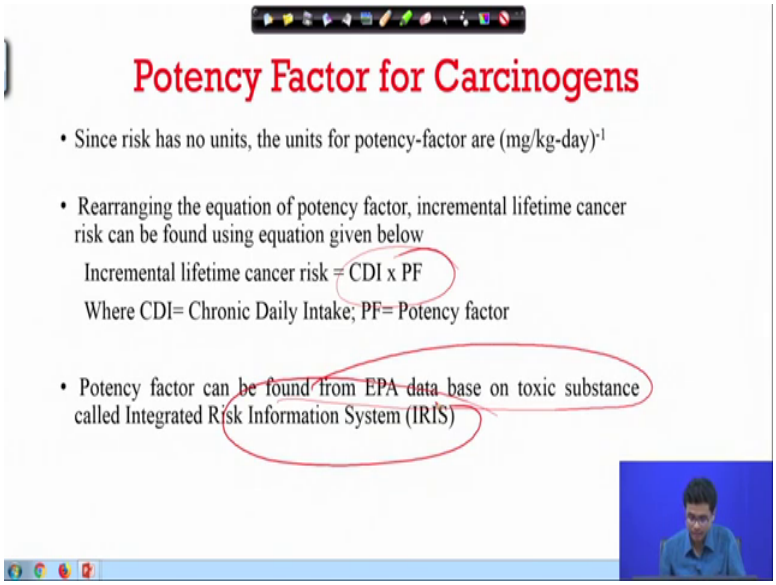

First chronic daily incremental lifetime cancer risk the first just I have a brief revision of your course like what is the potency factor, it is the resulting dose response curve the resulting dose response curve has the incremental risk of cancer.

So, the resulting dose response curve has the incremental risk of cancer on the y axis and the lifetime average daily dose on the x axis. So, in the x axis there will be a dose and in the y axis there will be response.

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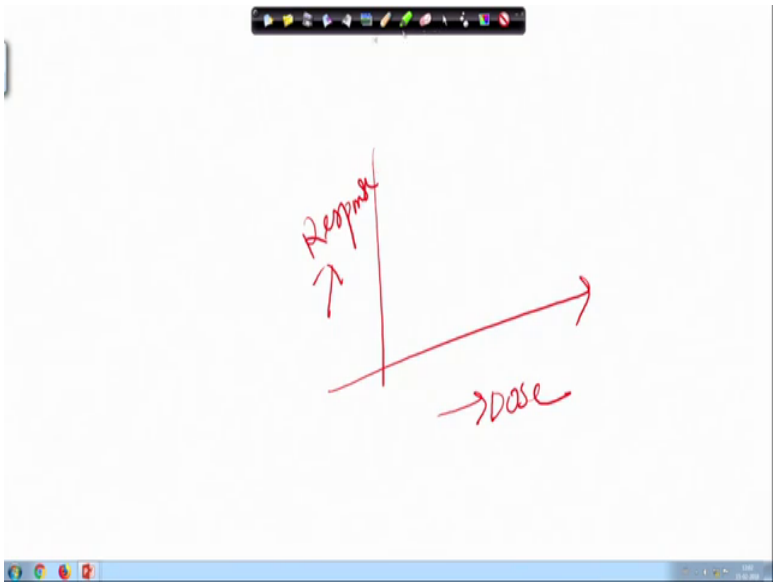

So, in the x axis there will be dose and in the y axis there will be response. So, at low doses, dose response curve assumed to be linear, at low doses dose response curve assumed to be linear. The slope of the dose response curve is called the potency factor. So, potency factor can be determine incremental lifetime cancer risk divided by chronic daily intake. So, chronic daily intake see these are the important assumption for chronic daily intake.

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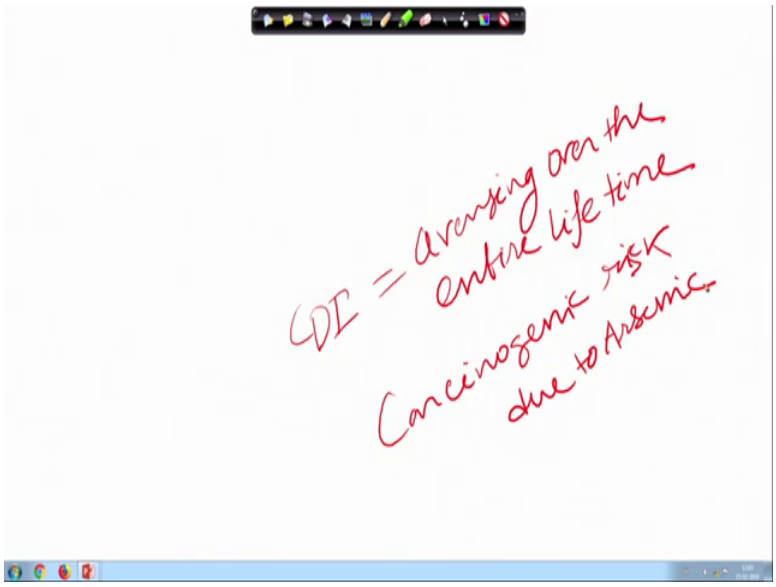

This is the averaging over the entire lifetime entire lifetime because in this case we are determining the carcinogenic or carcinogenic risk due to consumption of arsenic due to arsenic. So, slope of the doses response curve is called the potency factor and potency factor is determined due to incremental lifetime cancer risk divided by chronic daily intake.

So, if you vary this equation, it will become the increment ILCR that is incremental lifetime cancer risk equal to chronic daily intake into potency factor, we are in this equation. So, potency factor is found from the EPA data base of the toxic substance and once we did, one thing you should keep in mind that while calculating the risk for cancer or carcinogenic substance you suit average the dose over the entire lifetime. So, your average daily dose 2 milligram per litre of arsenic is present, 2 litre per day your consuming 365 days per year, 10 years you have consumed, but you have average it for your 70 years, why because this is carcinogenic. This equation becomes 2 milligram per

litre, 2 litre per day into 365 days per year into 10 years divided by 70 into 365 into 10, when it is non carcinogenic and this which is amount which substance is carcinogenic which substance is non carcinogenic that already environmental protection agency or develop some database, also we can determine based on the animal studies and human study that is shown in the lecture video lecture. If there is a sufficient human evidence, if there is sufficient animal evidence you can determine is a potentially like carcinogen.

Similarly, if there is a sufficient human evidence, if there is not much animal evidence you can determine, also be as the it is a potential B carcinogen. This way you can determine which substance is carcinogen which substance is non carcinogen, but please keep in mind that for carcinogenic substance, averaging time is entire lifetime for non carcinogenic substance this is only the exposure time. So, this way you can determine this is your this is your

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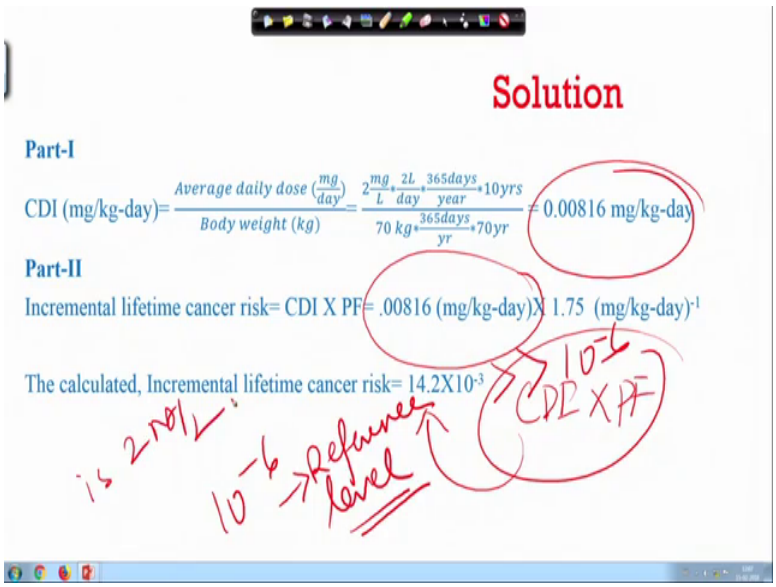

Chronic daily intake, now incremental lifetime cancer risk is simple, but chronic daily intake into potency factor. Now this is a incremental life which is quite high, 10 to the power minus 6, see 10 to the power minus 6 is the difference level. In this case there is a high chance of cancer, if the concentration of the arsenic in the water is 2 milligram per litre ok.

So, we are going to the next problem.

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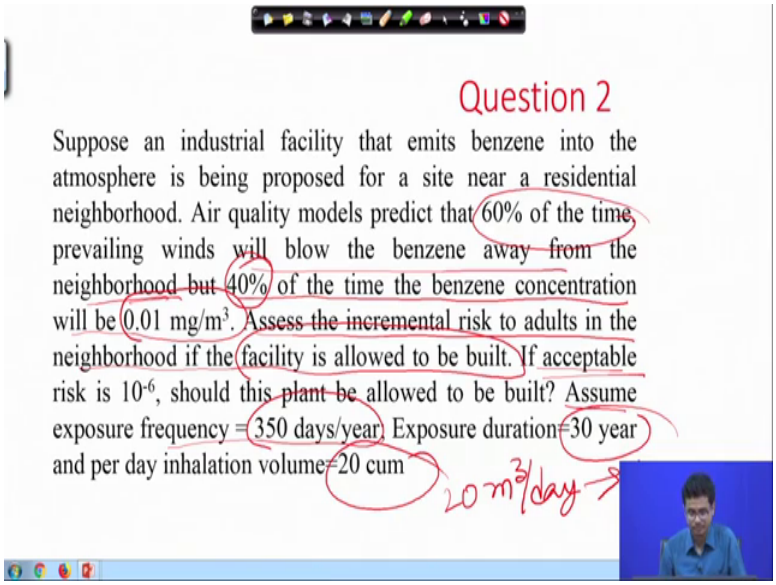

Next problem is, suppose an industrial facility that emits benzene into the atmosphere is being proposed for a site near a residential neighbourhood. Air quality model predicts, air quality model predict that 60 percent of the time prevailing wind will blow benzene away from the neighbourhood; that means, 60 percent of the time you will not be exposed, but 40 percent of the time, benzene concentration will be 0.01 milligram per metre cube; that means, for 40 percent of the time you will be exposed. So, assess the incremental risk to the adult neighbourhood if the facilities are whether the facilities allowed is allowed to be built or not.

So, in this case suppose you are an environmental engineer or you are in a important position in government in the in the government. So, you have to decide something you have to decide whether any industrial facility can be built or not based on your certain study, so based on a certain study. So, in this case what will be your decision? So, we have to do with this kind of study. So, you have to look at the whether what is the velocity of the wind, what is the direction of the wind blow, whether it is coming from the coming from the north east whether it is coming from the east west, up to what time it will blow it will blow away the pollutant, up to what time it will not blow away this pollutant. So, this why we have to determine lot of factors and ultimately you have to decide whether this facility is allowed to build or not.

Now, remaining in that assume exposure frequency 350 days per year for the problem exposure duration 30 year and per day inhalation volume 20 metre cube. So, you are assuming 20 metre cube per day we are breathing, 20 metre cube per day here we are breathing per day twenty metre cube year. So, what is a this is a similar first you have to determine the chronic daily intake. So, what is the chronic daily intake?

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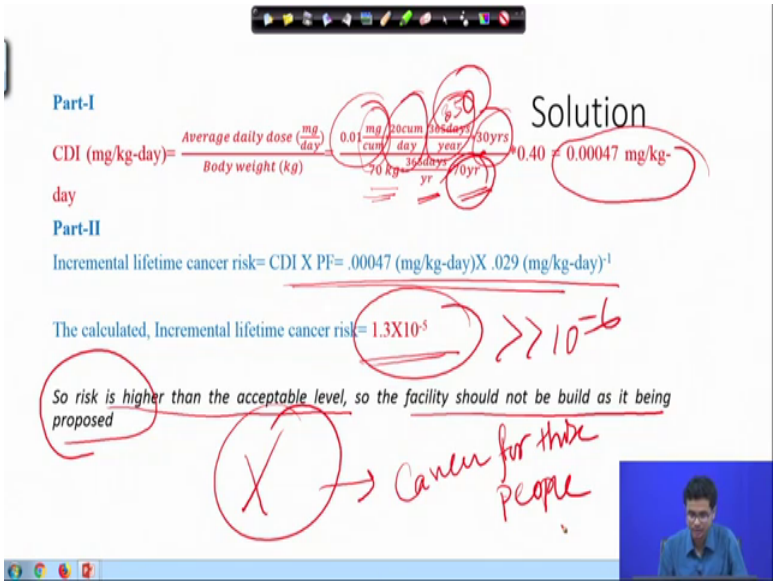

Just average daily dose divided by body weight. Again this is for same because this is a average over the entire lifetime 70 years. So, this way initially we have done it for the water factor like we have done we have seen that what example for the water.

Now, we are looking at air. So, this milligram per cube benzene is present, this much you are consuming per day, this much you are we are breathing per day 365 days per year into 30 year, sorry this will be 350, there is mistake this is 350 because exposer duration is 350. Then divided by 70 kg this is the total year and this is your entire lifetime. So, this now comes CDI comes us 0.00047, triple 047.

Similarly, you determine the can a incremental lifetime cancer risk this is 1.3 into 10 to the power minus 5 which is also greater than 10 to the power minus 6. So, what is our result? Risk is higher than the acceptable level. So, the facilities should not be build as it being proposed. So, in this case we are giving a negative indication that this facility cannot be build because this is there is the high chance of cancer for those people those who are living in the vicinity of the facility. Now will be going to the next problem.

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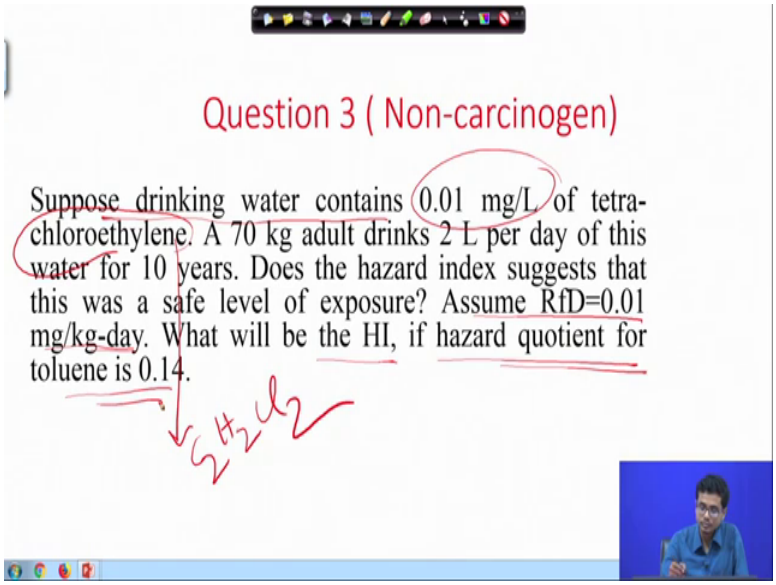

Now, we have seen the problem related to the carcinogen which causes cancer. Now, we are coming to the problem related to the non carcinogen. Non carcinogen also can cause cancer, but after a reference dose, that is why we have average it over the over its exposure over its duration of exposure. See for example, look at this problem, suppose drinking water contains 0.01 milligram of tetrachloroethylene C2 H2 CL2, a 70 kg adult drinks 2 litre per day of this water for 10 years, does the hazard index suggest that this was a safe level of exposure, assume reference dose is 0.01 milligram per kg per day and what will be the HI, if hazard quotient for toluene 0.14. So, what is the solution?

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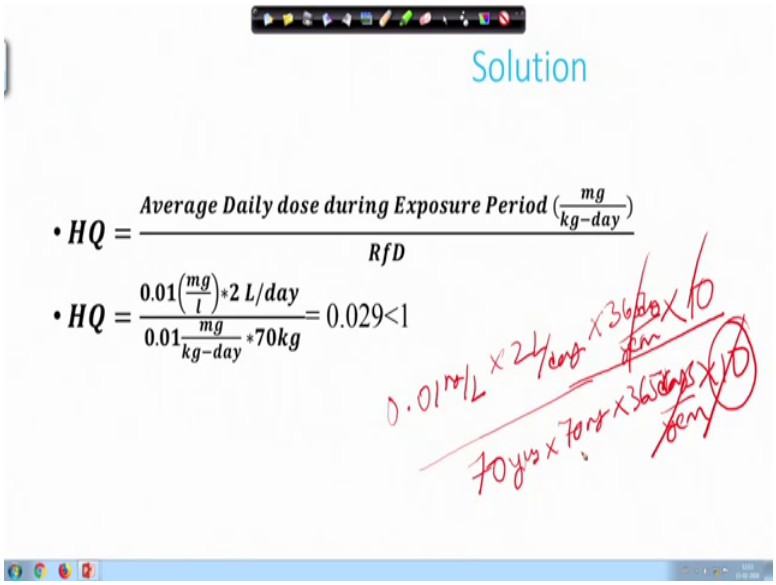

So, how to determine the hazard quotient, average daily dose during exposure period divided by R f D.

So, now in this case how to determine average daily dose, sorry how to determine average daily dose during exposure period, this is non carcinogen. So, you know that 0.01 milligram per litre you are consuming tetrachloroethylene, 2 litre per day divided by 70 into 365 per day year this per year into, in this case you have consume for 10 years 10 years.

Similarly, it will be average over your, this per year into 10 it will be average because this is non carcinogen. So, this will vanish. So, remaining if will see the equation, sorry one minute this will not be there 70 years not be there this is one. So, this way if will see the equation 0.01.

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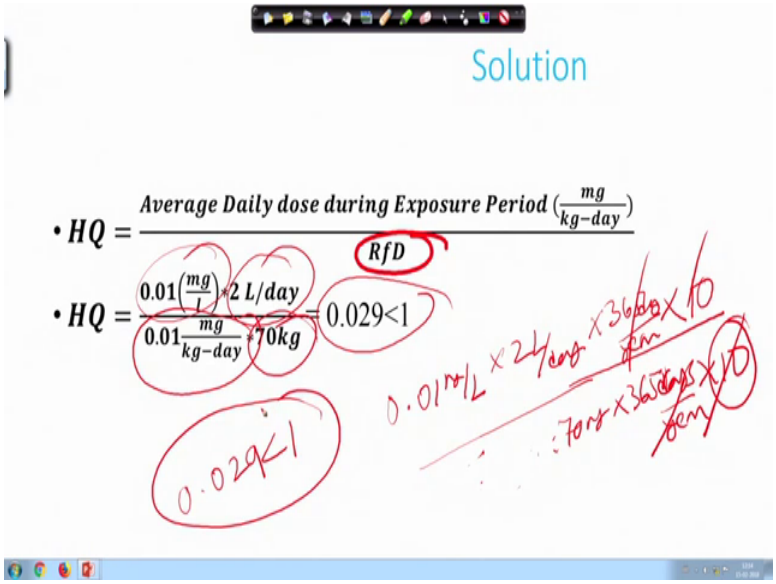

0.01 milligram per litre into 2 litre per day divided by 70 because we have average over its duration of exposure. We have not taken 70 years which is entire lifetime, now divided by R f D which is 0.01 milligram per k g per day, this why you will get hazard quotient 0.029 which is less than 1. So, does the hazard index suggest. So, what is the question, does the hazard index suggest that this was a safe level of exposure years because it is less than 1 anything hazard quo if hazard sorry hazard quotient is less than one, then it is the safe level of exposure if hazard quotient is less than 1.

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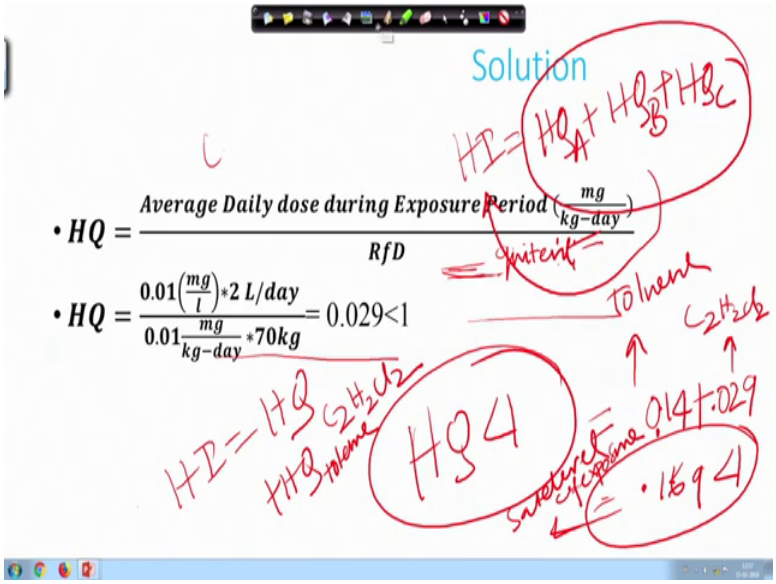

If hazard quotient is less than 1 this is the safe level of exposure.

Now, we have to determine the hazard index, now we determine the assume R f D equal to what will be the hazard index. So, there is a mistake this will be the hazard quotient does the hazard quotient suggest once again place, qui does the hazard quotient suggest that this was the safe level of exposure, yes. Now, assume what will be the hazard index if hazard quotient for toluene is 0.14 hazard index is nothing, but hazard quotient for say for tetrachloroethylene plus hazard quotient for toluene. So, what will be the hazard index it is 0.14 for toluene plus 0.029 plus 0.029 for tetrachloroethylene, this is for c 2 h 2 c l 2 this is for toluene what will be the value 0.169 this is also less than 1. So, it also indicates safe level of exposure. So, in this module what we have, what we have discussed, we have discussed how to determine the carcinogenic risk due to a particular pollutant, ok.

So, how it will be in for the carcinogenic risk it will be average over the entire lifetime, then how to determine the risk for a non carcinogenic substance it will be average only during the time of exposure and what is the hazard quotient average daily dose during exposure period divided by difference dose and what is the hazard index hazard, quotient for different chemical. Say for you have you have to determine the hazard index, you can you know the hazard quotient for chemical A, you know the hazard quotient for chemical B, you know the hazard quotient for chemical C in this way you can add and you can

determine the hazard index. Mostly this kind of problem will be given in the exam will give you to find out what is the incremental lifetime cancer risk it will give you the another other data also. So, you have to find out accordingly based on your conception please keep in mind that while calculating for carcinogenic substance you should average your dose over the entire lifetime.

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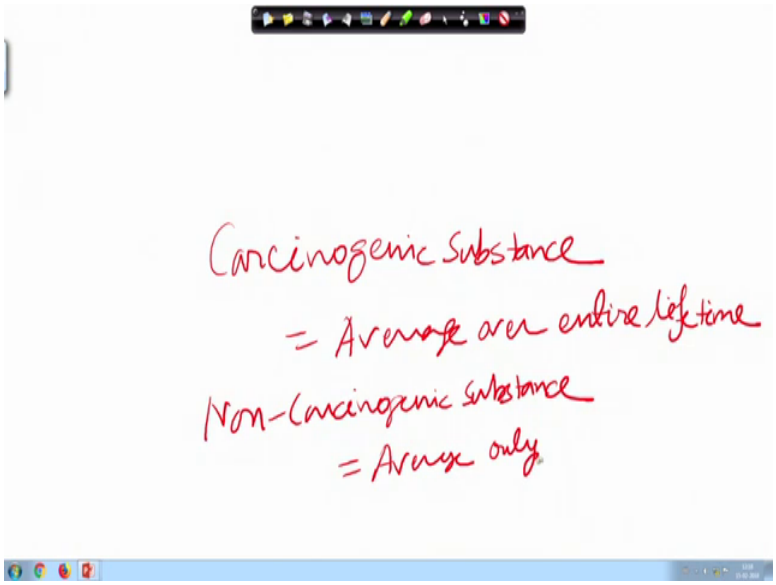

Once again I am giving you, one thing for carcinogenic substance average over entire lifetime for non carcinogenic substance average only or sorry, consider only the time of exposure.

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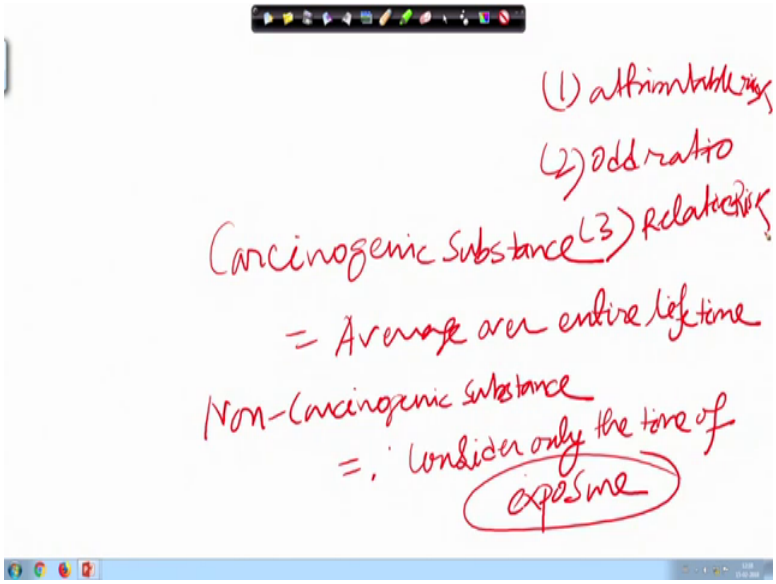

So, these are the 2 major things and another is determination of attributable risk, attributable risk odd ratio and relative risk this is also important.

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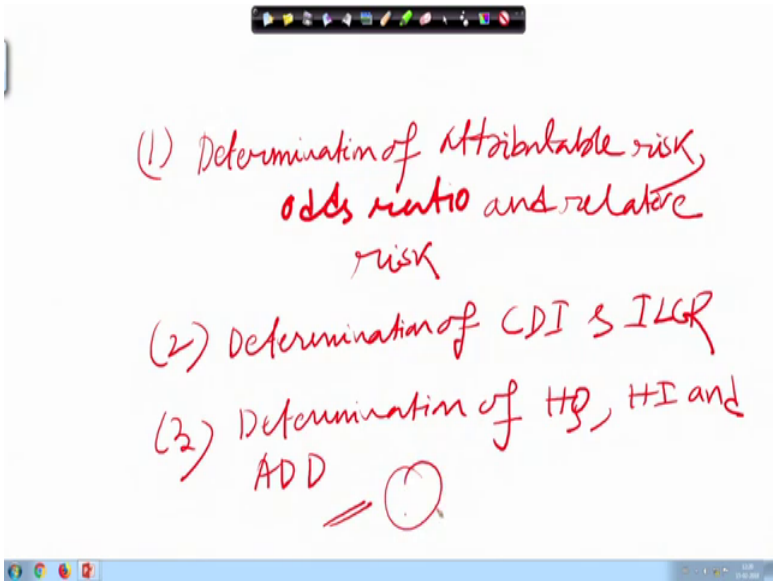

So, major important things for the exam first is determination of attributable risk odd ratio and relative risk, next is determination of CDI chronic daily intake and ILCR incremental lifetime cancer risk third determination of hazard quotient, hazard index and average daily dose. Hope this discussion will able to clear your doubts any problem if

you will face please reply in the forum will give your will give your will give our answer to in the forum.

Thank you very much for watching this tutorial.