CS 145 Images and Imagination

Practice Problems for Exam 2

1. String concatenation: Complete the `println` instruction so that the output of

```
for (int i =0; i < 10; i++) {
    int num = (int) random(100);
    println("i = " + i + ": The random number is " + num); //finish
}
```

2. For the function below:
   a. What is the return type? float
   b. What is the *name* of the parameter? red
   c. What is the *type* of the parameter? int
   d. Which of the following are legal ways (or reasonable) <u>*to call*</u> the function?

      i. `float r = convertRed();   // bad – no parameter`

      ii. `int r = convertRed(2.5);  // bad – wrong type for return`
      `//       and parameter`

      iii. `float r = convertRed(155);  // ok`

      iv. `convertRed(100);           // syntax ok but nothing done`
      `//     with return value`

      v. `stroke(convertRed(100), 1.0, 1.0));  // ok`

3. To set a color in Processing, you use the command stroke(r,g,b). To set a grayscale value, you just use a single number stroke(g) where g can be computed from the RGB value by adding together 30% of the red value, 59% of the green value, and 11% of the blue value. For example, if r=10 (out of 255), g =100, and b = 255, then the grayscale value will be g = (0.3*10)+(0.59*100)+((0.11*255) = 90.2. *Write a function that takes the three rgb integer values as parameters, and returns the grayscale value as a float.*

```
float calcGray(int r, int g, int b) {
    float gray = 0.3*r + 0.59*g + 0.11*b;
    return gray;
}
```

4. Complex numbers: Place the following in standard form a + b i.
   a. i^3 ______-i _____________
   b. $\sqrt{-36} + 3\ i^2$ ______- 3 + 6 i__________________
5. Complex numbers: Given z_1 = -1 + 7 i and z_2 = (2 + i). Calculate the following, placing the result in standard form
   a. z1 + z2 = ___1 + 8 i__
   b. z1 - z2 = ____-3 + 6 i____
   c. 2 z1 = ____-2 + 14 i ______
   d. z1 z1 = $z1^2$ = __-48 – 14 i______
   e. z1 z2 = __-9 + 13 i__
   f. $\bar{z}_1 + z_1$ = ___-2 _________
   g. $\bar{z}_1 z_1$ = ___50__________
   h. Length of z1 = | z1| = __$\sqrt{50}$ ____________
6. Class syntax: In class, we made use of a Complex class in Processing to compute the Mandelbrot set.
   a. How would you create a new Complex object with real component equal to 1.5 and imaginary component equal to -6 ?

      Complex c = new Complex(1.5, -6);

   b. In Processing, suppose you have created complex numbers c1, c2, and c3. How do you multiply c1 and c2 together, placing the result in c3?

      c3 = Complex.cMult(c1, c2);

   c. In Processing, suppose you have created complex numbers c1, c2, and c3. How do you compute (i.e. what is the syntax of) for computing
      c3 = c1*c2 + c1

      c3 = Complex.cAdd(Complex.cMult(c1, c2) , c1);

What is the standard form for the complex numbers whose values in polar coordinates are

d. r = 2, θ = 90° ___2 i_____

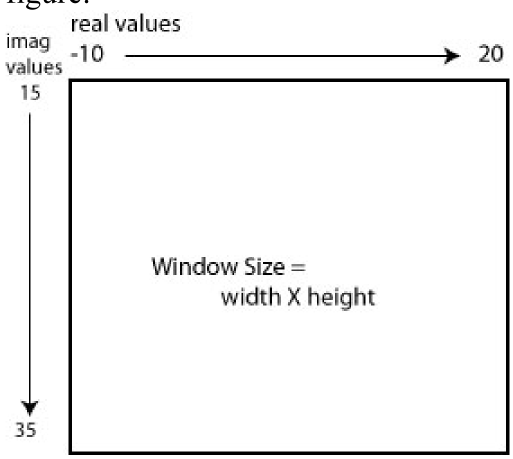
e. r = 1, θ = 180° _____- 1 ________

7. What is the polar coordinate representation (r, θ) for the following complex numbers

   a. – 3 i ____ (r, θ) = (3, 270) ____________

   b. 1 + i _____(r, θ) = ($\sqrt{2}$, 45) _____________

8. Rescaling: Given a region of the complex plane where the real component ranges between -10 and 20, and the imaginary part ranges between 15 and 35 as shown in the figure:



   a. How does one use the map function to determine the pixel location of the complex number
   z = 5 + 21 i.

```
int pixeli = map(5, -10, 20, 0, width );
int pixelj = map(21, 15, 35, 0, height );
```

   b. How does one use the map function to determine the complex number corresponding to the pixel (i,j)

```
int real = map(i, 0, width, -10, 20);
int imag = map(j, 0, height, 15, 35);
```

9. Convert the following `for-loop` to a `while` loop:

```
for (int i =0; i < 100; i++) {
    println(i);
}
```

```
int i = 0;
while (i < 100) {
   println(i);
   i++;
  }
```

10. Mandelbrot Set: Write a do-while loop that iterates on the complex function z = z2 + c. It stops when either the loop has iterated 100 times or the length of z exceeds 2. Initialize z and c to be z=0 and c = 0.5 + i.

```
int k = 0;
do {
  z  = Complex.cAdd(  Complex.cMult(z, z) ,  c );
  k++;
} while ( k < 100 &&  Complex.len(z) < 2);
```

11. Recursion: Write a recursive function to output the numbers from 0 to 100 *in reverse order*.

```
void setup() {
  printNums(100);
}

void printNums(int n) {
 if (n < 0) {
    return;
 }
 else {
    println(n);
    printNums(n-1);
 }
}
```

12. Recursion: Write a recursive function to add the numbers from 1 to n, for some value of n.

```
  void setup() {
    int n = 100;
    println ("The sum from 1 to "+ n + " is " + addNums(n));
  }

  int addNums(int n) {
    if (n <= 0) {
     return 0;
    }
    else {
      return n + addNums(n-1);
    }
}
```