

لو كنت تقود سيارة مصنعة لتسير في أمريكا، لكن على طريق في أوروبا مراقب بالرادار والسرعة القصوى مسجلة على لوحات الطريق 120، والتزمت بالأمر وقدت السيارة بسرعة 100 وفقا لمؤشر السرعة في لوحة القيادة أمامك، فستجد نفسك في ورطة مع شرطة المرور. لماذا؟

$$Speed [mile / h] = 1.61 Speed [km / h]$$

لو كنت مسافرا بالطائرة في زمن الكورونا وقيست حرارتك في مطار أمريكي وانت 90. هل ستستبعد من الرحلة؟

$$^{\circ}C = \frac{5}{9}(F - 32)$$

In engineering, a calculated quantity always has two parts: the numerical value and its associated units.

Therefore, the result of any engineering calculation must always be correct in two separate categories: It must have the correct numerical value, and it must have the correct units.

نتيجة أية حسابات هندسية يجب أن تحمل القيمة العددية الصحيحة والوحدات الصحيحة.

Units quantify Dimensions.

Dimensions are the fundamental quantities, such as mass, length, and time. Units provide us with a numerical scale whereby we can carry out a measurement of a quantity.

The units are established quite arbitrarily and are codified by civil law or cultural custom. How the dimension of length ends up being measured in units of feet or meters has nothing to do with any physical law. It is solely dependent on the creativity and ingenuity of people. Therefore, the basic tenets of units systems are often grounded in the complex roots of past civilizations and cultures.

THE SI UNIT SYSTEM

The International System of Units (in French, Le Système International d'Unités, which is where the “SI” comes from) is the metric standard of units and is based on MKS (meter, kilogram, second) units. The fundamental units in the SI system are:

- The meter (m), the fundamental unit of length.
- The second (s), the fundamental unit of time.
- The kilogram (kg), the fundamental unit of mass.
- The degree kelvin(K), the fundamental unit of temperature.
- The mole (mol), the fundamental unit of quantity of particles.
- The ampere (A), the fundamental unit of electric current.

UNIT NAMES AND ABBREVIATIONS

The next table lists several SI units that were named after the scientists who made discoveries in the fields in which these units are used. Note that these unit names do not begin with a capital letter, but their abbreviation is capitalized (e.g., newton, N).

SI units that were named after the scientists		
ampere (A)	joule (J)	siemens (S)
celsius (°C)	kelvin (K)	tesla (T)
coulomb (C)	newton (N)	volt (V)
farad (F)	ohm (Ω)	watt (W)
hertz (Hz)	pascal (Pa)	weber (Wb)

قواعد كتابة الوحدات ---- Rules in writing units

تكتب أسماء الوحدات مشتقة من اسم علم أم لا، مبتدئة بحرف صغير إلا في بداية الجملة.

عندما يكتب رمز الوحدة مختصراً، يبدأ بحرف كبير فقط إذا كان مشتقاً من اسم علم.

أثناء إجراء بعض العمليات الحسابية إذا احتاج الأمر لذكر وحدة مقدار ما، نضع الوحدة بين معترضتين [...].

Some Derived SI Units.

Quantity	Name	Symbol	Formula	Fundamental Units
Frequency	hertz	Hz	1/s	s ⁻¹
Force	newton	N	kgm/s ²	mkg s ⁻²
Energy	joule	J	Nm	m ² kg s ⁻²
Power	watt	W	J/s	m ² kg s ⁻³
Electric charge	Coulomb	C	As	As
Electric potential	volt	V	W/A	m ² kg s ⁻³ A ⁻¹
Electric resistance	ohm	Ω	V/A	m ² kg s ⁻³ A ⁻²
Electric capacitance	farad	F	C/V	m ⁻² kg ⁻¹ s ⁴ A ²

SI Unit Prefixes.

Multiples	Prefixes	Symbols	Submultiples	Prefixes	Symbols
10^{18}	exa	E	10^{-1}	deci	D
10^{15}	peta	P	10^{-2}	centi	c
10^{12}	tera	T	10^{-3}	milli	m
10^9	giga	G	10^{-6}	micro	μ
10^6	mega	M	10^{-9}	nano	n
10^3	kilo	k	10^{-12}	pico	p
10^2	hecto	h	10^{-15}	femto	f
10^1	deka	da	10^{-18}	atto	a

SIGNIFICANT FIGURES

تعطي الآلات الحاسبة نتائج العمليات الحسابية بعدد كبير من الأرقام (يمكن التحكم بذلك). يجب الاحتفاظ بعدد منها فقط، تكون له دلالة (أي معنى واقعي أو فائدة) ويتناسب مع الهدف المراد من التصميم ومع الدقة التي يحتاجها تنفيذ هذا التصميم.

DEFINITION OF A SIGNIFICANT FIGURE

A significant figure is any one of the digits 1, 2, 3, 4, 5, 6, 7, 8, and 9. (0) is a significant except when it is used simply to fix the decimal.

Example: In 0.500 or 0.632000 the zeroes are significant, but in 0.006 or 0.000968 the zeroes are NOT significant.

The number 234 has three significant figures, and the number 7305 has four significant figures, since the zero within the number is a legitimate significant digit.

Leading zeroes before a decimal point are not significant. Thus, the number 0.000,452 has three significant figures (4, 5, and 2), the leading zeroes (including the first one before the decimal point) being place markers rather than significant figures.

Calculation Rules

Engineering calculations often deal with numbers having unequal numbers of significant figures. Several rules have been developed for various computations. These rules are the result of strict mathematical understanding of the propagation of errors due to arithmetical operations such as addition, subtraction, multiplication, and division.

RULE 1: ADDITION AND SUBTRACTION

يجب أن لا يحوي ناتج جمع أو طرح عددين، أرقاماً ذات دلالة إلى يمين الفاصلة العشرية، أكثر مما هو معطى في العدد الأقل دقة بينهما.

For example, $113.2 + 1.43 = 114.63$, must be rounded to 114.6.

Similarly, $113.2 - 1.43 = 111.77$ must be rounded to 111.8.

And, $113.212 - 113.0 = 0.2$

RULE 2: MULTIPLICATION AND DIVISION

يجب أن لا يحوي ناتج جداء أو قسمة عددين أرقاما ذات دلالة، أكثر من عدد أرقام الدلالة الأقل بينهما.

For example, $(113.2) \times (1.43) = 161.876$, must be rounded to 162.

And, $113.2/1.43 = 79.16$, must be rounded to 79.2

because 1.43 contains the least number of significant figures (i.e., three).

RULE 3: ROUNDING NUMBERS UP OR DOWN

For example, if to round 113.2 to three significant figures, it would be 113.

If to round it further to two significant figures, it would be 110,

and if to round it to one significant figure, it would be 100 with the trailing zeroes representing placeholders only.

As another example, 116.876 rounded to five significant figures is 116.88, which further rounded to four significant figures is 116.9,

Which further rounded to three significant figures is 117.

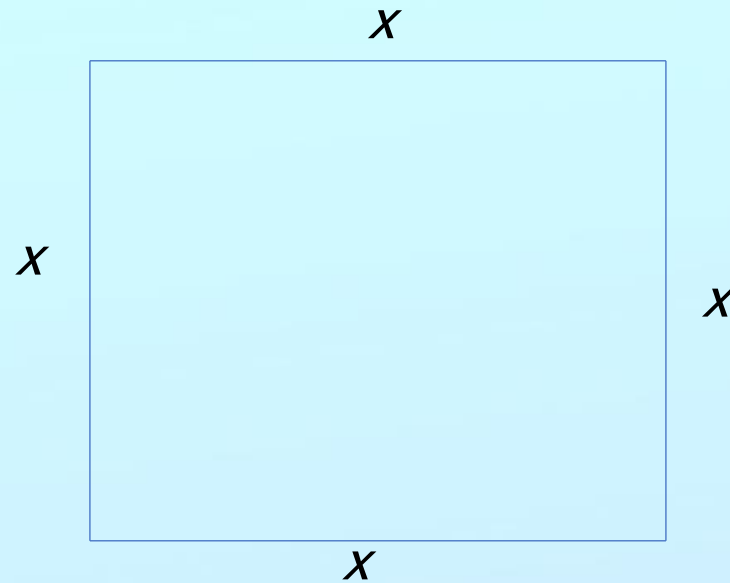
EXAMPLES

- The number of significant figures in 2.2900×10^7 is 5.
- The number of significant figures in 4.00×10^{-3} is 3.
- The number of significant figures in 480 is 2.
- The value of $345.678 - 345.912 = -0.234$.
- The value of $345.678 - 345.9 = -0.222 = -0.2$.

RULE 4: ONLY APPLY THE SIGNIFICANT FIGURES RULE TO YOUR FINAL ANSWER

For example, suppose you need to calculate the area of a circle and the answer is to be in square meter, but you are given the circle's radius as 22.5 cm. You can convert the radius into meter as $R = 22.5[\text{cm}]/100 [\text{cm/m}] = 0.225 \text{ m}$. Then you would calculate the circle's area as

$$A = \pi R^2 = (3.1416) \times (0.225 [\text{m}])^2 = 0.20428254 \text{ m}^2 = 0.204 \text{ m}^2 \text{ (rounded to 3 significant figures)}$$



A man wants to purchase the largest fenced-in square ranch he can afford. He has 320,000,000 SP available for the purchase. Fencing costs 10×10^6 SP a kilometer, and land costs 100×10^6 SP a square kilometer.

How large a ranch, as measured by the length of one side of the square, can he buy?

Need: The length of a side of the largest square of land the man can buy.

Knowns: Fencing costs 10×10^6 SP a kilometer, and land costs 100×10^6 SP square kilometer. The man has 320,000,000 SP to invest.

How: Let the unknown length = X kilometers. It may not be immediately obvious how to write an equation to find X . Now sketch the ranch.

مسألة تقدير: كم حلاق رجالي تحتاج مدينة عدد سكانها 60,000 نسمة.