Engineering Formula Sheet

Statistics

Mean

$$\mu = \frac{\sum x_i}{n}$$

μ = mean value
$\sum x_i$ = sum of all data values (x_1, x_2, x_3, …)
n = number of data values

Standard Deviation

$$\sigma = \sqrt{\frac{\sum (x_i - \mu)^2}{n}}$$

σ = standard deviation
x_i = individual data value (x_1, x_2, x_3, …)
μ = mean value
n = number of data values

Mode

Place data in ascending order.
Mode = most frequently occurring value

If two values occur at the maximum frequency the data set is *bimodal.*
If three or more values occur at the maximum frequency the data set is *multi-modal.*

Median

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

n = number of data values

Range

Range = $x_{max} - x_{min}$

x_{max} = maximum data value
x_{min} = minimum data value

Probability

Frequency

$$f_x = \frac{n_x}{n}$$

$$P_x = \frac{f_x}{f_a}$$

f_x = relative frequency of outcome x
n_x = number of events with outcome x
n = total number of events
P_x = probability of outcome x
f_a = frequency of all events

Binomial Probability (order doesn't matter)

$$P_k = \frac{n!(p^k)(q^{n-k})}{k!(n-k)!}$$

P_k = binomial probability of k successes in n trials
p = probability of a success
q = 1 – p = probability of failure
k = number of successes
n = number of trials

Independent Events

P (A and B and C) = $P_A P_B P_C$

P (A and B and C) = probability of independent events A and B and C occurring in sequence
P_A = probability of event A

Mutually Exclusive Events

P (A or B) = $P_A + P_B$

P (A or B) = probability of either mutually exclusive event A or B occurring in a trial
P_A = probability of event A
Σx_i = sum of all data values (x_1, x_2, x_3, …)
n = number of data values

Conditional Probability

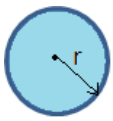
$$P(A|D) = \frac{P(A) \cdot P(D|A)}{P(A) \cdot P(D|A) + P(\sim A) \cdot P(D|\sim A)}$$

P (A|D) = probability of event A given event D
P(A) = probability of event A occurring
P(~A) = probability of event A not occurring
P(D|~ A) = probability of event D given event A did not occur

Plane Geometry

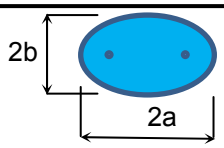
Circle

Circumference = $2\pi r$
Area = πr^2



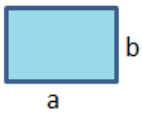
Ellipse

Area = $\pi a b$



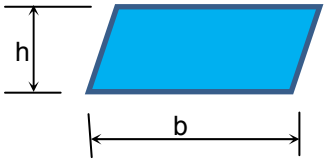
Rectangle

Perimeter = 2a + 2b
Area = ab



Parallelogram

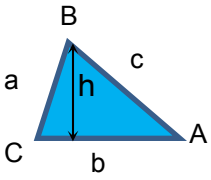
Area = bh



Triangle

Area = ½ bh

$a^2 = b^2 + c^2 - 2bc \cdot cos\angle A$
$b^2 = a^2 + c^2 - 2ac \cdot cos\angle B$
$c^2 = a^2 + b^2 - 2ab \cdot cos\angle C$



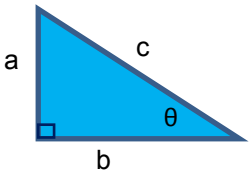
Right Triangle

$c^2 = a^2 + b^2$

$sin\,\theta = \frac{a}{c}$

$cos\,\theta = \frac{b}{c}$

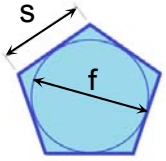
$tan\,\theta = \frac{a}{b}$



Regular Polygons

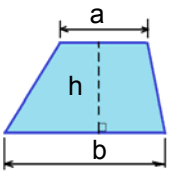
Area = $n\frac{s(\frac{1}{2}f)}{2}$

n = number of sides



Trapezoid

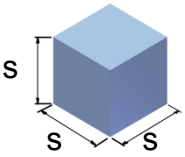
Area = ½(a + b)h



Solid Geometry

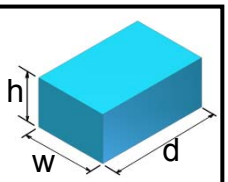
Cube

Volume = s^3
Surface Area = $6s^2$



Rectangular Prism

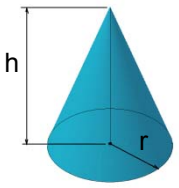
Volume = wdh
Surface Area = 2(wd + wh + dh)



Right Circular Cone

Volume = $\frac{\pi r^2 h}{3}$

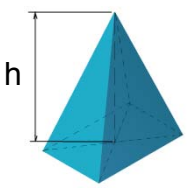
Surface Area = $\pi r \sqrt{r^2+h^2}$



Pyramid

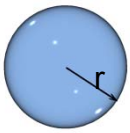
Volume = $\frac{Ah}{3}$

A = area of base



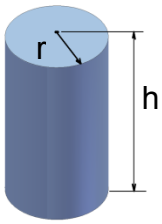
Sphere

Volume $\frac{4}{3}\pi r^3$
Surface Area = $4\pi r^2$



Cylinder

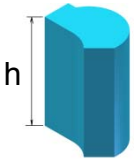
Volume = $\pi r^2 h$
Surface Area = $2\pi r h + 2\pi r^2$



Irregular Prism

Volume = Ah

A = area of base



Constants

g = 9.8 m/s^2 = 32.27 ft/s^2
G = 6.67 x 10^{-11} m^3/kg·s^2
π = 3.14159

Conversions

Mass

1 kg = 2.205 lb_m
1 slug = 32.2 lb_m
1 ton = 2000 lb_m

Length

1 m = 3.28 ft
1 km = 0.621 mi
1 in. = 2.54 cm
1 mi = 5280 ft
1 yd = 3 ft

Time

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

Area

1 acre = 4047 m^2
= 43,560 ft^2
= 0.00156 mi^2

Volume

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

Temperature Unit Equivalents

1 K = 1 ºC
= 1.8 ºF
= 1.8 ºR

See below for temperature calculation

Force

1 N = 0.225 lb_f
1 kip = 1,000 lb_f

Pressure

1 atm = 1.01325 bar
= 33.9 ft H_2O
= 29.92 in. Hg
= 760 mm Hg
= 101,325 Pa
= 14.7 psi
1psi = 2.31 ft of H_2O

Power

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

Energy

1 J = 0.239 cal
= 9.48 x 10^{-4} Btu
= 0.7376 ft·lb_f
1kW h = 3,600,000 J

Defined Units

1 J = 1 N·m
1 N = 1 kg·m / s^2
1 Pa = 1 N / m^2
1 V = 1 W / A
1 W = 1 J / s
1 Ω = 1 V / A
1 Hz = 1 s^{-1}
1 F = 1 A·s / V
1 H = 1 V·s / V

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

Equations

Mass and Weight

$M = VD_m$

$W = mg$

$W = VD_w$

V = volume
D_m = mass density
m = mass
D_w = weight density
g = acceleration due to gravity

Temperature

$T_K = T_C + 273$

$T_R = T_F + 460$

$T_F = \frac{5}{9} T_c + 32$

T_K = temperature in Kelvin
T_C = temperature in Celsius
T_R = temperature in Rankin
T_F = temperature in Fahrenheit

Force

$F = ma$

F = force
m = mass
a = acceleration

Equations of Static Equilibrium

$\Sigma F_x = 0$ $\Sigma F_y = 0$ $\Sigma M_P = 0$

F_x = force in the x-direction
F_y = force in the y-direction
M_P = moment about point P