

1. D Although Boyle's law makes this proposition directly:

$$P_1V_1 = P_2V_2$$

Both the combined gas law:

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$$

and also the ideal gas law:

$$PV = nRT$$

express the relationship if the temperature is held constant.

2. D All are true statements.
3. B At this point, the water level in the flask is still above the level in the tank. This signifies that the pressure exerted by the atmosphere (760 torr) is greater than the pressure of the gaseous phase of the flask.
4. B While at this point the total pressure of the gaseous phase in the flask is equal to the atmospheric pressure, that total pressure is the sum of the partial pressure of the collected gas and the partial pressure of water vapor (the vapor pressure of water at the temperature in the lab.)
5. D The partial pressure of the water vapor is about 1/20 the total pressure in the gaseous phase (760 torr). Therefore, one in twenty molecules in the gaseous phase are water (5%), and the remaining 95% are molecules of the collected gas. This relationship between pressure and number of molecules can be seen in the ideal gas law.

$$PV = nRT$$

(Note that much of the information given in the problem was unnecessary to find the solution.)

6. A Because the molecular weight of methane is almost three times less than that of propane, there are almost three times more molecules in 1 gram of methane. For the propane to occupy an equal volume, an equal number of molecules would need to be present.

7. A According to the ideal gas law, if the temperature in the laboratory is greater than before, the number of moles of gas in a given volume at a given pressure will be less. A is correct also because the mole fraction of water vapor will be greater (because the vapor pressure increases with temperature) ((This is why B is incorrect)). Beware of answers like C, which might be arrived at by the reflexive application of Charles' law, which applies to an isolated system in transition from an initial to a final state. Here, we are conducting different experiments. The volume will be attained when the levels of water in the flask and the tank draw even, and will be the same as before.
8. B
9. A The face-centered cubic structure is also called cubic closest packing and can utilize seventy-four percent of available space.