Metric Units

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CONCEPT 1 Metric Units

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Frequently Used Measurements, Greek Letters, and Prefixes

TABLE 1.1: Types of Measurements

Type of measurement	*Commonly used symbols*	*Fundamental units*
length or position	d, x, L	meters (m)
time	t	seconds (s)
velocity or speed	v, u	meters per second (m/s)
mass	m	kilograms (kg)
force	$\mathbf{F}$	Newtons (N)
energy	E, K, U, Q	Joules (J)
power	P	Watts (W)
electric charge	q, e	Coulombs (C)
temperature	T	Kelvin (K)
electric current	I	Amperes (A)
electric field	$\mathbf{E}$	Newtons per Coulomb (N/C)
magnetic field	$\mathbf{B}$	Tesla (T)

Measurements

TABLE 1.2: Prefix Table

SI prefix	In Words	Factor
nano (n)	billionth	$1 * 10^{-9}$
micro (μ)	millionth	$1 * 10^{-6}$
milli (m)	thousandth	$1 * 10^{-3}$
centi (c)	hundreth	$1 * 10^{-2}$
deci (d)	tenth	$1 * 10^{-1}$
deca (da)	ten	$1 * 10^{1}$
hecto (h)	hundred	$1 * 10^{2}$
kilo (k)	thousand	$1 * 10^{3}$
mega (M)	million	$1 * 10^{6}$
giga (G)	billion	$1 * 10^{9}$

Prefixes

TABLE 1.3: Frequently used Greek letters.

μ "mu"	τ "tau"	Φ "Phi"*	ω "omega"	ρ "rho"
θ "theta"	π "pi "	Ω "Omega"*	λ "lambda"	Σ "Sigma"*
α "alpha"	β "beta"	γ "gamma"	Δ "Delta"*	ε "epsilon"

Greek Letters Two very common Greek letters are Δ and Σ . Δ is used to indicate that we should use the change or difference between the final and initial values of that specific variable. Σ denotes the sum or net value of a variable.

Guidance

- Every answer to a physics problem must include units. Even if a problem explicitly asks for a speed in meters per second (m/s), the answer is 5 m/s, not 5.
- If a unit is named after a person, it is capitalized. So you write "10 Newtons," or "10 N," but "10 meters," or "10 m."
- Metric units use a base numbering system of 10. Thus a centimeter is ten times larger than a millimeter. A decimeter is 10 times larger than a centimeter and a meter is 10 times larger than a decimeter. Thus a meter is 100 times larger than a centimeter and 1000 times larger than a millimeter. Going the other way, one can say that there are 100 cm contained in a meter.

Example 1 **Question**: Convert 2500 m/s into km/s

Solution: A km (kilometer) is 1000 times bigger than a meter. Thus, one simply divides by 1000 and arrives at 2.5 km/s

Example 2 **Question**: The lengths of the sides of a cube are doubling each second. At what rate is the volume increasing?

Solution:The cube side length, x, is doubling every second. Therefore after 1 second it becomes $2x$. The volume of the first cube of side x is $x \times x \times x = x^3$. The volume of the second cube of side $2x$ is $2x \times 2x \times 2x = 8x^3$. The ratio of the second volume to the first volume is $8x^3/x^3 = 8$. Thus the volume is increasing by a factor of 8 every second.

Watch this Explanation

MEDIA

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Time for Practice

1. A tortoise travels 15 meters (m) west, then another 13 centimeters (cm) west. How many meters total has she walked?

2. A tortoise, Bernard, starting at point A travels 12 m west and then 150 millimeters (mm) east. How far west of point A is Bernard after completing these two motions?
3. $80\text{ m} + 145\text{ cm} + 7850\text{ mm} = X$ mm. What is X ?
4. A square has sides of length 45 mm. What is the area of the square in mm^2?
5. A square with area 49 cm^2 is stretched so that each side is now twice as long. What is the area of the square now? Include a sketch.
6. A rectangular solid has a square face with sides 5 cm in length, and a length of 10 cm. What is the volume of the solid in cm^3? Sketch the object, including the dimensions in your sketch.
7. As you know, a cube with each side 4 m in length has a volume of 64 m^3. Each side of the cube is now doubled in length. What is the *ratio* of the new volume to the old volume? Why is this ratio **not** simply 2? Include a sketch with dimensions.
8. What is the ratio of the mass of the Earth to the mass of a single proton? (See equation sheet.)
9. A spacecraft can travel 20 km/s. How many km can this spacecraft travel in 1 hour (h)?

Answers

1. 15.13 m
2. 11.85 m
3. $89,300$ mm
4. 2025 mm^2
5. 196 cm^2
6. 250 cm^3
7. $8:1$, each side goes up by 2 cm, so it will change by 2^3
8. $3.5 \times 10^{51} : 1$
9. $72,000$ km/h