1. **Vector Creation:**

   On the MATLAB Command Window, create the following vectors using the given commands

```
>> v1 = -12 : 3                    >> v2 = 2 : 5 : 27           >> v3 = 100 : -13 : 10
>> v4 = 0.98 : 15                  >> v5 = 0 : 0.4 : 5
>> v6 = [25;-3;18;-0.5;-12;89]     >> v7 = [25 -3 18 -0.5 -12 89]
>> v8 = [25,-3,18,-0.5,-12,89]     >> v9 = [25 -3,18 -0.5,-12,89]
```

   - Create a vector **x1** starting at -3.5 counting by increments of 0.7 and ending at 3.5.
   - Create another vector **x2** starting at 1.2, ending at -4.3 and with the same length as **x1**.
   - Create a column vector **Vec0** with the same length as **x1** and **x2** but whose every element is 0.
   - Create a row vector **Vec1** with the same length as **Vec0** but whose every element is 1.

2. **Elements of Vectors:**

   Type the following commands on the Command Window and compare the output to the brief notes given on the right hand side.

>> v1	[shows full vector]
>> v1(3)	[shows 3rd element of vector v1]
>> v1(0)	[no such element]
>> v1(2:6)	[shows elements 2 through 6]
>> v1([8 1 5])	[shows elements 8, 1 & 5]
>> v9=[8 1 5]	[followed by...]
>> v1(v9)	[also shows elements 8, 1 & 5 of v1]
>> v6(5)=78	[changes 5th element of v6 to 78]
>> v6(2:3)=[7 -8]	[changes elements 2 & 3 to 7 & -8 resp.]
>> v6(2:3)=[7-8]	[and...]
>> v6(2:3)=7-8	[or...]
>> v6(2:3)=-1	[changes both elements 2 & 3 to -1]
>> v2(10)	[no such element, on the other hand...]
>> v2(10)=51	[MATLAB obliges and fills in all in between elements with zeros]
>> v3=v3(:)	[changes v3 into a column vector]

3. **Vector Operations:**

   - Create a column vector **x3** with the same length as **x1** and **x2** but whose every element is -6.
   - Create a row vector **x4** with the same length as **x3** but whose every element is 9.
   - Find the sums of any two of **x1**, **x2** and **x4**. Find the sum of all three vectors.

- Is it possible to add **x3** to any of the vectors **x1**, **x2** or **x4**? What happens when you replace **x3** with its transpose?

In each of the following cases, create a new **vector** with the same length as **x1**:

- each element of the new vector is the square root of the corresponding element of **x4**.
- each element of the new vector is the square of the corresponding element of **x3**.
- each element of the new vector is the product of the corresponding elements of **x1** and **x2**.
- each element of the new vector is the result when 12 is divided by the corresponding element of **x3**.
- each element of the new vector is the result when each element of **x4** is divided by the corresponding element of **x3**.

4. **Matrices:**

We need to create the matrix **A** shown below;

```
1   1   1   1   1
1   2   4   8  16
1   3   9  27  81
1   4  16  64 256
1   5  25 125 625
```

Method I:

We realize that the columns of **A** are increasing powers of the column vector **x** =(1 : 5)' thus we could proceed as follows:

- Create the column vector **x**
- Form the matrix **A** by taking powers of **x** as follows

  >> A = [x.^0 x.^1 x.^2 x.^3 x.^4]   [or use commas instead of spaces...]

  >> A = [x.^0,x.^1,x.^2,x.^3,x.^4]

Method II:

Since each column of **A** corresponds to a particular power of the vector **x** = (1 : 5)' we could create two matrices, one containing the repeated vector **x** and the other containing the relevant powers:

- Create a matrix **A1** whose every column is the vector **x**.

```
1    1    1    1    1
2    2    2    2    2
3    3    3    3    3
4    4    4    4    4
5    5    5    5    5
```

- Create a row vector $\mathbf{y} = 0:4$ and use this vector to create the matrix **A2** below:

```
0    1    2    3    4
0    1    2    3    4
0    1    2    3    4
0    1    2    3    4
0    1    2    3    4
```

- Now create the matrix **A** by raising each element of **A1** to the corresponding element of **A2**.

Method III:

If **e1 = ones(1 , 5)** then the rows of **A1** above are products of the vector e1.

Similarly the columns of A2 are also products of **e1'** (the transpose of **e1**).

- Use **e1** to create each of the five rows of **A1** (name these r1 to r5).
- Similarly use **e1'** to create each of the five columns of **A2**, name these columns c1 to c5.
- Form the matrix **A1** using r1 to r5 and form **A2** using c1 to c5.
- Now form **A** by raising **A1** to **A2** as was done in Method II.

Method IV:

matrix A is a version of the so called Vandermonde matrix (type >> help vander)

>> A3 = vander(x)	[notice in this case that columns of A are decreasing powers of x]
>> A=fliplr(A3)	[flip matrix A3 left to right to obtain A]

There is also a command **flipud** that flips a matrix up down: try

```
>> flipud(A)
```

5. **Matrix Addressing:**
   - Create a matrix **B** whose elements are the intersection of all the rows of **A** with the columns 3, 4 and 5.
   - Create a matrix **C** whose elements are the intersection of all the columns of **A** with the rows 1 and 2
   - Create a matrix **D** whose elements are the intersection of rows 3 & 4 and columns 2, 3, 4 & 5 of **A**

6. **Some Special Matrices:**

   Create a script m-file **MyTD.m** and inside this m-file, use MATLAB's **spdiags** command to generate the 6×6 matrix **TD** below.

   [Creating this matrix, or any of the vectors involved, by manually typing-in the elements is NOT allowed!]

8	3	0	0	0	0
-5	8	3	0	0	0
0	-5	8	3	0	0
0	0	-5	8	3	0
0	0	0	-5	8	3
0	0	0	0	-5	8

   Create a script m-file **MySpdgs.m** and inside this m-file, use MATLAB's **spdiags** command to generate the 12×12 matrix **Spdgs** below.

   [Creating this matrix, or any of the vectors involved, by manually typing-in the elements is NOT allowed!]

-90	0	3	0	80	0	0	0	0	0	0	0
0	-87	0	4	0	70	0	0	0	0	0	0
40	0	-84	0	5	0	60	0	0	0	0	0
0	38	0	-81	0	6	0	50	0	0	0	0
0	0	36	0	-78	0	7	0	40	0	0	0
0	0	0	34	0	-75	0	8	0	30	0	0
0	0	0	0	32	0	-72	0	9	0	20	0
0	0	0	0	0	30	0	-69	0	10	0	10
0	0	0	0	0	0	28	0	-66	0	11	0
0	0	0	0	0	0	0	26	0	-63	0	12
0	0	0	0	0	0	0	0	24	0	-60	0
0	0	0	0	0	0	0	0	0	22	0	-57

7. **Linear systems:** Need to solve systems of the form **M x = b** using three methods:

   x = inv(M)*b,

   x = M^(-1)*b and

   x = M\ b.

   Do these calculations with **M** replaced by the matrices **A**, **TD** and **Spdgs** as follows:

   M = A   **b** = [3 2 -5 9 8]'

   M = TD   **b** = [3 2 -5 9 8 -4]'

   M = Spdgs   **b** = (12 : -1 : 1)'