Q10 Shelf-Life Prediction at Another Temperature

Shelf life at a new storage temperature from the shelf life at a known temperature and the Q10 factor, with the equivalent activation energy.

Method: Q10 temperature coefficient for accelerated shelf-life testing

Input parameters

Unit system: SI

Parameter	Value	Unit
Shelf life at the known temperature	180.00	d
Known storage temperature	25.000	°C
New storage temperature	35.000	°C
Rate increase for 10 K	2.5000	

Calculated results

Parameter	Value	Unit
Shelf life at the new temperature	72.000	d
Acceleration factor	2.5000	
Equivalent activation energy over this range	69.995	kJ/mol

Notes for this case

• Q10 is how many times faster a deterioration reaction goes when the temperature rises by 10 K. Shelf life scales inversely with the rate: $\theta_2 = \theta_1 / Q10^{((T_2 - T_1)/10)}$. Accelerated shelf-life tests at 35–45 °C use this to predict life at room temperature. Q10 values of about 2–3 are typical for chemical changes; microbial spoilage and phase changes (fat melting, glass transitions) do not follow it, so confirm the prediction at the real storage temperature.

Formula and method

$$\theta_2 = \frac{\theta_1}{Q_{10}^{(T_2 - T_1)/10}}, \quad E_a = \frac{R \ln Q_{10}^{(T_2 - T_1)/10}}{1/T_1 - 1/T_2}$$

Variables

θ_1	Shelf life at the known temperature	s
T_1	Known storage temperature	K
T_2	New storage temperature	K
Q_{10}	Rate increase for 10 K	-
θ_2	Shelf life at the new temperature	s
θ_1/θ_2	Acceleration factor	-
E_a	Equivalent activation energy over this range	J/mol

Method and standards

Q10.

Assumptions and limits

- Single dominant deterioration reaction.

References

Q10 temperature coefficient for accelerated shelf-life testing

Report details

Report reference	FCC-PSN8-K7DE (the same inputs always give the same reference)
Generated	23 November 2026, 17:51 UTC
Calculator	Q10 Shelf-Life Prediction at Another Temperature
Method last reviewed	17 November 2026
Software release	FireCAD Calc, release of 22 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/food-dairy/q10-shelf-life

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.