CONVERSIONS

Angle

1 rad	= 57.3 deg
π rad	**= 180 deg**

Area

1 acre	= 4047 m^2
	= 0.00156 mi^2

Energy

1 J	= 0.239 cal
	= 9.48×10^{-4} BTU
	= 0.7376 ft lb_f
1 kW h	**= 3,600,000 J**

Force

1 N	= 0.225 lb_f
	= 1 E 5 dyne
1 kip	**= 1,000 lb_f**

Length

1 m	= 3.28 ft
1 km	= 0.621 mi
1 in	**= 2.54 cm**
1 mi	**= 5,280 ft**
1 yd	**= 3 ft**

Mass

1 kg	= 2.205 lb_m
1 slug	= 32.2 lb_m
1 ton	**= 2,000 lb_m**

Power

1 W	= 3.412 BTU/h
	= 0.00134 hp
	= 14.34 cal/min
	= 0.7376 ft lb_f/s

Pressure

1 atm	= 1.01325 bar
	= 33.9 ft H_2O
	= 29.92 in Hg
	= 760 mm Hg
	= 101,325 Pa
	= 14.7 psi

Time

1 d	**= 24 h**
1 h	**= 60 min**
1 min	**= 60 s**
1 yr	= 365 d

Temperature

1 K	**= 1 °C**
	= 1.8 °F
	= 1.8 °R

Volume

1 L	= 0.264 gal
	= 0.0353 ft^3
	= 33.8 fl oz
1 mL	**= 1 cm^3 = 1 cc**

Named Units

1 cP	= 0.01 g/(cm s)
1 F	= 1 A s/V
1 H	= 1 V s/A
1 Hz	= 1 s^{-1}

1 J	= 1 N m
1 N	= 1 kg m/s^2
1 Pa	= 1 N/m^2
1 St	= 1 cm^2/s

1 V	= 1 W/A
1 W	= 1 J/s
1 Ω	= 1 V/A

Conversions shown in bold text above indicate exact conversions

SI PREFIXES

Numbers Less Than One		
Power of 10	**Prefix**	**Abbreviation**
10^{-1}	deci-	d
10^{-2}	centi-	c
10^{-3}	milli-	m
10^{-6}	micro-	μ
10^{-9}	nano-	n
10^{-12}	pico-	p
10^{-15}	femto-	f
10^{-18}	atto-	a
10^{-21}	zepto-	z
10^{-24}	yocto-	y

Numbers Greater Than One		
Power of 10	**Prefix**	**Abbreviation**
10^{1}	deca-	da
10^{2}	hecto-	h
10^{3}	kilo-	k
10^{6}	Mega-	M
10^{9}	Giga-	G
10^{12}	Tera-	T
10^{15}	Peta-	P
10^{18}	Exa-	E
10^{21}	Zetta-	Z
10^{24}	Yotta-	Y

FUNDAMENTAL DIMENSIONS [BASE SI UNITS]

I	electric current [A]	M	mass [kg]	T	time [s]
J	light intensity [cd]	N	amount of substance [mol]	Θ	temperature [K]
L	length [m]				

COMMON DERIVED UNITS IN THE SI SYSTEM

Dimension	SI Unit	Base SI Units	Derived from
Force (F)	newton [N]	$1\text{ N} = 1\dfrac{\text{kg m}}{\text{s}^2}$	F = m a Force = mass times acceleration
Energy (E)	joule [J]	$1\text{ J} = 1\text{ N m} = 1\dfrac{\text{kg m}^2}{\text{s}^2}$	E = F d Energy = force times distance
Power (P)	watt [W]	$1\text{ W} = 1\dfrac{\text{J}}{\text{s}} = 1\dfrac{\text{kg m}^2}{\text{s}^3}$	P = E/t Power = energy per time
Pressure (P)	pascal [Pa]	$1\text{ Pa} = 1\dfrac{\text{N}}{\text{m}^2} = 1\dfrac{\text{kg}}{\text{m s}^2}$	P = F/A Pressure = force per area
Voltage (V)	volt [V]	$1\text{ V} = 1\dfrac{\text{W}}{\text{A}} = 1\dfrac{\text{kg m}^2}{\text{s}^3\text{ A}}$	V = P/I Voltage = power per current

PHYSICAL CONSTANTS [VALUE AND UNITS]

c	speed of light in a vacuum	$= 3 \times 10^{8}$ m/s
e	Euler's number (base of natural logarithm)	= 2.71828 . . .
	elementary charge of an electron	$= 1.602 \times 10^{-19}$ C
φ	Golden ratio	= 1.61803 . . .
F	Faraday's constant	$= 9.65 \times 10^{4}$ C/mol
g	acceleration due to gravity	= 9.8 m/s^2 on Earth
G	gravitational constant	$= 6.67 \times 10^{-11}$ (N m^2)/kg^2
h	Planck constant	$= 6.62 \times 10^{-34}$ J s
k	Boltzmann constant	$= 1.38 \times 10^{-23}$ J/K
k_e	Coulomb's constant	$= 9 \times 10^{9}$ (N m^2)/C^2
N_A	Avogadro's number	$= 6.022 \times 10^{23}$ mol^{-1}
π	ratio of circle circumference to diameter	= 3.14159 . . .
R	gas constant	= 8314 (Pa L)/(mol K) = 0.08206 (atm L)/(mol K)
σ	Stefan-Boltzmann constant	$= 5.67 \times 10^{-8}$ W/(m^2 K^4)

Equations

Circuits: Ohm's Law
$V = I\,R$

Circuits: Parallel Resistors
$$R_{eff} = \left(\frac{1}{R_1} + \frac{1}{R_2} + \cdots + \frac{1}{R_{N-1}} + \frac{1}{R_N}\right)^{-1}$$

Circuits: Series Resistors
$R_{eff} = R_1 + R_2 + \cdots + R_{N-1} + R_N$

Density
$\rho = m/V$

Efficiency
$\eta = \text{output}/\text{input}$

Work
$W = F\,\Delta x$

Potential Energy
$PE = m\,g\,\Delta H$

Kinetic Energy, translational
$KE_T = \frac{1}{2}\,m\,(v_f^2 - v_i^2)$

Kinetic Energy, rotational
$KE_R = \frac{1}{2}\,I\,(\omega_f^2 - \omega_i^2)$

Kinetic Energy, total
$KE = KE_T + KE_R$

Thermal Energy
$Q = m\,C_p\,\Delta T$

Force: Newton's 2^{nd} Law
$F = m\,a$

Interpolation
$$\frac{(A - A_1)}{(A_2 - A_1)} = \frac{(B - B_1)}{(B_2 - B_1)}$$

Power
$P = E/t$

Power: Joule's First Law
$P = I^2\,R$

Pressure
$P = F/A$

Pressure, Hydrostatic: Pascal's Law
$P_{hydro} = \rho\,g\,H$

Pressure, Total
$P_{total} = P_{surface} + \rho\,g\,H$

Pressure: Ideal Gas Law
$P\,V = n\,R\,T$

Specific Gravity
$SG = \rho_{object}/\rho_{water}$

Specific Weight
$\gamma = w/V$

Springs: Hooke's Law
$F = k\,x$

Springs: Parallel
$k_{eff} = k_1 + k_2 + \cdots + k_{N-1} + k_N$

Springs: Series
$$k_{eff} = \left(\frac{1}{k_1} + \frac{1}{k_2} + \cdots + \frac{1}{k_{N-1}} + \frac{1}{k_N}\right)^{-1}$$

Temperature
$$\frac{T\,[°F] - 32}{180} = \frac{T\,[°C] - 0}{100}$$
$T\,[K] = T\,[°C] + 273$
$T\,[°R] = T\,[°F] + 460$

Temperature: Newton's Law of Cooling
$T = T_0\,e^{-kt}$

Viscosity, Dynamic: Newton's Law of Viscosity
$\tau = \mu\,(\Delta v/\Delta y)$

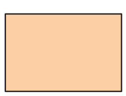
Viscosity, Kinematic
$\nu = \mu/\rho$

Weight
$w = m\,g$

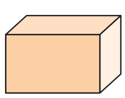
Young's Modulus
$\sigma = E\,\varepsilon$

Geometric Formulas

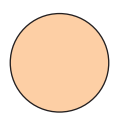
Rectangle
Area $= a\,b$
Perimeter $= 2\,a + 2\,b$



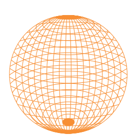
Rectangular Parallelepiped
Volume $= a\,b\,c$
Surface area $= 2\,(a\,b + a\,c + b\,c)$



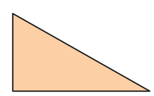
Circle
Area $= \pi\,r^2$
Perimeter $= 2\pi\,r$



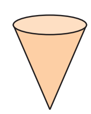
Sphere
Volume $= 4/3\,\pi\,r^3$
Surface area $= 4\,\pi\,r^2$



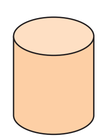
Triangle
Area $= \frac{1}{2}\,b\,H$



Right Circular Cone
Volume $= 1/3\,\pi\,r^2\,H$



Right Circular Cylinder
Volume $= \pi\,r^2\,h$
Lateral Surface Area $= 2\pi\,r\,H$



Miscellaneous Equations

Antoine equation

$$P = 10^{\left(A - \frac{B}{T+C}\right)}$$

Cantilever Beam Deflection

$$P = K\,\Delta$$

Discharging Capacitor

$$V = V_0\, e^{-t/RC}$$

Energy in an Inductor

$$E = \frac{1}{2} L I^2$$

Moore's Law

$$T = T_0\, 2^{\frac{t}{2}}$$

Oscillating spring

$$f = \frac{1}{2\pi}\sqrt{\frac{k}{m}}$$

Poiseuille's Equation

$$R = \frac{8\mu L}{\pi r^4}$$

Pythagoras' Theorem

$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

Resonant frequency for one inductor and one capacitor

$$f_R = \frac{1}{2\pi\sqrt{L\,C}}$$

Shockley Equation

$$I = I_0\left(\frac{V_D}{e^{nV_t} - 1}\right)$$

Torricelli's Law

$$v = \sqrt{2\,g\,H}$$

van der Waals Equation

$$\left(P + \frac{an^2}{V^2}\right)(V - b\,n) = n\,R\,T$$

Bingham plastic

$$\tau = \mu\frac{\Delta v}{\Delta y} + \tau_0$$

Dimensionless Number Equations

Coefficient of Drag

$$C_d = \frac{F}{\frac{1}{2}\rho v^2 A_p}$$

Friction factor: Laminar Flow

$$f = \frac{64}{Re}$$

Friction factor: Blasius Approximation

$$f = 0.316\,(Re)^{-1/4}$$

Friction factor: Colebrook

$$\frac{1}{\sqrt{f}} = -2\,\log\left(\frac{\varepsilon/D}{3.7} + \frac{2.51}{Re\sqrt{f}}\right)$$

Mach Number

$$Ma = \frac{speed_{object}}{speed_{sound\ in\ air}}$$

Power Number

$$N_P = \frac{P}{\rho n^3 D^5}$$

Reynolds Number: Use with Coefficient of Drag

$$Re = \frac{D_p \rho v}{\mu}$$

Reynolds Number: Pipe Flow

$$Re = \frac{\rho D v}{\mu}$$

$Re < 2000$ = laminar flow
$2000 < Re < 10{,}000$ = transition flow
$Re > 10{,}000$ = turbulent flow

Reynolds Number: Use with Power Number

$$Re = \frac{D^2 n \rho}{\mu}$$

Statistics Equations

Mean

$$\bar{X} = \frac{1}{N}(X_1 + X_2 + \cdots + X_N) = \frac{1}{N}\sum_{j=1}^{N} X_j$$

Median

Place data in ascending order.
If N = odd, median = central value.
If N = even, median = mean of two central values.

Variance

$$V_x^2 = \frac{1}{N-1}((\bar{X} - X_1)^2 + \cdots + (\bar{X} - X_N)^2) = \frac{1}{N-1}\sum_{j=1}^{N}(\bar{X} - X_j)^2$$

Standard Deviation

$$SD_X = \sqrt{V_X^2}$$

MATLAB Graphing Properties

Most MATLAB graphing functions have the ability to apply special properties for customization of the appearance of a graph. This document contains a partial list of common property names and values available. In most cases, the property name and property values are placed inside of single quotes; exceptions are noted below. All functions are case sensitive, but properties names and parameters are not case sensitive. For example, the command Plot will not work in place of plot; for color 'black' and 'Black' and 'b' and 'B' all work; 'MarkerSize', 'MARKERSIZE', and 'markersize' all work.

Line Style		Marker Style				Color	
-	solid	*	Asterisk	.	Point	k	Black
--	dashed	o	Circle	V	Triangle: downward-point	b	Blue
-.	dash-dot	x	Cross	<	Triangle: left-point	c	Cyan
:	dotted	+	Plus sign	>	Triangle: Right-point	g	Green
				^	Triangle: Upward-point	m	Magenta
		d `diamond`	Diamond	h `hexagram`	Hexagram (6-pointed star)	r	Red
		s `square`	Square	p `pentagram`	Pentagram (5-pointed star)	y	Yellow
						w	While

The Marker Styles as noted and Color properties can be expressed as either the abbreviation (d) or the full word (diamond).

Plotting Properties: `plot`

Property Name	Purpose: To Change...	Values, in Single Quotes	Default
`LineWidth`	Width of line (in units of points)	Numerical values without single quotes	0.5 points
`MarkerEdgeColor`	Border color of marker	See **COLOR** list	Default marker color
`MarkerFaceColor`	Fill color of marker *Works for markers: o d s h p V < > ^*	See **COLOR** list	Default marker color
`MarkerSize`	Size of marker (in units of points)	Numerical values without single quotes	6 points

Legend Properties: `legend`

All legend properties except `location` must be adjusted using the `set` command, not directly in the legend function. First, a legend name (a handle) is defined by `LegendName = legend(`…`)`. The `LegendName` is used with `set` to adjust the legend display properties.

Property Name	Purpose: To Change...	Values, in Single Quotes	Default
`LineWidth`	Width of line (in units of points) bordering the legend	Numerical values without single quotes	0.5 points
`EdgeColor`	Border color around legend box	See **COLOR** list	`black`
`Color`	Background color of legend box	See **COLOR** list	`white`
`TextColor`	Text color of legend entries	See **COLOR** list	`black`
`FontSize` `FontAngle` `FontWeight`	Attribute of text legend entries	See related entries under `Text Properties`	

`Location`	Location of legend in FIGURE window
	NW N NE
	W E
	SW S SE
		`North` `South` `East` `West`
		`NorthEast` `NorthWest`
		`SouthEast` `SouthWest`
			Inside plot box

		`__Outside` (__ is a directional operator above)	Outside plot box
		`Best`	Inside plot box with least data conflict
		`BestOutside`	Outside plot box in least unused space

NOTE: The use of `Color` as a property in MATLAB is inconsistent. In a legend, `Color` refers to background color, whereas in most text related objects it refers to font color and `BackgroundColor` is for the background color. In a legend, the font color is assigned using `TextColor`.

Original source: http://www.mathworks.com/help/techdoc

Stephan, Bowman, Park, Sill, Ohland

MATLAB Graphing Properties

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Text Properties: `text`, `xlabel`, `ylabel`, `title`

Property Name	Purpose: To Change ...	Values, Place in Single Quotes			Default
`BackgroundColor`	Background color of the textbox	See **`COLOR`** list **`[X,Y,Z]`** Custom: Amount of red (X), green (Y), and blue (Z); each value is between 0 and 1			Transparent
`Color`	Text color in the textbox	See Color list			**`black`**
`EdgeColor`	Border color around the textbox	See Color list			**`none`**
*The following commands are only enabled when the **`EdgeColor`** property is changed to a visible color.*					
`LineStyle`	Line style bordering the textbox	See **`LINE STYLE`** list			**-**
`LineWidth`	Line width (in unit of points) of line bordering the textbox	Numerical values without single quotes			0.5 points
`Margin`	Space (in unit of pixels) between text in textbox and line bordering textbox	Numerical values without single quotes			2.0 points
`FontAngle`	Font angle	**`normal`**	**`italic`**		**`normal`**
`FontSize`	Font size (in units of points)	Numerical values without single quotes			10.0 points
`FontWeight`	Font weight	**`normal`**	**`bold`**	**`demi`**	**`normal`**
`HorizontalAlignment`	Alignment of textbox at (x,y) location	**`left`**	**`center`**	**`right`**	**`left`**
`VerticalAlignment`	Alignment of textbox at (x,y) location	**`top`**	**`middle`**	**`bottom`**	**`middle`**
		`baseline`	**`cap`**		

Special Characters

These special characters are available for use in graphs in the title, legend, axis labels and text boxes.

Greek Letters						Math Symbols				Just for Fun	
`\alpha`	α	`\epsilon`	ε	`\pi`	π	`\approx`	≈	`\pm`	±	`\heartsuit`	♥
`\beta`	β	`\eta`	η	`\rho`	ρ	`\leq`	≤	`\circ`	°	`\leftarrow`	←
`\gamma`	γ	`\theta`	θ	`\sigma`	σ	`\geq`	≥	`\partial`	∂	`\Leftarrow`	⇐
`\Gamma`	Γ	`\lambda`	λ	`\Sigma`	Σ	`\neq`	≠	`\int`	∫	`\rightarrow`	→
`\delta`	δ	`\mu`	μ	`\tau`	τ	`\infty`	∞	`\div`	÷	`\Rightarrow`	⇒
`\Delta`	Δ	`\nu`	ν	`\Omega`	Ω					`\copyright`	©

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