A 1.22 gram of unknown liquid is vaporized at 100 degrees Celsius and 102 kPa. the sample occupies 617 ml. If the percentage composition of this compound is 59.96% carbon, 13.42% hydrogen and 26.62% oxegyn, derive the molecular formula.

Solution. We derive the simplest formula of the compound, based on the percentage of the elements. Suppose there is 100 g of substance, then we find the molar ratio of the elements: v(C):v(H):v(O)=$\frac{59.96}{\mathrm{M(C)}}:\frac{13.42}{\mathrm{M(H)}}:\frac{26.62}{\mathrm{M(O)}}=\frac{59.96}{12}:\frac{13.42}{1}:\frac{26.62}{16}=5:13.42:1.66=3:8:1.$

So, the simplest formula for the desired compound is C_3H_8O.

Further, we have the following data: m(compound)=1.22 grams, t=100 degrees Celsius, or 100+273=373 degrees Kelvin, p=102 kPa, V=617 ml, or 0.617 L, then, according to the Mendeleev-Clapeyron equation, we can calculate the molar mass of the compound: pV=$\frac{m(compound)}{M}RT$, M=$\frac{m(compound)RT}{pV}=\frac{1.22\times8.31\times373}{102\times0.617}=60\ \frac{g}{mol}$. The molar mass of a simple substance, the formula of which we found above, is: M(C_3H_8O)=3×M(C)+8×M(H)+M(O)=36+8+16=60 $\frac{g}{mol}$. The molar masses are the same, then the formula of the compound: C_3H_8O.

Answer: C_3H_8O.