Examrace

Competitive Exams: Physics: SI Unit System

Other quantities, called derived quantities, are defined in terms of the seven base quantities via a system of quantity equations. The SI derived units for these derived quantities are obtained from these equations and the seven SI base units. Examples of such SI derived units are given below, where it should be noted that the symbol 1 for quantities of dimension 1 such as mass fraction is generally omitted.

Examples of SI derived units

Derived quantity	Name	Symbol
area	square meter	m2
volume	cubic meter	m3
speed, velocity	meter per second	m/s
acceleration	meter per second squared	m/s2
wave number	reciprocal meter	m − 1
mass density	kilogram per cubic meter	kg/m3
specific volume	cubic meter per kilogram	m3/kg
current density	ampere per square meter	A/m2
magnetic field strength	ampere per meter	A/m
amount-of-substance concentration	mole per cubic meter	mol/m3
luminance	candela per square meter	cd/m2

mass fraction	kilogram per kilogram, which may be represented by the number 1	kg/kg = 1

SI Derived Units

For ease of understanding and convenience, 22 SI derived units have been given special names and symbols

SI derived units with special names and symbols

Derived quantity	Name	Symbol	Expression in terms of other SI units	Expression in terms of SI base units
plane angle	radian (a)	rad	N/A	m x m − 1 = 1 (b)
solid angle	steradian (a)	sr (c)	N/A	m2 × m − 2 = 1 (b)
frequency	hertz	Hz	N/A	s − 1
force	newton	N	N/A	m x kg x s − 2
pressure, stress	pascal	Pa	N/m2	m − 1 x kg x s − 2
energy, work, quantity of heat	joule	J	N x m	m2 x kg x s − 2
power, radiant flux	watt	W	J/s	m2 x kg x s − 3
electric charge, quantity of electricity	coulomb	C	N/A	s x A
electric potential difference, electromotive force	volt	V	W/A	m2 x kg x s − 3 × A − 1
capacitance	farad	F	C/V	m − 2 x kg-1 × s4 x A2

electric resistance	ohm	V/A	N/A	m2 x kg x s − 3 × A − 2
electric conductance	siemens	S	A/V	m − 2 x kg-1 × s3 x A2

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Derived quantity	Name	Symbol	Expression in terms of other SI units	Expression in terms of SI base units
magnetic flux	weber	Wb	V x s	m2 x kg x s − 2 × A − 1
magnetic flux density	tesla	T	Wb/m2	kg x s − 2 × A − 1
inductance	henry	H	Wb/A	m2 x kg x s − 2 × A − 2
Celsius temperature	degree Celsius	° C	N/A	K
luminous flux	lumen	lm	cd x sr (c)	m2 × m − 2 x cd = cd
illuminance	lux	lx	lm/m2	m2 × m − 4 x cd = m − 2 x cd
activity (of a radionuclide)	becquerel	Bq	N/A	s − 1
absorbed dose, specific energy (imparted), kerma	gray	Gy	J/kg	m2 × s − 2
dose equivalent (d)	sievert	Sv	J/kg	m2 × s − 2
catalytic activity	katal	kat	N/A	s − 1 x mol

1. The radian and steradian may be used advantageously in expressions for derived units to distinguish between quantities of a different nature but of the same dimension; some examples are given in Table 4.
2. In practice, the symbols rad and sr are used where appropriate, but the derived unit "1" is generally omitted.
3. In photometry, the unit name steradian and the unit symbol sr are usually retained in expressions for derived units.
4. Other quantities expressed in sieverts are ambient dose equivalent, directional dose equivalent, personal dose equivalent, and organ equivalent dose.

Note on Degree Celsius

The derived unit in above table with the special name degree Celsius and special symbol° C deserves comment. Because of the way temperature scales used to be defined, it remains common practice to express a thermodynamic temperature, symbol T, in terms of its difference from the reference temperature T0 = 273.15 K, the ice point. This temperature difference is called a Celsius temperature, symbol t, and is defined by the quantity equation t = T-T0.

The unit of Celsius temperature is the degree Celsius, symbol° C. The numerical value of a Celsius temperature t expressed in degrees Celsius is given by

$t/°\ C = T/K - 273.15$.

It follows from the definition of t that the degree Celsius is equal in magnitude to the kelvin, which in turn implies that the numerical value of a given temperature difference or temperature interval whose value is expressed in the unit degree Celsius (° C) is equal to the numerical value of the same difference or interval when its value is expressed in the unit kelvin (K).

Thus, temperature differences or temperature intervals may be expressed in either the degree Celsius or the kelvin using the same numerical value. For example, the Celsius temperature difference t and the thermodynamic temperature difference T between the melting point of gallium and the triple point of water may be written as

$t = 29.7546°\ C = T = 29.7546\ K$.