

Elementary MATLAB Course

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Second Set of Optional Exercises

Problem 1. A rocket is launched vertically. At time $t = 0$, the rocket's engine shuts down. At that time, the rocket reached an altitude of 500 m and rose at a velocity of 125 m/s. Gravity then takes over. The height of the rocket as a function of time is:

$$h(t) = -\frac{9.8}{2} t^2 + 125 t + 500 \quad (t > 0)$$

Create a function called `height` that accepts time as an input and returns the rocket's height. Then, Find the time between 0 to 30 seconds when the rocket starts to fall back to the ground.

Problem 2. Perhaps the most famous equation in physics is:

$$E = mc^2$$

Which relates energy (E) to mass (m). The speed of light in a vacuum (c) is the property that links the two together. The speed of light in a vacuum is $2.9979 \times 10^8 \frac{m}{s}$.

- Create a function called `energy` to find the energy corresponding to a given mass in kilograms. Make sure that the c variable must be a global variable!
- Use your function to find the energy corresponding to masses from 1 kg to 10^6 kg. (Hint: use `logspace` command to generate mass vector!)

Problem 3. Solve these systems of linear equations:

$$\begin{cases} 2x + 3y - z = 10 \\ 4x - y + 2z = 5 \\ x + 2y + 3z = 15 \end{cases}$$

$$\begin{cases} 2x + 3y - z + 4w = 10 \\ 4x - y + 2z - 3w = 5 \\ x + 2y + 3z + w = 15 \\ 3x - y + 4w = 6 \end{cases}$$

$$\left\{ \begin{array}{l} 2x_1 + 3x_2 - x_3 + 4x_4 - x_5 + 2x_6 + 5x_7 - 3x_8 + x_9 - 2x_{10} = 10 \\ x_1 + 2x_2 + 3x_3 + x_4 + 2x_5 + 3x_6 + 4x_7 - 2x_8 + x_9 + 3x_{10} = 5 \\ 3x_1 + x_2 - 2x_3 + 3x_4 + 4x_5 + 5x_6 - x_7 + 2x_8 - 3x_9 + x_{10} = 15 \\ 4x_1 + x_2 + 2x_3 + x_4 - 3x_5 + 6x_6 + 2x_7 + 3x_8 + 4x_9 - x_{10} = 8 \\ 2x_1 - x_2 + 3x_3 + 2x_4 + 4x_5 + x_6 - x_7 + 2x_8 + 3x_9 + 4x_{10} = 20 \\ x_1 + 3x_2 - x_3 + 2x_4 + 3x_5 - 2x_6 + 5x_7 + x_8 + 3x_9 - x_{10} = 12 \\ 3x_1 - 2x_2 + 4x_3 + x_4 + 3x_5 + 2x_6 + 4x_7 - x_8 + 2x_9 - 3x_{10} = 25 \\ x_1 + 2x_2 + x_3 + 4x_4 + 3x_5 - x_6 - 2x_7 + x_8 + 3x_9 + 2x_{10} = 18 \\ 2x_1 - x_2 + 3x_3 + 2x_4 + 4x_5 + x_6 + 3x_7 - x_8 + 2x_9 + 4x_{10} = 30 \\ 4x_1 + x_2 + 2x_3 + 3x_4 - x_5 + 4x_6 + 2x_7 + 3x_8 - x_9 + x_{10} = 22 \end{array} \right.$$