# L.1 UNITS AND GRAPHS

THE VORTEX EDU
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1. Fundamental and Derived Units
2. Identifying Graphs

## FUNDAMENTAL AND DERIVED UNITS

The **fundamental metric units** (SI units) in physics cover the basic quantities measured, such as length, mass, and time. The units measure a quantity and are given a unit name and symbol. Table 1.1 lists the fundamental quantities along with the unit names and symbols.

**Table 1.1** Fundamental Quantities and Units

| Quantity (Symbol) | Unit Name | Symbol |
|---|---|---|
| Length ($l$) | Meter | m |
| Mass ($m$) | Kilogram | kg |
| Time ($t$) | Second | s |
| Electric current ($I$) | Ampere | A |
| Temperature ($T$) | Kelvin | K |
| Amount of substance ($n$) | Mole | mol |

**Derived units** are combinations of one or more of the fundamental units. Table 1.2 lists common derived units used in physics.

**Table 1.2** Derived Units

| Quantity (symbol) | Unit Name | Symbol | Fundamental Units |
|---|---|---|---|
| Area ($A$) | Area | $m^2$ | $m^2$ |
| Volume ($V$) | Volume | $m^3$ | $m^3$ |
| Density ($\rho$) | Density | $kg/m^3$ | $kg/m^3$ |
| Frequency ($f$) | Hertz | Hz | $s^{-1}$ |
| Force ($F$) | Newton | N | $kg \cdot m/s^2$ |
| Energy ($E$) | Joule | J | $N \cdot m = kg \cdot m^2/s^2$ |
| Power ($P$) | Watt | W | $J/s = kg \cdot m^2/s^3$ |
| Pressure ($P$) | Pascal | Pa | $N/m^2 = kg/m \cdot s^2$ |
| Electric charge ($q$) | Coulomb | C | $A \cdot s$ |
| Electric potential ($V$) | Volt | V | $J/C = J/A \cdot s = kg \cdot m^2/A \cdot s^3$ |

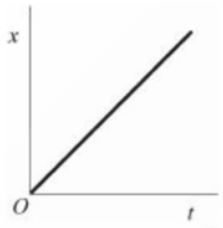
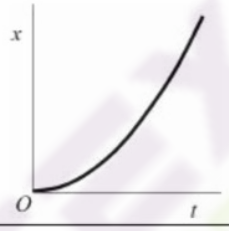
**EXAMPLE 1.1**

**Derived Units**

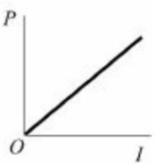
The unit of force is the newton. What are the fundamental units that make up the newton?

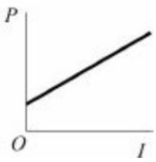
| Prefix | Abbreviation | Value |
|---|---|---|
| peta | P | $10^{15}$ |
| tera | T | $10^{12}$ |
| giga | G | $10^{9}$ |
| mega | M | $10^{6}$ |
| kilo | k | $10^{3}$ |
| hecto | h | $10^{2}$ |
| deca | da | $10^{1}$ |
| deci | d | $10^{-1}$ |
| centi | c | $10^{-2}$ |
| milli | m | $10^{-3}$ |
| micro | μ | $10^{-6}$ |
| nano | n | $10^{-9}$ |
| pico | p | $10^{-12}$ |
| femto | f | $10^{-15}$ |

**Table 1.3** Identifying Graphs

| Desired Graph | What's the Trick? | Graph |
|---|---|---|
| How would $x = vt$ appear on an $x$ versus $t$ graph? | Solve for $x$ (dependent variable). $x = v\,t$ Examine $t$ (independent variable). $t$ is *not* squared, *not* under a square root, and *not* inverted. The graph must be linear (directly proportional). |   |
| How would $x = \frac{1}{2}\,at^2$ appear on an $x$ versus $t$ graph? | Solve for $x$ (dependent variable). $x = \frac{1}{2}\,a\,t^2$ Examine $t$ (independent variable). $t$ is *squared* . The graph is quadratic (a parabola). |   |
| How would $T = 2\pi\sqrt{L/g}$ appear on a $T$ versus $L$ graph? | Solve for $T$ (dependent variable). $T = 2\pi\sqrt{L/g}$ Examine $L$ (independent variable). $L$ is under a *square root.* |   |
| How would $PV = nRT$ appear on a $P$ versus $V$ graph? | Solve for $P$ (dependent variable). $P = nRT\frac{1}{V}$ Examine $V$ (independent variable). $V$ is *inverted* . The graph is a hyperbola (inversely proportional). |   |

Which graph best represents the equation, $P = I^2 R$ ?

(A)


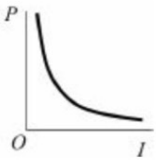

(B)



(C)

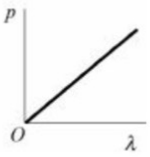


(D)



(E)



Which graph best represents the equation $p = h/\lambda$?

(A)



(B)

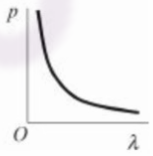


(C)



(D)



(E)



Which graph best represents the equation $F = k\,x$ ?

(A)



(B)



(C)



(D)



(E)