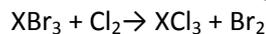An element X has a tribromide with the empirical formula XBr3 and a trichloride with the empirical formula XCl3. The tribromide is converted to the trichloride according to the equation

$$XBr_3 + Cl_2 \rightarrow XCl_3 + Br_2$$

If the complete conversion of 1.334 g of XBr_3 results in the formation of 0.722 g of XCl_3, what is the atomic mass of the element X?

Solution:

We use the equivalents law:

$$\frac{m(XBr_3)}{m(XCl_3)} = \frac{E(XBr_3)}{E(XCl_3)} \; ,$$

The equivalent mass of XBr_3 is: $E(XBr_3)=E(X)+E(Br)=E(X)+79.904$, and the equivalent mass of XBr_3 is: $E(XCl_3)=E(X)+E(Cl)=E(X)+35.453$.

So, $\dfrac{1.334}{0.722} = \dfrac{E(X)+79.904}{E(X)+35.453}$, from this $1.334 \cdot E(X)+47.294=0.722 \cdot E(X)+57.691$,

$$E(X) = \frac{10.397}{0.612} = 16.989 \, g/mol$$

Because, the element X is three valence, the atomic mass of this element is:
Ar(X)=E(X)·3=16.989·3=50.967 amu.

Answer:

The atomic mass of the element X is 50.967 amu.