Important Comments on Phase Transitions

On Friday 12/3/99 we discussed in lectures Phase Transitions.The 11 AM lecture will be shown on PIVoT.

The Ideal Gas Law ONLY holds (approximately) when you have ONLY gas.WHENEVER THERE IS ANY LIQUID PRESENT, THE GAS LAW CANNOT BE USED.

During the 11 AM lecture, near 11:45 AM, I said that the pressure inside the paint can will never make it to 17 mm Hg as the volume of the can decreased (the can imploded). That is incorrect.

If there were no air in the can left when I closed it, in other words, if all air had been replaced by water vapor (gas) of 100 C (due to the boiling water in the can), then the pressure inside the can should go down all the way to about 17 mm Hg (about 1/45 of an atmosphere) as the water gas/vapor inside the can cooled to room temperature of 20 C. The fact that the can imploded, (the volume decreased), makes NO difference.

Inside the can is liquid water and water vapor. They co-exist and they are in thermal equilibrium (i.e. they have the same temperature). This means that as the can cools, that more and more water vapor will condense into liquid water (the gas law does NOT hold). When room temperature is reached, the pressure inside must be about 17 mm Hg as that is the only pressure at which liquid water and water vapor can exist together in thermal equilibrium. This is INDEPENDENT of the volume of the can.

The situation is no different for any gas that co-exists with its own liquid. Assume we have CO_2 liquid and gas in a cylinder (as was the case for the fire extinguisher shown in my lectures). The gas and the liquid both have a temperature of about 20 C. That means that the
pressure inside the cylinder is about 60 atm as this is the ONLY pressure (at 20 C) at which the two can co-exist. Imagine now that we decrease the volume of the cylinder (e.g. using a piston), without changing the temperature. Some of the gas will now turn into liquid, but the pressure will REMAIN at 60 atm. Not until ALL the gas has turned into liquid (by further decreasing the volume), will we be able to increase the pressure.

Listen once more to the explanation that I gave when I discussed the General Phase Diagram in this lecture, and also take another look at the phase diagram

of CO_2 that I showed (this diagram is shown below).

\\/\/////alter Lewin