Mass Fraction ↔ Mole Fraction Conversion (up to 5 Components)

Convert a mixture's composition between mass fractions and mole fractions for up to five components from their molar masses, with the mean molar mass.

Method: Definitions: y_i = (w_i/M_i)/Σ(w_j/M_j); w_i = y_i M_i/Σ y_j M_j

Input parameters

Unit system: SI

Parameter	Value	Unit
Composition given as	Mass fractions (convert to mole)	
Component 1: fraction	70.000	%
Component 1: molar mass	28.013	kg/kmol
Component 2: fraction	20.000	%
Component 2: molar mass	31.999	kg/kmol
Component 3: fraction	10.000	%
Component 3: molar mass	44.010	kg/kmol
Component 4: fraction	0	%
Component 4: molar mass	18.015	kg/kmol
Component 5: fraction	0	%
Component 5: molar mass	39.948	kg/kmol

Calculated results

Parameter	Value	Unit
Component 1: converted fraction	74.568	%
Component 2: converted fraction	18.652	%
Component 3: converted fraction	6.7807	%
Component 4: converted fraction	0	%
Component 5: converted fraction	0	%
Mean molar mass	29.841	kg/kmol

Formula and method

$$y_i = \frac{w_i/M_i}{\sum_j w_j/M_j}, \quad w_i = \frac{y_i M_i}{\sum_j y_j M_j}$$

Variables

given	Composition given as	-
x_1	Component 1: fraction	-
M_1	Component 1: molar mass	kg/kmol
x_2	Component 2: fraction	-
M_2	Component 2: molar mass	kg/kmol
x_3	Component 3: fraction	-
M_3	Component 3: molar mass	kg/kmol

x_4	Component 4: fraction	-
M_4	Component 4: molar mass	kg/kmol
x_5	Component 5: fraction	-
M_5	Component 5: molar mass	kg/kmol
x'_1	Component 1: converted fraction	-
x'_2	Component 2: converted fraction	-
x'_3	Component 3: converted fraction	-
x'_4	Component 4: converted fraction	-
x'_5	Component 5: converted fraction	-
$\bar{M}$	Mean molar mass	kg/kmol

Method and standards

Definitions.

Assumptions and limits

- Up to five components.

References

- Definitions: y_i = (w_i/M_i)/Σ(w_j/M_j); w_i = y_i M_i/Σ y_j M_j

Report details

Report reference	FCC-ENW1-4SCG (the same inputs always give the same reference)
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Method last reviewed	12 November 2026
Software release	FireCAD Calc, release of 17 November 2026
Release checks	3 reference cases of this calculator, computed independently, are checked on every release

Results are for engineering estimation. Verify critical designs against the referenced standards and your own data.

This calculator online

https://calc.firecad.com/chemical/gas-mixtures/mass-mole-fraction-conversion

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.