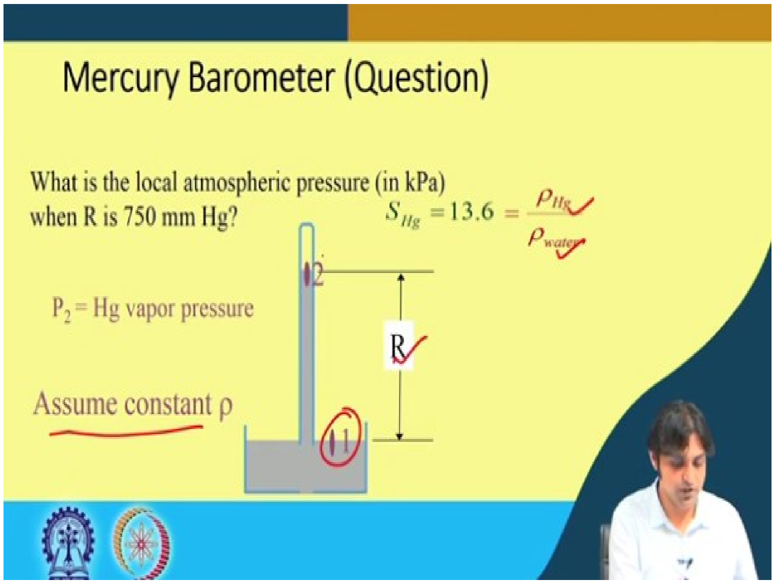
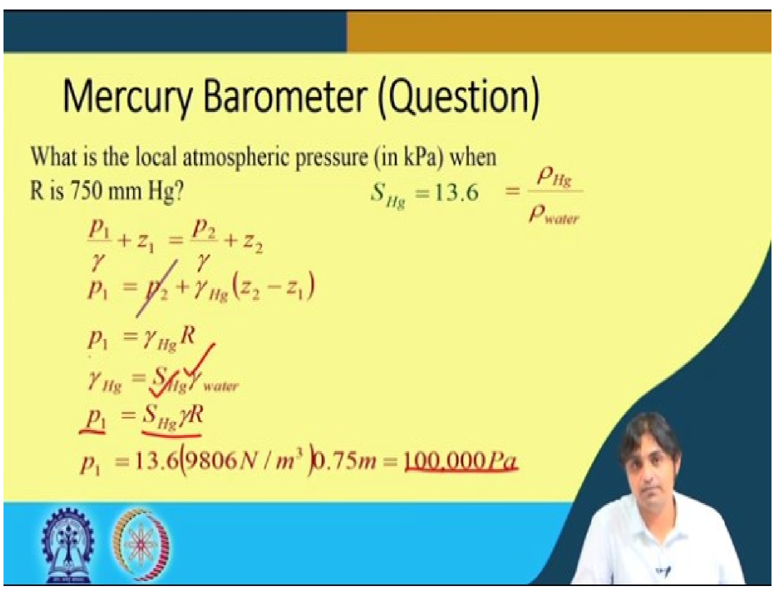


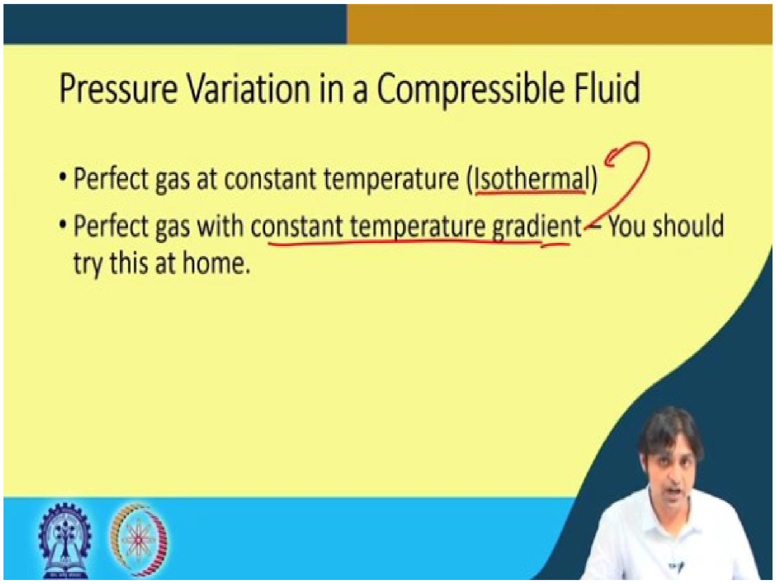
So, this is the barometer . This is the principle of working of barometers. Now, a simple question is, what is the local atmospheric pressure when R is 750 millimeters of Hg. This is R we are just going to see we have given the $\frac{\rho_{Hg}}{\rho_W}$=13.6 then we have assumed incompressible fluid constant ρ, we are going to see how it works. So, this is point 1 here and this is point 2 here.

(Refer Slide Time: 26:11)



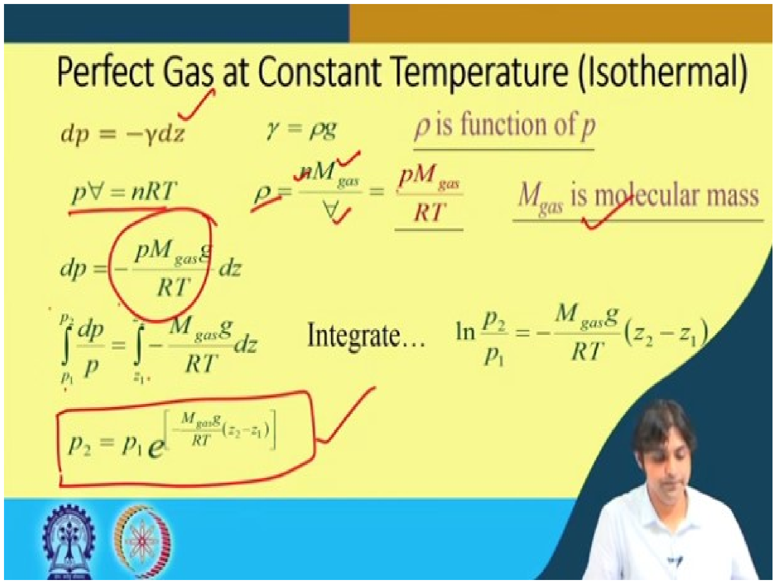
So, we have seen this equation piezometric head is constant. So, we can also write let me erase this one. P1 is $P_1 = P_2 + \gamma_{Hg}(Z_2 - Z_1)$. We are putting this piezometric head equation between point 1 and point 2 and we want to calculate the pressure at p1. p 2 atmospheric pressure so, atmospheric pressure we assume gauge pressure that can be assumed 0 that you have read in fluid mechanics. So, pressure at point one will be $\gamma_{Hg}(Z_2 - Z_1)$ we have seen was R if you just go back here this P 2 - p 1 z2 - z 1this is point 2. So, this $(Z_2 - Z_1)$= R. So, going to γ_{Hg}, γ_{Hg} can be written as a S_{Hg}*γ_w.. So, pressure will be $P= S_{hg}\,\gamma_w$ * R, on calculation it is going to give almost hundred 100,000 Pascal. So, this is one example as well of calculating the pressure p1 but this is also indicating how this barometer system works.

(Refer Slide Time: 27:33)



Now, we must also be a little aware about the pressure variations in a compressible fluid. So, there are 2 processes, one is perfect gas at constant temperature isothermal that we have been seeing till now. Secondly perfect gas with constant temperature gradient and actually you should try this at home. We are not going to cover at this because in working this is the derivation is same as isothermal I mean with different the way it works is the same. So, you should try this at home after watching this lecture.

(Refer Slide Time: 28:12)



Now, we are going to do perfect gas at constant temperature that is isothermal process, we start with the same old equation $dp = -\gamma\ dz$. And where gamma is $\gamma = \rho g$ where the ρ is a function of P. So, because in gas it is $PV = nRT$ that is the thumb rule for isothermal. So, ρ can be written as n*M_{gas}/V or in other terms we can write it as pM_{gas} / RT, M_{gas} is the molecular mass which we have seen in lecture number 1.

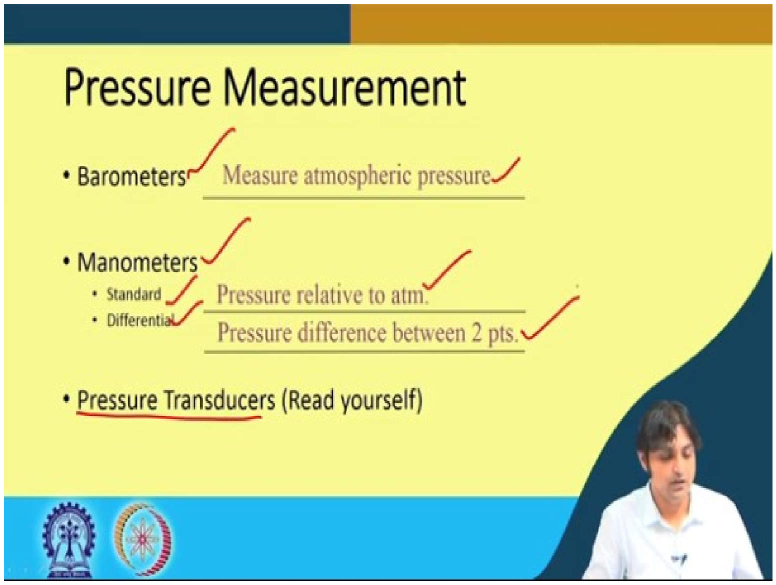
So, dp will be $dp = -\gamma\ dz$, so this is $-\gamma$. Correct? Because we already seen here, we just multiplied the density with G here. So, now, we start simply integrating from P 1to p 2, and z1 to z2 simple integration, and if you integrate this, we are going to get because it is dp / p. So, that becomes *ln (p2/p1)* and dz is a simple integration yielding (Z_2 - Z_1). So, the pressure at point 2 in a constant temperature will be given as

$$p_2 = p_1 e^{-[\frac{M_{gas}\, g}{RT}(Z_2 - Z_1)]}$$

.

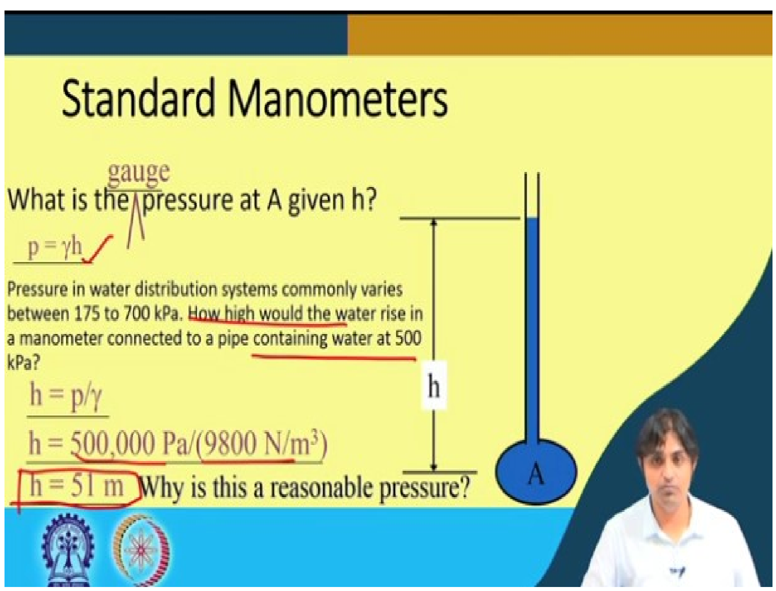
So, in case of constant temperature isothermal the perfect gas, the pressure variation will be like this. So, very simple derivation but a little more intriguing than the one that we did before for you know, pressure variation within the liquid where we got simply piezometric head.

(Refer Slide Time: 30:01)



Pressure measurement devices, we have discussed one already barometers, there are manometers a standard manometer or a differential manometer and the pressure transducers. This is out of the scope, but you must have already done it in your fluid mechanics class, probably in your second year. So, what does barometers do? Barometers measure the atmospheric pressure. Manometers, this standard manometer measures the pressure relative to the atmosphere differential the pressure it measures the pressure difference between 2 points.

(Refer Slide Time: 30:42)

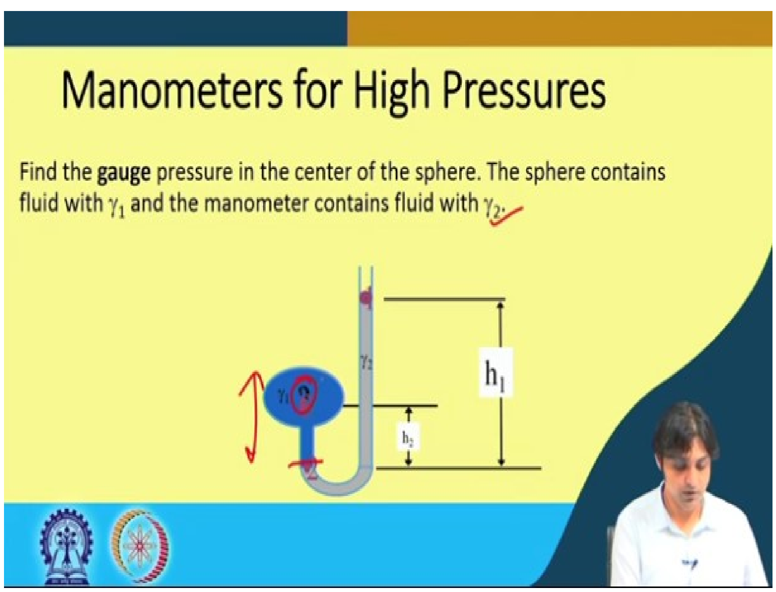


For standard manometers. What is the pressure? So how it works is very simple example. So, what is if we are asked, what is the pressure at A given the height, more importantly we should mention what is the gauge pressure. Because gauge means we are not counting the atmospheric pressure. So, p can be written a simply γh . So, pressure in water distribution system for example, commonly varies between 175 to 700 kilo Pascal's.

So, how high would the water rise in a manometer connected to a pipe containing water at 500 *kPa*. So, the question actually here is, if we want to measure the pressure in a water distribution system, what will this height h in a manometer be? We are already told that the pressure variation in a distribution system varies between 175 to 700. In this example, they have asked us we choose 500 kilopascals. So, very simple equation we substitute p pressure is given γh we know, so, h can be written as $h = p/\gamma$ p is 500,000 Pascal divided by γ is 9800 N/m^3. So, this will give the height 51 *m* of water will rise in the manometer that has water in it that is why you see 51 *m* is too high. So, that is why this is the reason of using denser liquids like mercury, the height to which it will rise will be much less compared to the simply if you want to calculate you can divide it by you know 13.6.

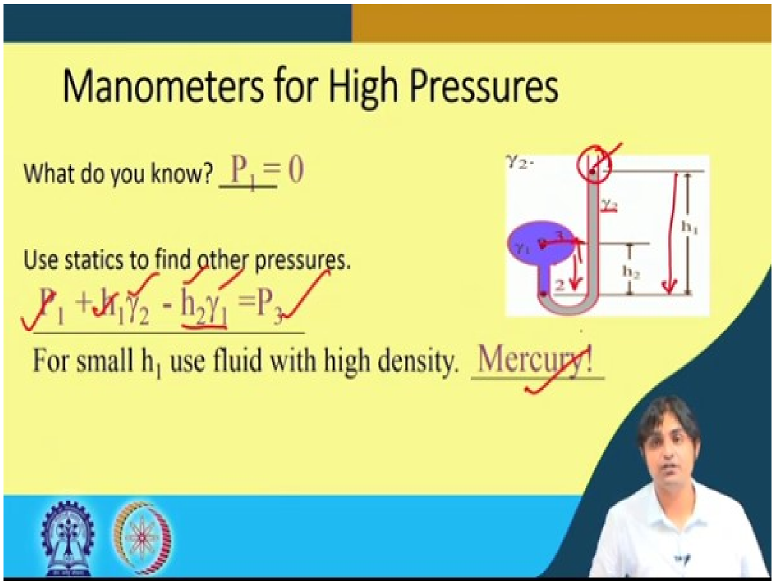
So, it will be something like around less than, you know, 4 *m* or something.
So, why is this a reasonable pressure. I mean, this is the reasonable pressure. I think you think about it, we can discuss that in the forum.

(Refer Slide Time: 32:51)



Another example for a differential you know, manometer. So, find the gauge pressure in the center of the sphere. So, this is not a differential. So, we are we are going to measure the high pressures. So, find the gauge pressure in the center of the sphere, here the sphere contains fluid up till here with γ_1 density and the manometer contains fluid with density γ_2 . So, we have to find pressure here. So, this is point 1, we assume we assume point 2 here and we assume point 3 here, the center.

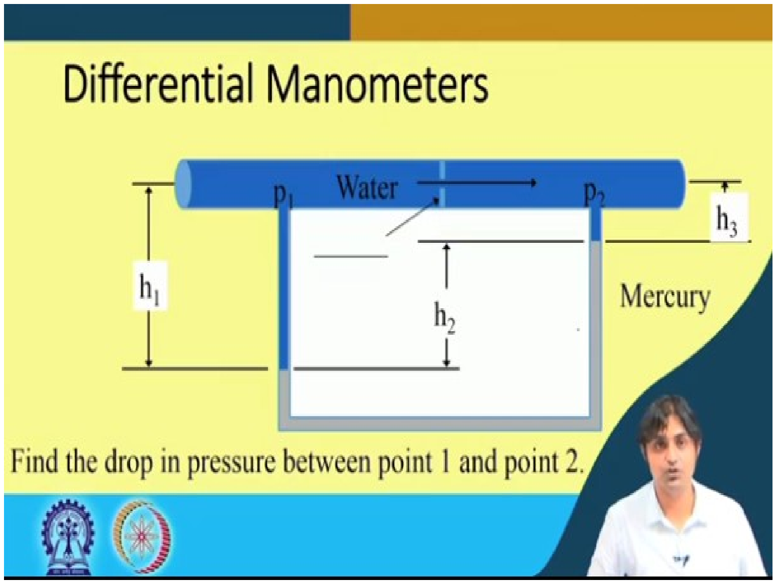
(Refer Slide Time: 33:31)



So, what do we know, we know that pressure at 1 is 0 because this is exposed to atmosphere. We have to use statics to find the other pressures here. So, P1 so, if the pressure at here it is $p_1 + h_1\gamma_2$ because the same fluid the pressure is increasing as direction multiplied by the density, this is the pressure $h_1\gamma_2$. So, now we are going up by how much, h2, if you want to go to the center we are going up so $-h_2\gamma_1$ should be equal to p_3.

So, we have found out p3 is $P_3 = p_1 + h_1\gamma_2 - h_2\gamma_1$. So, we know p_1 that is 0 we know h_1 we know γ_2 we know h_2 we know γ_1. So, we can easily find out P_3, for small h for the small h_1 we know this one we use fluid with high density, because in reality the atmospheric pressure must be taken into account p_1. So, we generally use mercury in manometers.

(Refer Slide Time: 34:49)



So, I think we will start with this particular slide in our next lecture and talk about differential manometers. Thank you so much.