

[**May use one 8.5 × 11 inch sheet of paper for notes. It must be turned in with your exam.**]

Show all of your work clearly in the space provided or on the additional page at the end of the exam. If the additional page is used, clearly identify to which exam question it is related. Be sure to **read each problem carefully**. Note that the exam is double sided.

**1.** (10 points) Precisely explain the difference between a class field and an object field. Show an example of each.

**2.** (10 points) Define **overloaded method** and illustrate your definition with a concise example.

**3.** (10 points) Suppose a class does not have the `toString()` method implemented. How will objects of the class behave differently if the `toString()` was implemented.



4. (20 points) Write a complete program (a main method in a class called `Ques3`) that asks the user to type in his/her first and last name and hit enter. The program should then display the number of letters in the first name and the number of letters in the last name to the console and write the name to a file called “name.txt”. The user must enter his/her name on one line. Below shows a sample run of the program:

```
Console
=====
```

```
Please enter your first and last name on one line:
Chris Taylor
Your first name has 5 letters
Your last name has 6 letters
```

```
name.txt file contents
=====
Chris Taylor
```



4. cont...

5. Complete the implementations of the methods in the following class:

```
public class Complex {  
    private int real;  
    private int imaginary;  
  
    public Complex() {  
        real = 0;  
        imaginary = 0;  
    }  
}
```

(a) (10 points)

```
    public Complex(int real, int imaginary) {
```

```
    } // End of constructor
```

**(b)** (15 points)

```
/**
 * Returns the sum of the calling object and the object passed in.
 * The value of the calling object should not be changed.
 * @return the sum of the calling object and the object passed in.
 */
public Complex subtract(Complex that) {
```

```
} // End of add
```

(c) (15 points)

```
/**
 * Returns the product of the calling object and the object passed in.
 * The value of the calling object should not be changed.
 * @return the product of the calling object and the object passed in.
 */
public Complex multiply(Complex that) {
```

```
    } // End of multiply
} // End of Complex Class
```

6. (15 points) Complete a program that creates three complex number objects and calculates the following:  $((3 + i3) + (1 + i0)) * (8 + i3)$

```
public class Midterm {  
    public static void main(String[] args) {
```

```
    } // End of main  
} // End of Midterm
```



Additional space — indentify which problem your work is associated with.