Q1

For the function, $y = 0.8x^3 - 2.1x^2 + 0.75x$ calculate the value of y for the following values of x using element-by-element operations: -2, -1, 0, 1, 2, 3, 4.

Q2

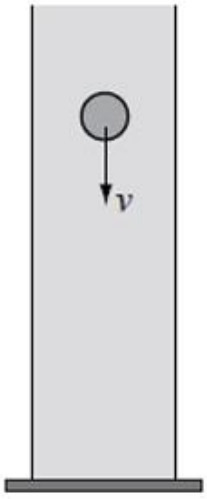
For the function, $y = \frac{x^2-2}{x+4}$ calculate the value of y for the following values of x using element-by-element operations: -3, -2, -1, 0, 1, 2, 3.

Q3

An aluminum sphere ($r = 0.2$ cm) is dropped in a glass cylinder filled with glycerin. The velocity of the sphere as a function of time $v(t)$ can be modeled by the equation

$$v(t) = \sqrt{\frac{V(\rho_{al} - \rho_{gl})g}{k}} \tanh\left(\frac{\sqrt{V(\rho_{al} - \rho_{gl})gk}}{V\rho_{al}} t\right)$$

where V is the volume of the sphere, $g = 9.81\ \text{m/s}^2$ is the gravitational acceleration, $k = 0.0018$ is a constant, and $\rho_{al} = 2700\ \text{kg/m}^3$ and $\rho_{gl} = 1260\ \text{kg/m}^3$ are the density of aluminum and glycerin, respectively. Determine the velocity of the sphere for $t = 0, 0.05, 0.1, 0.15, 0.2, 0.25, 0.3$, and 0.35 s.



Q4

The length $|\mathbf{u}|$ (magnitude) of a vector $\mathbf{u} = x\mathbf{i} + y\mathbf{j} + z\mathbf{k}$ is given by $|\mathbf{u}| = \sqrt{x^2 + y^2 + z^2}$. Given the vector $\mathbf{u} = 23.5\mathbf{i} - 17\mathbf{j} + 6\mathbf{k}$, determine its length two ways:

(*a*) Define the vector in MATLAB, and then write a mathematical expression that uses the components of the vector.

(*b*) Define the vector in MATLAB, then use element-by element operations to create a new vector with elements that are the squares of the elements of the original vector. Then use MATLAB built-in functions `sum` and `sqrt` to calculate the length. All of these steps can be written in one command.

Q5

Define x and y as the vectors $x = [1, 3, 5, 7, 9]$ and $y = [2, 5, 8, 11, 14]$. Then use them in the following expressions to calculate z using element-by-element calculations.

(*a*) $z = \dfrac{xy^2}{x + y}$ (*b*) $z = x(x^2 - y) - (x - y)^2$

Q6

Show that $\lim_{x \to 1} \dfrac{x^2 - 1}{x - 1} = 2$.

Do this by first creating a vector x that has the elements: 5, 3, 2, 1.5, 1.1, 1.001, and 1.00001. Then, create a new vector y in which each element is determined from the elements of x by $\dfrac{x^2 - 1}{x - 1}$. Compare the elements of y with the value 2 (use format long to display the numbers).

Q7

Solve the following system of five linear equations:

$$
\begin{aligned}
3u + 1.5v + w + 0.5x + 4y &= -11.75 \\
-2u + v + 4w - 3.5x + 2y &= 19 \\
6u - 3v + 2w + 2.5x + y &= -23 \\
u + 4v - 3w + 0.5x - 2y &= -1.5 \\
3u + 2v - w + 1.5x - 3y &= -3.5
\end{aligned}
$$