Gas Mixture Pseudo-Critical Properties (Kay's Rule)

Pseudo-critical temperature, pressure and acentric factor of a gas mixture of up to four components by Kay's rule, with reduced conditions.

Method: Perry's Chemical Engineers' Handbook; 9th ed. (McGraw-Hill, 2019); ...

Input parameters

Unit system: SI

Parameter	Value	Unit
Temperature	26.850	°C
Pressure (absolute)	50.000	bar
Mole fraction 1	85.000	%
T_c of 1	-82.590	°C
p_c of 1	45.990	bar
ω of 1	0.011400	
Mole fraction 2	10.000	%
T_c of 2	32.170	°C
p_c of 2	48.720	bar
ω of 2	0.099500	
Mole fraction 3	5.0000	%
T_c of 3	-146.95	°C
p_c of 3	33.980	bar
ω of 3	0.037700	
Mole fraction 4 (0 = none)	0	%
T_c of 4	30.980	°C
p_c of 4	73.770	bar
ω of 4	0.22390	

Calculated results

Parameter	Value	Unit
Pseudo-critical temperature	-74.332	°C
Pseudo-critical pressure	45.663	bar
Mixture acentric factor	0.021525	
Pseudo-reduced temperature	1.5089	
Pseudo-reduced pressure	1.0950	

Notes for this case

- The components' critical temperatures or pressures differ by more than a factor of two: Kay's rule becomes unreliable; use a mixing rule with interaction (for example in an equation of state).

Formula and method

$$T_{pc} = \sum y_i T_{ci}, \quad p_{pc} = \sum y_i p_{ci}, \quad \omega_m = \sum y_i \omega_i$$

Variables

T	Temperature	K

p	Pressure	Pa
y_1	Mole fraction 1	-
T_{c1}	T_c of 1	K
p_{c1}	p_c of 1	Pa
ω_1	ω of 1	-
y_2	Mole fraction 2	-
T_{c2}	T_c of 2	K
p_{c2}	p_c of 2	Pa
ω_2	ω of 2	-
y_3	Mole fraction 3	-
T_{c3}	T_c of 3	K
p_{c3}	p_c of 3	Pa
ω_3	ω of 3	-
y_4	Mole fraction 4 (0 = none)	-
T_{c4}	T_c of 4	K
p_{c4}	p_c of 4	Pa
ω_4	ω of 4	-
T_{pc}	Pseudo-critical temperature	K
p_{pc}	Pseudo-critical pressure	Pa
ω_m	Mixture acentric factor	-
T_r	Pseudo-reduced temperature	-
p_r	Pseudo-reduced pressure	-

Method and standards

Kay's rule.

Assumptions and limits

- Mole-fraction averages, normalised when the fractions add up to between 99 and 101 % (a note shows the sum).
- A note checks whether the components' critical temperatures and pressures differ by more than a factor of two. Pressure is absolute.

References

• Perry's Chemical Engineers' Handbook
• 9th ed. (McGraw-Hill, 2019)
• sec. 2 (pseudocritical properties of mixtures, Kay's rule)

Report details

Report reference	FCC-MZ6A-3H1Y (the same inputs always give the same reference)
Generated	17 November 2026, 19:36 UTC
Calculator	Gas Mixture Pseudo-Critical Properties (Kay's Rule)
Method last reviewed	13 November 2026
Software release	FireCAD Calc, release of 17 November 2026
Release checks	2 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/kay-pseudocritical-mixture

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.