Q- A room is filled with saturated moist air at 30°C and a total pressure of 100 kPa. If the mass of dry air in the room is 100 kg, what is the mass of water vapours in the room?

The water vapours in air behaves as ideal gas and therefore we may consider the moist air as a mixture of two ideal gases, where total pressure is the sum of the pressure exerted by the components individually.

The saturated vapor pressure is a constant at a given temperature and is measured experimentally. We have tables for SVP at different temperatures.

According to the table the SVP at 30^0C is 31.7 mm of mercury which is equal to 1333 Pa. So, the pressure exerted by the air is 100 – 1.333 = 98.667 KPa.

Using ideal gas equation PV = n RT = (m/M) RT (m is the mass of gas and M is molar mass) the volume V of the gas is given as

$$V = (m/M)\,(RT/P) = (100000/29)(8.31 \times 303)/98667 = 88\ m^3.$$

So now if the mass of water vapor is m' then using the gas equation

$$P'V = (m'/M')\,RT$$

or $$m'/M' = P'V / RT = 1333*88/(8.31 \times 303) = 46.6 \text{ mol}$$

Therefore, mass of water vapor

$$m' = 46.6 \times 18 = 838.8 \text{ gm} = 0.8388 \text{ kg}.$$