Problem 1: Matrix-vector and matrix-matrix operations (12 points)

Given the matrices **A** and **B** and the vector v

$$\mathbf{A} = \begin{bmatrix} 2 & -1 & 0 \\ -1 & 2 & -1 \\ 0 & -1 & 2 \end{bmatrix}, \ \mathbf{B} = \begin{bmatrix} 3/4 & 1/2 & 1/4 \\ 1/2 & 1 & 1/2 \\ 1/4 & 1/2 & 3/4 \end{bmatrix}, \ v = \begin{bmatrix} 3 \\ 6 \\ 3 \end{bmatrix}$$

Perform the following calculations **by hand**, showing all your work:

(a) $\mathbf{A}v$
(b) $v^T\mathbf{A}$
(c) $v^T\mathbf{A}v$
(d) $\mathbf{AB}$

Problem 2: MATLAB colon notation (4 points)

Given the matrix

$$\mathbf{C} = \begin{bmatrix} 11 & 5 \\ 2 & 1 \\ 18 & 7 \end{bmatrix}$$

Write the two statements to create $s = (11, 2, 18)^T$ and $t = (11, 5, 2, 1, 18, 7)$ by extracting the rows and columns of **C**.

Problem 3: MATLAB built-in functions to create matrix (10 points)

Write a one-line expression to create the following matrix

$$\begin{bmatrix} 1 & 0 & 0 & 0 & 1 \\ -1 & 1 & 0 & 0 & 1 \\ -1 & -1 & 1 & 0 & 1 \\ -1 & -1 & -1 & 1 & 1 \\ -1 & -1 & -1 & -1 & 1 \end{bmatrix}$$

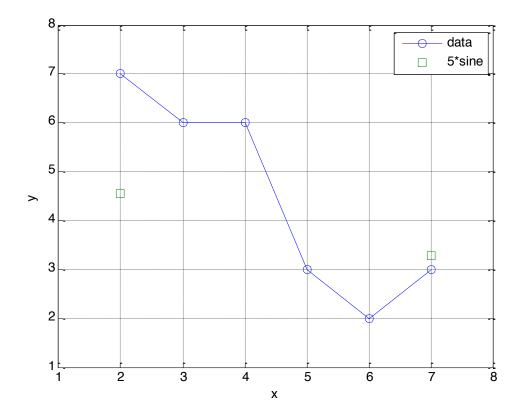Hint: one solution uses matrix addition and the built-in *tril*, *ones*, *eye*, and *zeros* commands.

Problem 4: MATLAB vectorization (12 points)

Given the x vector $x = [21\ 22\ 23\ 24]$ and **B** matrix created using the MATLAB command B=ones(3,3), write the one-line vectorized copy operations that has the same effect as the following scalar loop

```
k=0;
for i=2:3
    for j=1:2
        k=k+1;
        B(i,j)=x(k);
    end
```

end

Hint: the built-in *reshape* function would be helpful.

Problem 5 (Q31 of the textbook): MATLAB plotting (10 points)
Given the sequence of MATLAB statements below, what additional statements are necessary to create the exact plot shown below? Do not create any additional data. Do not worry about the fonts or font sizes in the legend or on the axes. Do not use the interactive plot-editing tools in MATLAB version 5.3 or later.

x = [2 3 4 5 6 7];
y = [7 6 6 3 2 3];
z = 5*sin(x);