1. (5 pts each, 15 pts total) Arrays:
   a) Declare and create an array of floats called x containing 20 elements.
      
      float x[] = new float[20];

   b) Use a loop to initialize the array with random numbers in the range 0 to 100.
      
      for (int i = 0; i < x.length; i++) {
         x[i] = random(100);
      }

   c) Write another loop which adds together all of the elements in x and prints the final sum.
      
      float sum = 0;
      for (int i = 0; i < x.length; i++) {
         sum = sum + x[i];
      }
      println("sum = " + sum);
2. (8 pts) given the equation for \( y \) as a function of angle \( \Theta \):

\[
y = shift + amplitude \times \sin(\Theta)
\]

What values need to be assigned to \( shift \) and \( amplitude \) so that the graph of \( y \) will be between 10 and 50 as shown in the picture below:

Ans: \( shift = 30 \) \( amplitude = 20 \)

Show your work below:

\[
\text{Max} - \text{Min} = 50 - 10 = 40 \\
\text{amplitude} = \frac{40}{2} = 20 \\
\text{shift} = \text{min} + \text{amplitude} = 10 + 20 = 30
\]

3. (2 pts each, 6 pts total) What are the sine and cosine of the angles below? No memorization is required. You should be able to obtain the answers using logic, your knowledge of how trig functions are defined, and the information in the figure on the right.

a) \( \sin(30^\circ) = .5 \) \( \cos(30^\circ) = .866 \)

b) \( \sin(120^\circ) = .866 \) \( \cos(120^\circ) = -0.5 \)

c) \( \sin(-150^\circ) = -.5 \) \( \cos(-150^\circ) = -.866 \)
4. (15 pts total) Matrix Stack: In answering the questions below, please specify the actual value of the transformations. For example, if i=2 in line 7, then the rotation should be written as rotate(10) rather than rotate(5*i).

Line 1    void setup() {
Line 2      size(300,300);
Line 3      scale(1,-1);
Line 4      translate(width/2, height/2);
Line 5      for (int i = 0; i < 3; i++) {
Line 6          pushMatrix();
Line 7          rotate(5*i);
Line 8          translate(10*i,20);
Line 9          ellipse(0,0,20,20);
Line 10         popMatrix();
Line 11     }
Line 12   }

a) (3 pts) What is in the matrix stack after executing Line 4?

\[
\begin{align*}
\text{translate(width/2, height/2)} \\
\text{scale(1,-1)}
\end{align*}
\]

b) (9 pts) What is the matrix stack at Line 9 when i=0, 1, 2?

\[
\begin{array}{ccc}
\text{translate(0,20)} & \text{translate(10,20)} & \text{translate(20,20)} \\
\text{rotate(0)} & \text{rotate(5)} & \text{rotate(10)} \\
\text{translate(width/2, height/2)} & \text{translate(width/2, height/2)} & \text{translate(width/2, height/2)} \\
\text{scale(1,-1)} & \text{scale(1,-1)} & \text{scale(1,-1)}
\end{array}
\]

\[
\begin{array}{ccc}
i = 0 & i = 1 & i = 2
\end{array}
\]

c) (3 pts) What is the matrix stack at Line 12 (at the point the program ends)

\[
\begin{align*}
\text{translate(width/2, height/2)} \\
\text{scale(1,-1)}
\end{align*}
\]
5. (4 pts each, 20 pts total) Parameters: Given the code below:

```java
void setup() {
  float wx = 30.0;
  drawRect(wx, 20.0);
  println("wx = "+wx);
}

void drawRect(float w, float h) {
  translate(width/2, height/2);
  rect(0,0,w,h);
  w = 2*w;
  println("w = " + w);
}
```

What is the scope of the following variables (i.e. give the range of Line numbers):

a) **wx** Lines: ___2-5______

b) **w** Lines: ___7-12_____

c) **h** Lines: ___7-12_____

Answer the following questions:

d) What is the *exact* printed output of the program (be careful to get the order correct).

   \[
   \begin{align*}
   \text{w} &= 60 \\
   \text{wx} &= 30
   \end{align*}
   \]

e) What is the size in pixels (i.e. the values of its width and height) of the rectangle which is drawn at line 9?

   \[
   \begin{align*}
   \text{rectangle width} &= ___30______ \\
   \text{rectangle height} &= ___20______
   \end{align*}
   \]
6. (3 pts each, 24 pts total) Transformations:

```java
void setup() {
    size(100, 100);
    // transformations go here
    makeShape();
}
void makeShape() {
    beginShape();
    vertex(0, 0);
    vertex(10, 0);
    vertex(10, 10);
    vertex(40, 10);
    vertex(40, 20);
    vertex(0, 20);
    endShape(CLOSE);
}
```

- a) `translate(width/2, height/2);`
  ans: __8____

- b) `translate(width/2, 0);
      rotate(radians(90));`
  ans: __2____

- c) `translate(0, height/2);
      rotate(radians(90));
      translate(0, -height/2);`
  ans: __5____

- d) `translate(40, 0);
      scale(-1, 1);`
  ans: __3____

- e) `rotate(radians(45));
      translate(width/2, 0);`
  ans: __7____

- f) `translate(width/2, 0);
      rotate(radians(45));`
  ans: __4____

- g) `scale(2.5);
      translate(0, height/4);`
  ans: __6____

- h) `translate(0, height/4);
      scale(2.5);`
  ans: __1____
7. (1 pt each, 12 pts total) Circle True or False

a) True or False  When you call a function, you use formal parameters and when you define a function, you use actual parameters.

b) True or False  In a stack, the first item added is always the last item removed.

c) True or False  90 degrees is equivalent to $\pi/2$ radians.

d) True or False  Array indices always start at 1.

e) True or False  When you declare an array, you set aside memory for the array elements.

f) True or False  A unit circle has a diameter of 1.

g) True or False  Scale and translation transformations are commutative with each other.

h) True or False  Rotation transformations are commutative with other rotation transformations.

i) True or False  Tangent is defined as $\tan(\theta) = \cos(\theta)/\sin(\theta)$.

j) True or False  In Processing, resetMatrix() will empty out the matrix stack.

k) True or False  The angle, 300°, is in quadrant II.

l) True or False  $\sin(\theta) = \cos(\theta - 90^\circ)$ where $\theta$ is given in degrees. (If you aren’t sure, try it out for a few different values of $\theta$.)