Name: _____

CS 145 Images and Imagination

Exam 2

Score:

1. (max 15) _____
2. (max 8) _____
3. (max 6) _____
4. (max 15) _____
5. (max 20) _____
6. (max 24) _____
7. (max 12) _____

Total Score: (max 100) _____

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

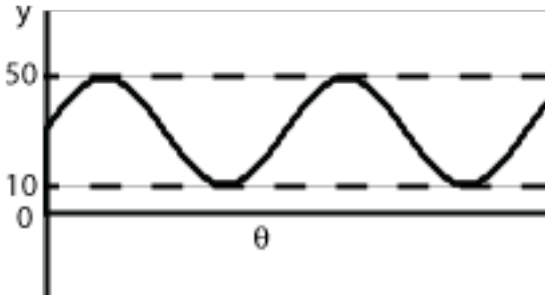
   b) Use a loop to initialize the array with random numbers in the range 0 to 100.

   c) Write another loop which adds together all of the elements in x and prints the final sum.

2. (8 pts) given the equation for y as a function of angle Θ:

$$y = shift + amplitude * \sin(\Theta)$$

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* = _____ *amplitude* = _____

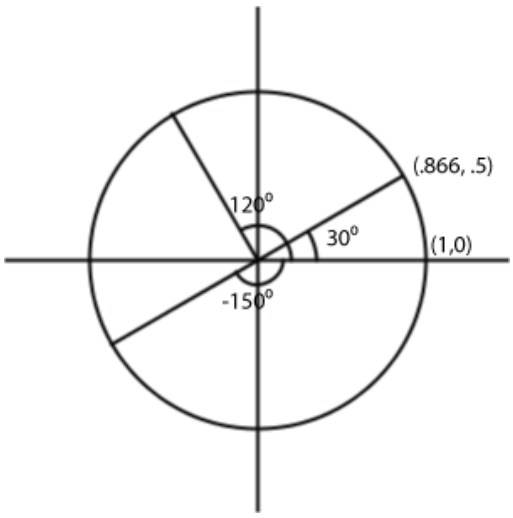
Show your work below:

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°) = _____ cos(30°) = _____

b) sin(120°) = _____ cos(120°) = _____

c) sin(-150°) = _____ cos(-150°) = _____

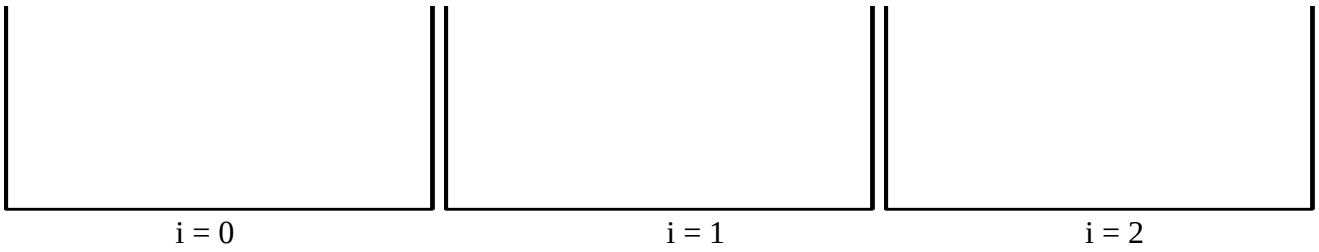


4. (15 pts total) Matrix Stack: In answering the questions below, please specify the actual value of the transformations. For example, if i=2 in line 7, then the rotation should be written as rotate(10) rather than rotate(5*i).

```
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?

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



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

5. (4 pts each, 20 pts total) Parameters: Given the code below:

```
Line 1.      void setup() {
Line 2.          float wx = 30.0;
Line 3.          drawRect(wx, 20.0);
Line 4.          println("wx = " + wx);
Line 5.      }
Line 6.
Line 7.      void drawRect(float w, float h) {
Line 8.         translate(width/2, height/2);
Line 9.         rect(0,0,w,h);
Line 10.        w = 2*w;
Line 11.        println("w = " + w);
Line 12.     }
```

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

a) `wx` `Lines:` _____

b) `w` `Lines:` _____

c) `h` `Lines:` _____

Answer the following questions:

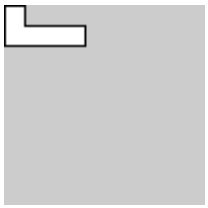
d) What is the *exact* printed output of the program (be careful to get the order correct).

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?

rectangle width = _____ rectangle height = _____

6. (3 pts each, 24 pts total) Transformations:

```
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);
 }
```



The program on the left will generate the above picture when no transformations are used. For each of the sets of transformations below, determine which picture will be drawn if the transformations are placed in the location indicated by the comment line.

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

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

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

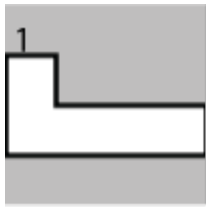
d)
```
translate(40, 0);
scale(-1, 1);
```
ans: _____

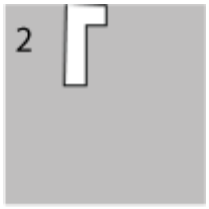
e)
```
rotate(radians(45));
translate(width/2, 0);
```
ans: _____

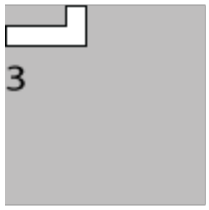
f)
```
translate(width/2, 0);
rotate(radians(45));
```
ans: _____

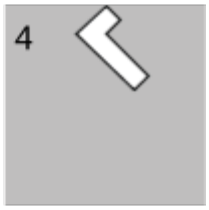
g)
```
scale(2.5);
translate(0, height/4);
```
ans: _____

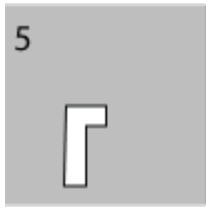
h)
```
translate(0, height/4);
scale(2.5);
```
ans: _____

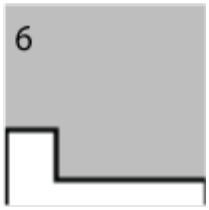


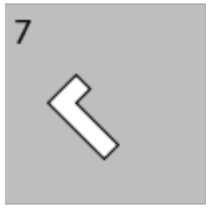


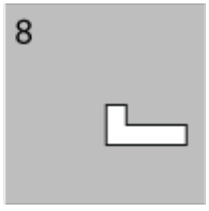












7. (1 pt each, 12 pts total) Circle True or False

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 θ is given in degrees. (If you aren't sure, try it out for a few different values of θ.)