***** Newton's Second Law *****

- Program to illustrate Mathcad to students

* *Some unit stuff*

- Length

$1cm = 0.01\ m$

$1in = 2.54\,cm$

$in = 25.4\,mm$

$km = 1 \times 10^{3}\ m$

$km = 1000\ m$

- Energy

$1J = 2.388 \times 10^{-4} kcal$

$kJ :=$

$kJ := 1000J$

$kJ = 1 \times 10^{3}\ J$

- Mass

$kg = 1 \times 10^{3} gm$

$g = 9.807\ \frac{m}{s^2}$ - This is the gravitational acceleration

- Volume

$gal = 0.134\,ft^{3}$ - This is the US gallon

$gal = 0.833\,galUK$

$galUS :=$

$galUS := gal$

$galUS = 0.134\,ft^{3}$

- Amount of matter

$kmol = 1 \times 10^{3}\ mol$ - This did not work until I defined the kmol

$kmol \equiv 1000mol$

* *Simple calculation*

- Applicable equation

  F = mass·acceleration

- Define F

  $F := mass \cdot acceleration$ - This does not work because the variable mass and acceleration are not defined

- Inputs

  $mass := 1kg$

  $acceleration := 9.8\frac{m}{s^2}$

- Computation

  $F_1 := mass \cdot acceleration$ - Results $F_1 = 9.8\,N$

  $F_1 = 2.203\,lbf$

* *Simple calculation (but using simplified notation)*

- Applicable equation

  F = m·a

- Inputs

  $m := 1kg$

  $a := 9.8\frac{m}{s^2}$ - Now the m does not mean metre, but 1 kg!

- Computation

  $F_2 := m \cdot a$

  $F_2 = 9.8\,\frac{kg^2}{s^2}$

  $F_2 = 2.203\,\frac{kg}{m}\,lbf$

* *Redo simple calculation (using simplified notation, but not using the reserved "m")*

$m = 1\ kg$

$m := 100cm$ - This is to restore the Matchcad definition of m

- Applicable equation

  F = mass·acc

- Inputs

  $mass := 1kg$

  $acc := 9.8\frac{m}{s^2}$

- Computation

  $F_3 := mass \cdot acc$

  $F_3 = 9.8\,N$

  $F_3 = 2.203\,lbf$

* Create arrays

$i := 0, 1 .. 4$

$mass_i := i \cdot kg$

$i =$

0
1
2
3
4

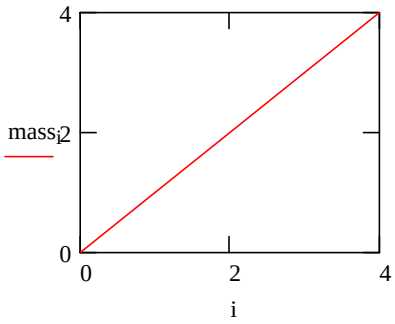
$$mass = \begin{pmatrix} 0 \\ 1 \\ 2 \\ 3 \\ 4 \end{pmatrix} kg$$

- It is essential to distinguish between the subscript and the array index number

$mass_0 :=$ - I used the subscript

$mass_0 = 0\ kg$ - I used the array index number

- Plot results from array



- Create a function

- For example, could define the following function

$F(mass, acc) = mass \cdot acc$

- Create the function

$F(mass, acc) := mass \cdot acc$

$$mass = \begin{pmatrix} 0 \\ 1 \\ 2 \\ 3 \\ 4 \end{pmatrix} kg \qquad acc = 9.8 \frac{m}{s^2}$$

$$F(mass, acc) = \begin{pmatrix} 0 \\ 9.8 \\ 19.6 \\ 29.4 \\ 39.2 \end{pmatrix} N$$

- Try it with various inputs

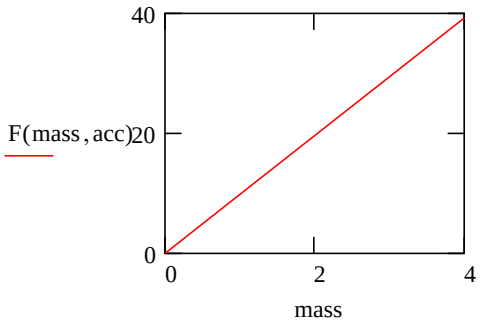
$F(mass_1, acc) = 9.8\ N$

$F(2kg, acc) = 19.6\ N$

$F\left(1lb, 32.2 \frac{ft}{s^2}\right) = 1.001\,lbf$

$F\left(1lb, \frac{9.8}{6} \frac{m}{s^2}\right) = 0.167\,lbf$

- Plot using a function



********** End of Program **********