

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

- Program to illustrate Mathcad to students

* *Some unit stuff*

- Length

$$1 \text{ cm} = 0.01 \text{ m}$$

$$1 \text{ in} = 2.54 \text{ cm}$$

$$\text{in} = 25.4 \text{ mm}$$

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

$$\text{km} = 1000 \text{ m}$$

- Energy

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

$$\text{kJ} := \blacksquare$$

$$\text{kJ} := 1000 \text{ J}$$

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

- Mass

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

$$g = 9.807 \frac{\text{m}}{\text{s}^2}$$

- This is the gravitational acceleration

- Volume

$$\text{gal} = 0.134 \text{ ft}^3$$

- This is the US gallon

$$\text{gal} = 0.833 \text{ galUK}$$

$$\text{galUS} := \blacksquare$$

$$\text{galUS} := \text{gal}$$

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

- Amount of matter

$$\text{kmol} = 1 \times 10^3 \text{ mol}$$

- This did not work until I defined the kmol

$$\text{kmol} \equiv 1000 \text{ mol}$$

*** Simple calculation**

- Applicable equation
 $F = \text{mass} \cdot \text{acceleration}$

- Define F

$F := \text{mass} \cdot \text{acceleration}$

- This does not work because the variable mass and acceleration are not defined

- Inputs

$\text{mass} := 1\text{kg}$

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

- Computation

$F_1 := \text{mass} \cdot \text{acceleration}$

- Results

$$F_1 = 9.8 \text{ N}$$

$$F_1 = 2.203 \text{ lbf}$$

*** Simple calculation (but using simplified notation)**

- Applicable equation

$F = m \cdot a$

- Inputs

$\underline{m} := 1\text{kg}$

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

- Now the m does not mean metre, but 1 kg!

- Computation

$F_2 := m \cdot a$

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

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

*** Redo simple calculation**

(using simplified notation, but not using the reserved "m")

$m = 1 \text{ kg}$

$\underline{m} := 100\text{cm}$

- This is to restore the Matchcad definition of m

- Applicable equation

$F = \text{mass} \cdot \text{acc}$

- Inputs

$\underline{\text{mass}} := 1\text{kg}$

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

- Computation

$F_3 := \text{mass} \cdot \text{acc}$

$$F_3 = 9.8 \text{ N}$$

$$F_3 = 2.203 \text{ lbf}$$

*** Create arrays**

$$i := 0, 1..4$$

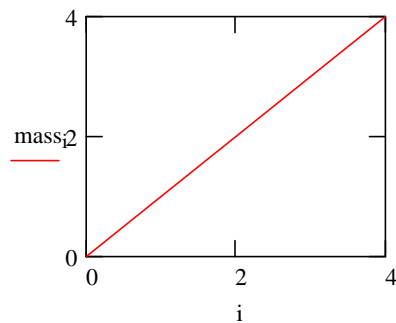
$$\underline{\text{mass}}_i := i \cdot \text{kg}$$

$$i = \begin{array}{|c|} \hline 0 \\ \hline 1 \\ \hline 2 \\ \hline 3 \\ \hline 4 \\ \hline \end{array} \quad \text{mass} = \begin{pmatrix} 0 \\ 1 \\ 2 \\ 3 \\ 4 \end{pmatrix} \text{ kg}$$

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

$\text{mass}_0 := \blacksquare$ - I used the subscript

$\text{mass}_0 = 0 \text{ kg}$ - I used the array index number

- Plot results from array**- Create a function**

- For example, could define the following function

$$F(\text{mass}, \text{acc}) = \text{mass} \cdot \text{acc}$$

- Create the function

$$\underline{\text{F}}(\text{mass}, \text{acc}) := \text{mass} \cdot \text{acc}$$

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

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

- Try it with various inputs

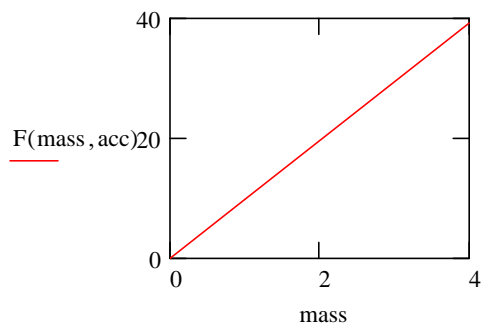
$$F(\text{mass}_1, \text{acc}) = 9.8 \text{ N}$$

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

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

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

- Plot using a function



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