Pure substance-1

A substance that has a fixed chemical composition throughout is called a pure substance.

Now there are two important keywords in this:
1. Fixed Chemical Composition
2. Throughout

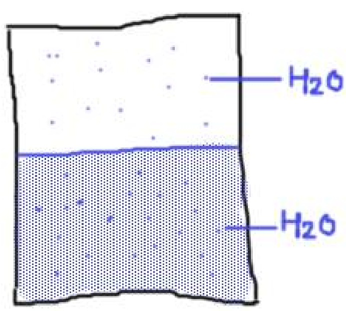
I will explain them one by one

Keyword No 1: Fixed Chemical Composition:

A mixture of oxygen and nitrogen is a pure substance since throughout the system, the chemical composition is fixed: O2 + N2. Whatever corner of the system you pick, the same chemical composition will be there. There will be two

Keyword No 2: Throughout

It has an extended meaning. Throughout the phases of the substance, it should maintain fixed chemical composition.
Let us take water for example. It's chemical composition is H2O. Be it ice, liq water or vapour. So it is a pure substance.
What do you think about air?

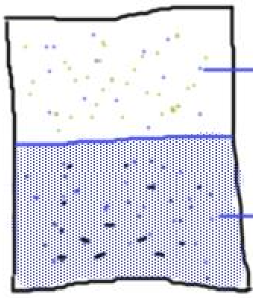


Air has a FIXED chemical composition. Is it a pure substance? Yes

GASEOUS AIR is a pure substance since throughout the mixture, composition is same.

LIQUIFIED air is also a pure substance for the same reason.

But if we talk about just AIR, it means we are talking about all phases of air together. SO what is wrong will collectively calling air a pure substance?



It will not remain pure throughout. During liquification, some gases will get liquified while some will not. So, the composition in gaseous and liquid phase will be different.

It means the chemical composition is not same throughout. Hence it get disqualified!

Does the temperature increase during phase change? Comment with reason.

IMPORTANT .
The water boils at 100 deg C. Is this statement correct?

ANS:

Pressure change causes the.. boiling temp to also change..

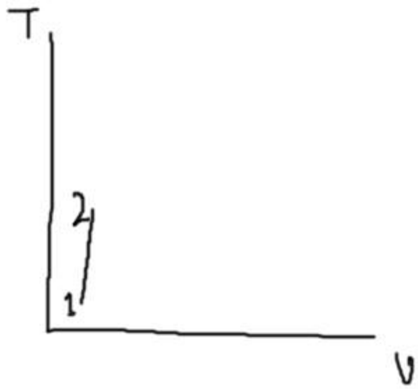
Temperature at which any liquid boils is directly proportional to th pressure above it. If P chnages, T changes.

Now there are different states in which a matter can exist: Solid, Liquid and Gas. This is what we have learnt till schools. In engg, let's move a step further and know about some further subdivisions.

Consider a piston–cylinder device containing liquid water at 20°C and 1 atm pressure Under these conditions, water exists in the liquid phase, and it is called a compressed liquid, or a subcooled liquid, meaning that it is not about to vaporize.

Now to kept on heating the system, the temperature went on increasing. As more heat is transferred, the temperature keeps rising until it reaches 100°C At this point water is still a liquid, but any heat addition will cause some of the liquid to vaporize. That is, a phase-change process from liquid to vapor is about to take place. A liquid that is about to vaporize is called a saturated liquid.

In the figure below, All the states between 1 and 2 are compressed liquid states.
State 2 is saturated liquid state.



Notice that there is very little variation in volume with increasing pressure.

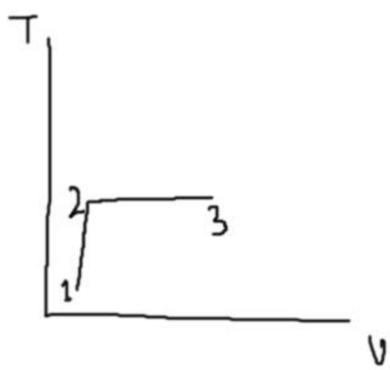
Reason: It is a liquid, v of liquids does not vary significantly with T, like it does for gases

Isiliye.. gas more compressible hai

Once boiling starts, the temperature stops rising until the liquid is completely vaporized. That is, the temperature will remain constant during the entire phase-change process if the pressure is held constant. As we continue transferring heat, the vaporization process continues until the last drop of liquid is vaporized. At this point, the entire cylinder is filled with vapor. A vapor that is about to condense is called a saturated vapor.

Process 2-3 is boiling, note that T remains constant.

State 3 is saturated vapour state.

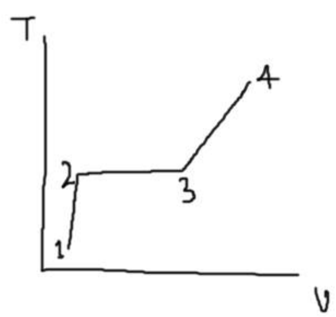


Refer to the figure A substance at states between 2 and 3 is referred to as a saturated liquid–vapor mixture since the liquid and vapor phases coexist in equilibrium at these states.

it is a mixture of saturated liq and sat vapour. A concept I will explain in further events. Just keep names in mind for now.

Vapor that is not about to condense (i.e., not a saturated vapor) is called a superheated vapor. Therefore, water at state 4 is a superheated vapor.

Note the slope of 3-4 is diff from 1-2. Heating a gas increases v more than increase in liq



What is the difference between a gas and a vapour?

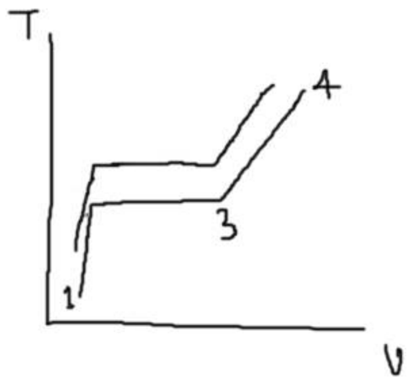
critical temperature se upar hai toh gas

A gas near condensation is known as vapour.

Can we say Gas is mixture and Vapour is Pure?

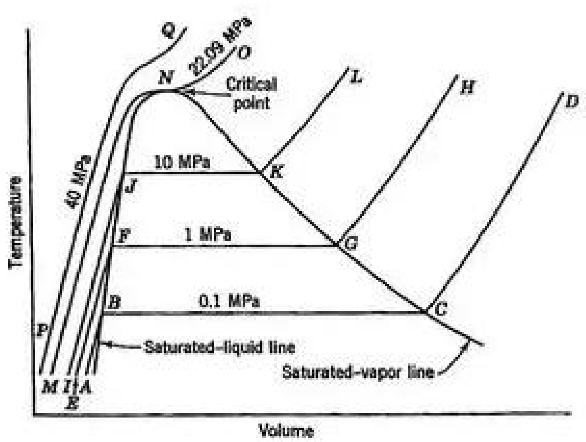
No. We can not say that. They are same chemically.

The curve obtained in #12 has been obtained by doing a const pressure heating.
What if we would have used a pressure higher than we used for this case?
The temp at which phase change begin would have moved up

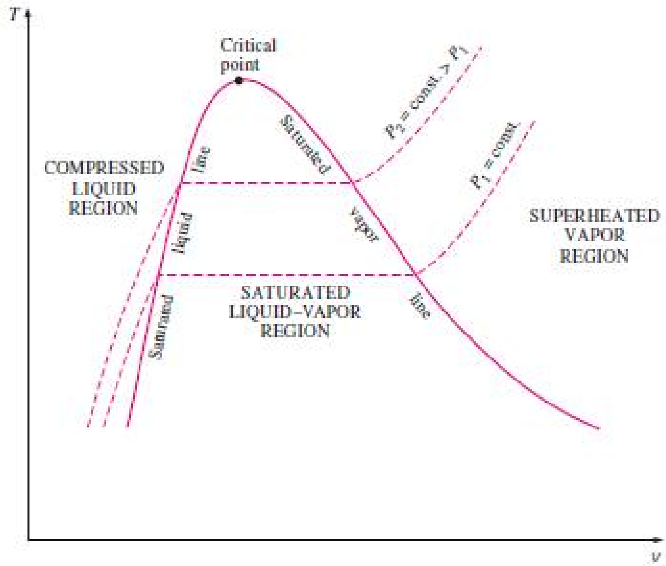


Plotting such curves for a variety of pressures would give a series of curves. Joining all of them will give us a curve like this:

All the point J, F and B are sat liq, so the line on which they lie is called as sat liq line.
Same goes for sat vap line



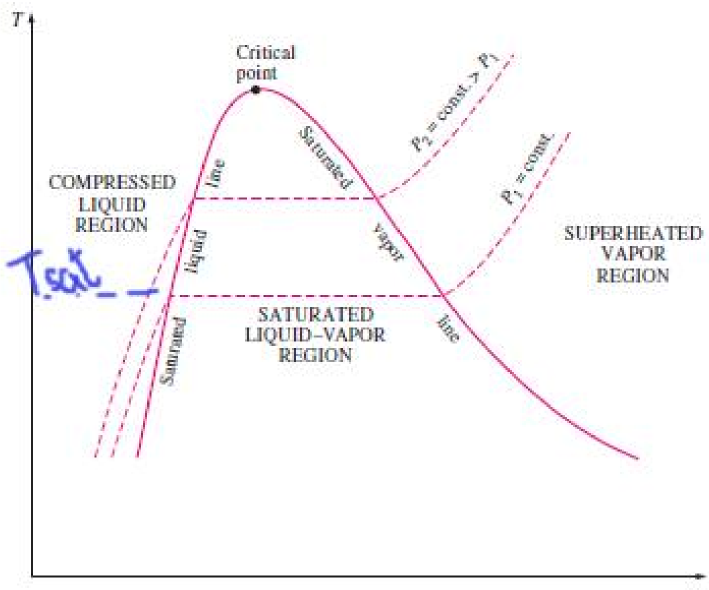
One more image to make the understanding better.



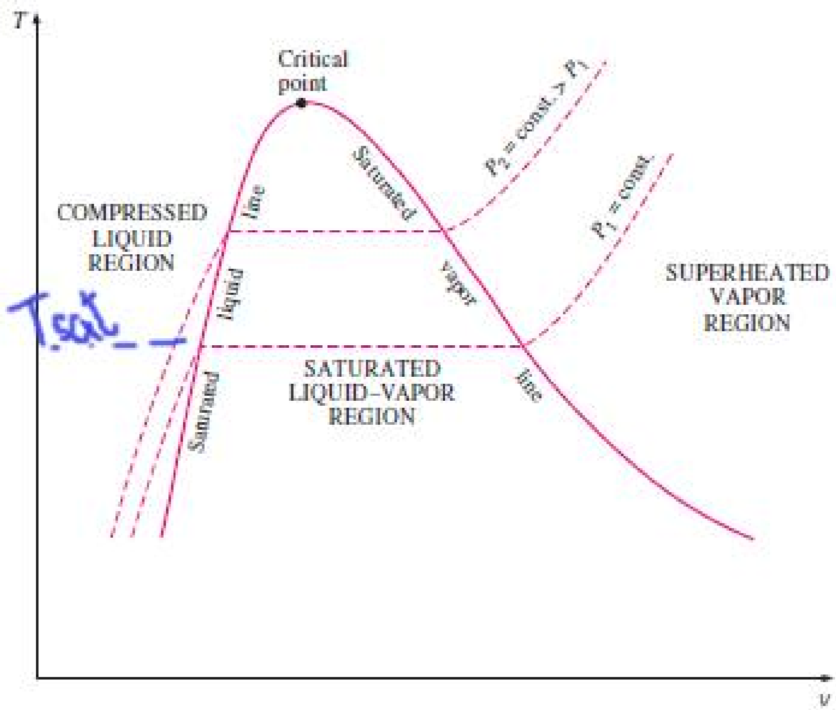
The temperature at which phase change starts at a particular pressure is known as Saturation Temperature.

Shown by T sat in image below

The corresponding pressure is known as P sat



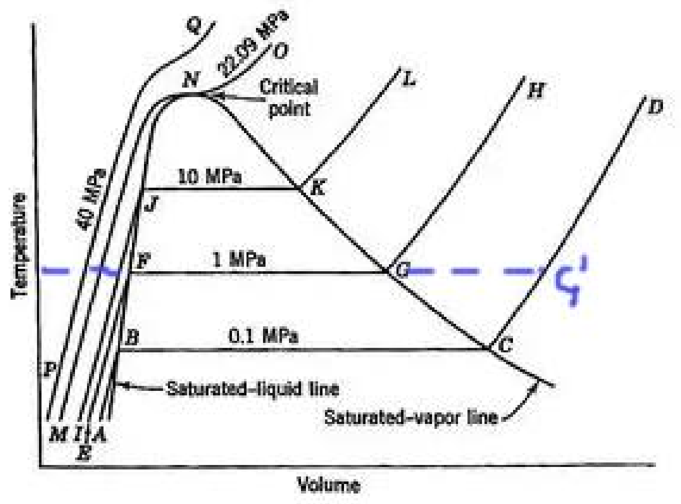
The point at which sat liq and sat vap lines merge is known as critical point.
Shown by the top most point on the curve.
Since the curve is dome-shaped, it is also known as saturation dome.



If P< (Psat at same temperature), determine the state of the substance.

p> psat will be subcooled
Superheated

The Q I asked this:
If P<P(G), where would that point lie?



Take point P(G'). and compare it with P(sat) at same temperature, which is P(G). P(G') < P(G). Where does P(G') lie? In super heated.

That is why I posted the same dia from 2 diff perspectives.

Theek se analyse kro upr wale figure ko. Notice that P(sat) increases with T(sat)