You have 2 hours to complete this test.

There are 5 multi-part questions in this test. Create a script named `test1.m` to answer the questions. For each part of each question, create a new cell (section) in your script. You do not need to publish a report from your script.

You have access to the internet during this test. Please do not use any communication software such as email, text chat, social media services, etc.

When you are finished your test, submit your script using the online submit service `https://webapp.eecs.yorku.ca/submit/`

1. (9 points)

    (a) (1 point) Create a row vector named x containing the 11 elements $-5, -4, -3, ..., 4, 5$. Avoid typing in all 11 elements individually.

    (b) (1 point) Show how to get the value of the first element of x.

    (c) (1 point) Show how to change the value of the first element of x to -1000.

    (d) (1 point) Show how to get the value of the last element of x.

    (e) (1 point) Show how to change the value of the last element of x to $+1000$.

    (f) (1 point) Show how to remove the middle elment of x.

    (g) (1 point) Show how to insert the new element -6 to the front of x

    (h) (1 point) Show how to insert the new element with value 1.5 between the elements with values 1 and 2 in x

    (i) (1 point) After doing 1(f)–(h), show how to get the number of elements in x.

2. (7 points)

    (a) (1 point) Create a column vector named y containing the 11 elements $50, 40, 30, ..., -40, -50$. Avoid typing in all 11 elements individually.

    (b) (2 points) Show how to get all of the elements of y that start with an odd number (i.e., get every second element of y starting from the first element; you do not need code that actually checks if the element starts with an odd number).

    (c) (2 points) Show how to change all of the elements of y that start with an odd number; change the values of the elements by dividing them by 2.

    (d) (2 points) After doing 2(c) show how to remove all of the elements of y that end with 0 (again, you do not need code that actually checks if the element ends with 0).

3. (14 points)

    (a) (1 point) Create a matrix named A having the following values:

$$\begin{bmatrix} 16 & 2 & 3 & 13 \\ 5 & 11 & 10 & 8 \\ 9 & 7 & 6 & 12 \end{bmatrix}$$

    (b) (1 point) Show how to find the number of rows in the matrix A (the answer is obviously 3 but your solution should work for any matrix A).

    (c) (1 point) Show how to find the number of columns in the matrix A (the answer is obviously 4 but your solution should work for any matrix A).

    (d) (1 point) Show how to get the value of the element in row 2 and column 4 of A.

    (e) (2 points) Show how to get the values of the elements in the first row of A.

    (f) (2 points) Show how to change the first row of A to:

$$\begin{bmatrix} 4 & 3 & 2 & 1 \end{bmatrix}$$

    (g) (2 points) Show how to get the values of the elements in the third column of A.

    (h) (2 points) Show how to insert a new row with values:

$$\begin{bmatrix} 6 & 7 & 8 & 9 \end{bmatrix}$$

    to the bottom of A

    (i) (2 points) After doing 3(h), show how to insert a new column:

$$\begin{bmatrix} 1 \\ 2 \\ 3 \\ 4 \end{bmatrix}$$

    between the existing first and second columns of A

4. (10 points) Hooke's law for a simple linear spring states that the force F required by an agent to change the length of the spring by an amount Δx is given by

$$F = k\Delta x$$

and that the potential energy U stored in the spring is given by

$$U = \frac{1}{2}k(\Delta x)^2$$

Plot F and U as a function of Δx on the same graph for 50 equally spaced values of Δx in the range -2 to 2. Use a spring constant value of $k = 1.5$. Label the x-axis of the graph. Include a legend that indicates which curve is the force and which curve is the potential energy.

5. (10 points) The following are all short-answer written questions. Include your answers in your script as comments. In MATLAB you can create a comment that spans multiple lines like so:

```
%{
    This
    is
    a multiline comment.
%}
```

(a) (2 points) Suppose that you are working in a base-3 **unsigned** number system where the digits are 0, 1, and 2. Consider the base-3 number 2011. What is the decimal (base-10) value of the base-3 number? Show how you calculated your answer.

(b) (2 points) Consider the **signed** 4-digit binary number 1011. What is the decimal (base-10) value of the binary number? Show how you calculated your answer.

(c) (2 points) In mathematics, the value of $\sin(\pi)$ is exactly 0. Explain why the MATLAB expression:

```
sin(pi) == 0
```

outputs 0 (or false) instead of 1. There are actually at least two different (but related) reasons why the output is 0 instead of 1.

(d) (2 points) Your fellow student has written a script that calculates a sinusoidal wave $y(t) = A\sin(2\pi ft)$:

```
% amplitude
    A= 1;

% frequency
z =5;

% 100 equally spaced time steps between 0 and 1
t=[0:0.01:1];

% sinusoidal wave
sin = A * sin(2 * pi * z * t);
```

The script seems to run fine, but there are many stylistic errors. List 4 style errors that the student has made.

(e) (2 points) After running your friend's script from 5(d), you try running your own script that correctly calculates a similar sinusoidal wave. Your script, that used to run perfectly, now results in an error. Explain why MATLAB now thinks that there is an error in your script.