Instructions:

- This is a 90-minute, closed-book exam; no calculators are allowed.
- The exam is worth a total of 100 points, so it's about one point per minute!
- Read each problem completely, including any provided code, before starting it.
- Raise your hand if you have any questions.
- Use the backs of pages or ask for additional sheets of paper as necessary.
- Clarity, conciseness, and good programming style count for credit.
- If you supply multiple answers, we will grade only one.
- Use only MATLAB code. No credit for code written in other programming languages.
- Assume there will be no input errors.
- Do not modify given code unless instructed to do so.
- Do not write user-defined functions or subfunctions unless instructed to do so.
- Do not use switch, try, catch, break, or continue statements.
- You may find the following MATLAB predefined functions useful:
  - abs, sqrt, rem, floor, ceil, round, rand, zeros, ones, linspace, length, input, fprintf, disp, plot, bar
- Examples:
  - `rem(5,2) → 1`, the remainder of 5 divided by 2
  - `rand` → a random real value in the open interval (0,1)
  - `floor(6.9), floor(6) → 6`, rounds down to the nearest integer
  - `ceil(8.1), ceil(9) → 9`, rounds up to the nearest integer
  - `length([2 4 8]) → 3`, length of a vector
  - `linspace(2,9,5) →` a vector with 5 values uniformly distributed in the interval [2,9]
Question 1: (10 points)

(a) What is the output from executing the following script? If the program doesn’t terminate or if there will be an error during execution, write the word “error” instead of the output.

```matlab
v = [5 3 1 2 6];
for k = 1:4
    v(k) = v(k+1);
    disp(v(k))
    if v(k)<k
        k = 9;
    end
end
```

Output:

(b) What will be printed when the following script is executed? Use the specified print format.

<table>
<thead>
<tr>
<th>Script</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>x = 4;</td>
<td>function y = moo(x,z)</td>
</tr>
<tr>
<td>y = 8;</td>
<td>y = x+1;</td>
</tr>
<tr>
<td>z = moo(x+1,y);</td>
<td>x = z;</td>
</tr>
<tr>
<td>fprintf('z is %d\n', z)</td>
<td>z = y+1;</td>
</tr>
<tr>
<td>fprintf('x is %d\n', x)</td>
<td>fprintf('x is %d\n', x)</td>
</tr>
<tr>
<td>fprintf('y is %d\n', y)</td>
<td>fprintf('z is %d\n', z)</td>
</tr>
</tbody>
</table>

Output:

Exam score:

Q1: (10) _____ _____
Q2: (20) _____ _____
Q3: (20) _____ _____
Q4: (25) _____ _____
Q5: (25) _____ _____
Total: (100) _____ _____
Question 2: (20 points)

(a) Fill in the blank below to assign to \( w \) a randomly generated value such that \( w \) is equally likely to be any real value in the open interval \((-13,2)\).

\[
w = \______________________________;
\]

(b) Given a vector \( v \) that has a length greater than 2, we define the “neighbor sums” to be the sums of adjacent (i.e., neighboring) values in \( v \). For example, the vector

\[
\begin{bmatrix}
6 & -3 & -5 & 1 & 4 & 1 & 2 & 0.1
\end{bmatrix}
\]

has the neighbor sums

\[
\begin{bmatrix}
3 & -8 & -4 & 5 & 5 & 3 & 2.1
\end{bmatrix}
\]

Write a fragment below to determine and print the largest neighbor sum of a given vector \( v \). In the example above, the largest neighbor sum is 5. DO NOT use any built-in functions other than \texttt{length}.

\[
\text{fprintf('Largest neighbor sum in v is \%f\n', _________________ )}
\]
Question 3: (20 points)

(a) Implement the following function as specified:

```matlab
function [vol, linLen] = boxFeatures(X, Y, Z)
% Return the volume and "linear length" of a rectangular box with length X,
% width Y, and height Z. X, Y, and Z are in meters.
% vol: the volume in cubic meters.
% linLen: the "linear length" in meters, which is the sum of the length,
% width, and height of the box.
```

(b) A courier determines the charge for shipping a rectangular box of goods as follows: A box heavier than 30kg or that has a volume greater than 2m³ is not allowed. The base charge for an allowed box is $14. Every kilogram over 10kg is additionally charged $1.30. Furthermore, a box heavier than 10kg and that has a linear length greater than 2.5m incurs a $5 surcharge.

Complete the fragment below to display the charge for shipping a box. If the box is not allowed, display the words “not allowed”. Make effective use of the function `boxFeatures` from Part (a); assume that it is correctly implemented and accessible.

```matlab
L = input('Enter the length of the box in meters: ');
W = input('Enter the width of the box in meters: ');
H = input('Enter the height of the box in meters: ');
M = input('Enter the weight of the box in WHOLE kilograms (no fractional part): ');
% Write your code below.
```
Question 4: (25 points)

Implement the function below as specified.

```matlab
function [x, y] = myRandomWalk(xf, yf, u)

% Perform a random walk starting from position (0,0). In each step, move north or
% east one unit and it is u times as likely to move north as to move east. The
% walk ends when position (xf,yf) is reached or when 90 steps have been taken,
% whichever happens first.
% Vectors x and y store the path of the walk such that (x(k),y(k)) is the position
% BEFORE the kth step of the walk, i.e., x(1) and y(1) should store the starting
% point. Assume position (xf,yf) is different from the starting point.
% DO NOT use 2-d array.
```
Question 5: (25 points)

Complete the fragment below to draw an upside down brick pyramid. Each brick has height 1 and its width is user-entered. The number of bricks in the top row is user-entered and the top leftmost brick has its lower left corner at (0,0). Each row has one fewer brick than the row above and the bottom row has one brick only. Each row is centered relative to the top row.

Assume the availability of the function `DrawRect` and use it to draw each brick. For example, the command `DrawRect(5,7,3,1,'y')` draws a yellow rectangle that has width 3 and height 1 with its lower left corner at (5,7). An example figure is shown on the right.

```matlab
n = input('How many bricks will be in the top row of the pyramid? ');
w = input('How wide is one brick? ');
% Assume n is an integer > 1 and w is a positive real value.
figure; axis equal; hold on
% Write your code below.

title(sprintf('Top row has %d bricks. Each brick has width %.1f.', n,w))
hold off
```