# 27.2 Units, Constants, and Conversions

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| **Table 27.1 Physical quantities and their SI Units** | | | | |
|  | *symbol* | *SI measurement units* | *symbol* | *unit dimensions* |
| **distance** | ***d*** | **meter** | **m** | **m** |
| **mass** | ***m*** | **kilogram** | **kg** | **kg** |
| **time** | ***t*** | **second** | **s** | **s** |
| **electric charge\*** | ***Q*** | **coulomb** | **C** | **C** |
| **temperature** | ***T*** | **Kelvin** | **K** | **K** |
| **amount of substance** | ***n*** | **mole** | **mol** | **mol** |
| **luminous intensity** | ***I*** | **candela** | **cd** | **cd** |
| acceleration | *a* | meter per second squared | m/s2 | m/s2 |
| area | *A* | square meter | m2 | m2 |
| capacitance | *C* | farad | F | C2.s2/kg.m2 |
| concentration | *[C]* | molar | M | mol/dm3 |
| density | *D* | kilogram per cubic meter | kg/m3 | kg/m3 |
| electric current | *I* | ampere | A | C/s |
| electric field intensity | *E* | newton per coulomb | N/C | kg.m/C.s2 |
| electric resistance | *R* | ohm | Ω | kg.m2/C2.s |
| emf | *ξ* | volt | V | kg.m2/C.s2 |
| energy | *E* | joule | J | kg.m2/s2 |
| force | *F* | newton | N | kg.m/s2 |
| frequency | *f* | hertz | Hz | s-1 |
| heat | *Q* | joule | J | kg.m2/s2 |
| illumination | *E* | lux (lumen per square meter) | lx | cd/m2 |
| inductance | *L* | henry | H | kg.m2/C2 |
| magnetic flux | *φ* | weber | Wb | kg.m2/C.s |
| potential difference | *V* | volt | V | kg.m2/C.s2 |
| power | *P* | watt | W | kg.m2/s3 |
| pressure | *p* | pascal (newton per square meter) | Pa | kg/m.s2 |
| velocity | *v* | meter per second | m/s | m/s |
| volume | *V* | cubic meter | m3 | m3 |
| work | *W* | joule | J | kg.m2/s2 |

\* The official SI quantity is electrical current, and the base unit is the ampere. Electrical current is the amount of electrical charge (measured in coulombs) per unit of time.

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| **Table 27.2 Metric system prefixes** | | | |
| Factor | Decimal Representation | Prefix | Symbol |
| 1018 | 1,000,000,000,000,000,000 | exa | E |
| 1015 | 1,000,000,000,000,000 | peta | P |
| 1012 | 1,000,000,000,000 | tera | T |
| 109 | 1,000,000,000 | giga | G |
| 106 | 1,000,000 | mega | M |
| 103 | 1,000 | kilo | k |
| 102 | 100 | hecto | h |
| 101 | 10 | deka | da |
| 100 | 1 |  |  |
| 10-1 | 0.1 | deci | d |
| 10-2 | 0.01 | centi | c |
| 10-3 | 0.001 | milli | m |
| 10-6 | 0.000 001 | micro |  |
| 10-9 | 0.000 000 001 | nano | n |
| 10-12 | 0.000 000 000 001 | pico | p |
| 10-15 | 0.000 000 000 000 001 | femto | f |
| 10-18 | 0.000 000 000 000 000 001 | atto | a |

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| **Table 27.3 Physical constants** | | |
| Planck constant | *h* | 6.6260755·10-34 J·s |
| Boltzmann constant | *kB* | 1.380658·10-23 J/ |
| Elementary charge | *e* | 1.60217733·10-19 C |
| Avogadro’s number | *NA* | 6.0221367·1023 particles/mol |
| Speed of light | *c* | 2.99792458·108 m/s |
| Electron rest mass | *me* | 9.1093897·10-31 kg |
| Proton rest mass | *mp* | 1.6726231·10-27 kg |
| Neutron rest mass | *mn* | 1.6749286·10-27 kg |
| Atomic mass unit | amu | 1.66054·10-27 kg |
| Gas constant | *R* | 8.31451 m2·kg/s2·K·mol |
| Molar volume | *Vmol* | 22.41383 m3/kmol |
| Faraday constant | *F* | 9.64846·104 C/mol |
| Gravitational constant | *G* | 6.673·10-11 m3/kg·s2 |
| Acceleration due to gravity | *g* | 9.80665 m/s2 |

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| **27.4 SI and customary units and conversions** | | | | | |
| *Quantity* | *SI Unit* | *Symbol* | *Customary Unit* | *Symbol* | *Conversion* |
| Length | meter | m | foot | ft | 1 m= 3.280 ft |
| Area | square meter | m2 | square foot | ft2 | 1 m2=10.76 ft2 |
| Volume | cubic meter | m3 | cubic foot | ft3 | 1 m3 = 35.32 ft3 |
| Speed | meter per second | m/s | foot per second | ft/s | 1 m/s = 3.280 ft/s |
| Acceleration | meter per second per second | m/s2 | feet per second per second | ft/s2 | 1 m/s2 = 3.280 ft/s2 |
| Force | newton | N | pound | lb | 1 N = 0.2248 lb |
| Work  (energy) | joule | J | foot-pound | ft.lb | 1 J = 0.7376 ft.lb |
| Power | watt | W | foot-pound per second | ft.lb/s | 1 W = 0.7376 ft.lb/s |
| Pressure | pascal | Pa | pound per square inch | lb/in2 | 1 Pa = 1.450 x 10-4 lb/in2 |
| Density | kilogram per cubic meter | kg/m3 | pound per cubic foot | lb/ft3 | 1 kg/m3 = 6.243 x 10-2 lb/ft3 |

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| **27.5 SI and customary units and conversions** | | | | |
| Quantity | Customary Unit | Metric Unit | Customary/Metric | Metric/Customary |
| Length | inch (in) | millimeter (mm) | 1 in = 25.4 mm | 1 mm = 0.0394 in |
|  | foot (ft) | meter (m) | 1 ft = 0.305 m | 1 m = 3.28 ft |
|  | yard (yd) | meter (m) | 1 yd = 0.914 m | 1 m = 1.09 yd |
|  | mile (mi) | kilometer (km) | 1 mi = 1.61 km | 1 km = 0.621 mi |
| Area | square inch (in2) | square centimeter (cm2) | 1 in2 = 6.45 cm2 | 1 cm2 = 0.155 in2 |
|  | square foot (ft2) | square meter (m2) | 1 ft2 = 0.0929 m2 | 1 m2 = 10.8 ft2 |
|  | square yard (yd2) | square meter (m2) | 1 yd2 = 0.836 m2 | 1 m2 = 1.20 yd2 |
|  | acre (acre) | hectare (ha) | 1 acre = 0.405 ha | 1 ha = 2.47 acre |
| Volume | cubic inch (in3) | cubic centimeter (cm3) | 1 in3 = 16.39 cm3 | 1 cm3 = 0.0610 in3 |
|  | cubic foot (ft3) | cubic meter (m3) | 1 ft3 = 0.0283 m3 | 1 m3 = 35.3 ft3 |
|  | cubic yard (yd3) | cubic meter (m3) | 1 yd3 = 0.765 m3 | 1 m3 = 1.31 yd3 |
|  | quart (qt) | liter (L) | 1 qt = 0.946 L | 1 L = 1.06 qt |
| Mass | ounce (oz) | gram (g) | 1 oz = 28.4 g | 1 g = 0.0352 oz |
|  | pound (lb) | kilogram (kg) | 1 lb = 0.454 kg | 1 kg = 2.20 lb |
|  | ton (ton) | metric ton (t) | 1 ton = 0.907 t | 1 t = 1.10 ton |
| Weight | pound (lb) | newton (N) | 1 lb = 4.45 N | 1 N = 0.225 lb |