Oxide of element has 72.72% oxygen. Relative vapor density of chloride with respect to hydrogen is 77. Calculate the atomic weight of that element.

Solution: Mass fraction of the oxygen in the oxide of the unknown element E can be calculated as:

$\omega(O) = \frac{y \cdot A(O)}{M(E_2O_y)} = \frac{y \cdot A(O)}{2 \cdot A(E) + y \cdot A(O)}$, then $\frac{1}{\omega(O)} = \frac{2 \cdot A(E) + y \cdot A(O)}{y \cdot A(O)} = \frac{2 \cdot A(E)}{y \cdot A(O)} + 1,$ and we can find the equivalent weight of the element: $A(E)/y = \frac{A(O)}{2} \cdot \left[\frac{1}{\omega(O)} - 1\right] = \frac{16}{2} \cdot \left[\frac{1}{0.7272} - 1\right] = 3.0$ g/eq.

As you know, relative density of the gas with respect to hydrogen can be calculated as: $D_{x/H_2} = \frac{M(x)}{M(H_2)}$, where $M(x)$ is the molar mass of the gas, g/mol.

Then, $M(ECl_y) = M(H_2) \cdot D_{ECl_y/H_2} = 2 \cdot 77 = 154$ g/mol.

$M(ECl_y) = A(E) + y \cdot A(Cl) = y \cdot \left[A(E)/y + A(Cl)\right]$, and then $y = \frac{M(ECl_y)}{A(E)/y + A(Cl)} = \frac{154}{3 + 35.5} = 4$.

$A(E) = 3 \cdot y = 3 \cdot 4 = 12$ g/mol.

Answer: 12 g/mol.