Scientific constants sheet

Defining constants and standard gravity

The first five values are exact SI defining constants. Standard gravity is an exact conventional reference, not a measurement of local gravitational acceleration. Measured inputs still carry uncertainty.

Speed of light in vacuum

$$c = 299\,792\,458\,\mathrm{m\,s^{-1}}$$

Exact SI defining constant. This is the speed in vacuum, not the propagation speed through an arbitrary material.

Planck constant

$$h = 6.62607015 \times 10^{-34}\,\mathrm{J\,s}$$

Exact SI defining constant. Preserve the exponent and the joule-second unit when using an energy-frequency relationship.

Elementary charge

$$e = 1.602176634 \times 10^{-19}\,\mathrm{C}$$

Exact, positive magnitude of the elementary charge. An electron has charge $-e$; the sign depends on the particle.

Avogadro constant

$$N_A = 6.02214076 \times 10^{23}\,\mathrm{mol^{-1}}$$

Exact SI defining constant. Specify the counted entity, such as atoms, molecules or ions, when connecting amount of substance and entity count.

Boltzmann constant

$$k_B = 1.380649 \times 10^{-23}\,\mathrm{J\,K^{-1}}$$

Exact SI defining constant. Absolute temperature in relationships using this constant is measured in kelvin, not Celsius readings.

Standard acceleration of gravity

$$g_n = 9.80665\,\mathrm{m\,s^{-2}}$$

Exact conventional value. For local weight use the appropriate local g; standard gravity does not describe every location or elevation.

Worked example / Weight under the standard-gravity convention

Use a mass of $2.000\,\mathrm{kg}$ with standard gravity. Report the force to four significant figures, matching the stated mass precision.

1. Choose the stated convention and distinguish mass from force.

$$W = mg_n$$

2. Multiply the mass by the conventional acceleration.

$$W = 2.000 \times 9.80665 = 19.6133\,\mathrm{N}$$

3. Round the force, not the defining reference value.

$$W \approx 19.61\,\mathrm{N}$$

This is a standard-gravity example. A local weight calculation needs local acceleration, and a precision statement should follow the actual measurement uncertainty.

Source checks & next step

BIPM: the SI defining constants / NIST: constants and conventional values

Convert force units / Full previews and sources: toolarithm.com/resources/formula-sheets