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The SI System: Seven Base Units

1. A costly unit mistake

On 23 September 1999 NASA's **Mars Climate Orbiter** came too close to Mars and was lost. One team's software reported thruster impulse in **pound-force seconds**, while the navigation team expected **newton seconds**. A single unit mismatch cost a spacecraft of about US$125 million.

2. One system for everyone: the SI

The **Système International d'Unités (SI, 1960)** is used worldwide. It is built on seven base units.



Base quantity	Unit	Symbol
Length	metre	m
Mass	kilogram	kg
Time	second	s
Electric current	ampere	A
Thermodynamic temperature	kelvin	K
Amount of substance	mole	mol
Luminous intensity	candela	cd

3. Derived units

Quantity	Unit	In base units
Force	newton (N)	kg m s^{-2} (F = ma)
Work, energy	joule (J) = N m	kg m^2 s^{-2}
Power	watt (W) = J/s	kg m^2 s^{-3}
Pressure	pascal (Pa) = N/m^2	kg m^{-1} s^{-2}
Charge	coulomb (C)	A s

Solved example

Q. Express the watt in SI base units.
A. W = J/s = (kg m^2 s^{-2})/s = **kg m^2 s^{-3}**.

Practice questions

1. (MCQ) Which is NOT a base unit? (a) kelvin (b) mole (c) newton (d) candela
2. (Very short) Name the SI unit of electric current.
3. (Numerical) Express the joule in base units.
4. (Numerical) Express the pascal in base units.
5. (Short) Why did the Mars Climate Orbiter fail?
6. (Very short) What is the SI base unit of temperature?

Answer key

1. (c).
2. Ampere (A).
3. kg m^2 s^{-2}.
4. kg m^{-1} s^{-2}.
5. One team used pound-force seconds and another newton seconds: a unit mismatch put the probe on a wrong path.
6. Kelvin (K).

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