

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

SP.772 FINAL EXAMINATION

WEDNESDAY, MAY 11, 2005

**Name:**

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INSTRUCTIONS: You have three hours to complete this exam. There are 180 total possible points. Good luck.

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## Java Basics: Expressions and Statements (10 points)

1. (4 pts) Given the declaration `int x = 9`, what is the value of the following expressions?

`x / 3.0 / 6 * 2` =

`x % (x / 7) * 7` =

`--x + ++x` =

`--x == x++` =

2. (6 pts) Rewrite the following code segment using `if-else` statements. Assume that `grade` has been declared as a type `char`.

```
switch (grade) {
    case 'A':
        System.out.println("Excellent");
    case 'B':
        System.out.println("Good");
    case 'C':
        System.out.println("OK");
    default:
        System.out.println("Let's talk");
}
```



5. (2 pts) Now that it is compiled, what command can you type to run the program?

When you run it, the Java interpreter gives the following *run-time* error:

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```
Exception in thread "main" java.lang.ArrayIndexOutOfBoundsException: 0
  at Echo.print(Echo.java:10)
  at Echo.main(Echo.java:4)
```

---

6. (2 pts) Which line (number) is actually responsible for the error?

7. (4 pts) Correctly rewrite this line:

Assume you save the changes, recompile, and run your program successfully.

8. (2 pts) What command do you type to run the program and produce the following output:

```
This test is hard
```



## Inheritance, Access Control, and Field Modifiers (35 points)

The first four questions reference three error-free Java files, which are printed on the next page: `Plant.java`, `Fruit.java`, and `Strawberry.java`. Each is in a separate package.

1. (5 pts) Add `import` statements to the files so that they compile.
2. (8 pts) Add a field to the `Strawberry` class to count the total number of `Strawberries` created in the program. The field should be accessible within `strawberries` package and within subclasses of `Strawberry`.
3. (10 pts) Implement the `Strawberry` constructor, remembering to update your count variable from question 2. A strawberry contains 3.2 kcal per gram.
4. (12 pts) Referencing your completed classes, write the output of the following code segments or write "error" if the code would generate a compiling or execution error:

Code Segment	Output
<pre>Strawberry s = new Strawberry(10); System.out.println(s);</pre>	
<pre>Fruit f = new Strawberry(20); System.out.println((Plant) f);</pre>	
<pre>Plant p = (Strawberry) new Fruit(1, 3); System.out.println(p.nutrition());</pre>	
<pre>Plant p = new Strawberry(100); System.out.println(p.nutrition());</pre>	

### Plant.java

```
package plants;

//to do: Add import statement, if necessary.

public interface Plant {
    public double nutrition();
}
```

### Fruit.java

```
package fruits;

//to do: Add import statement, if necessary.

public abstract class Fruit implements Plant {
    private double weight;
    private double kcalPerGram;

    public Fruit(double weight, double kcalPerGram) {
        this.weight = weight;
        this.kcalPerGram = kcalPerGram;
    }

    public double nutrition() { return weight * kcalPerGram; }

    public String toString() {
        return (nutrition() < 50 ? "delicious" : "nutritious");
    }
}
```

### Strawberry.java

```
package strawberries;

//to do: Add import statement, if necessary.

public class Strawberry extends Fruit {
    //to do: Declare field to count number of strawberries created

    public Strawberry(double weight) {
        //to do: Implement constructor; remember to update count field
    }

    public String toString() { return super.toString()+" strawberry"; }
}
```

## Implementing an Interface (40 points)

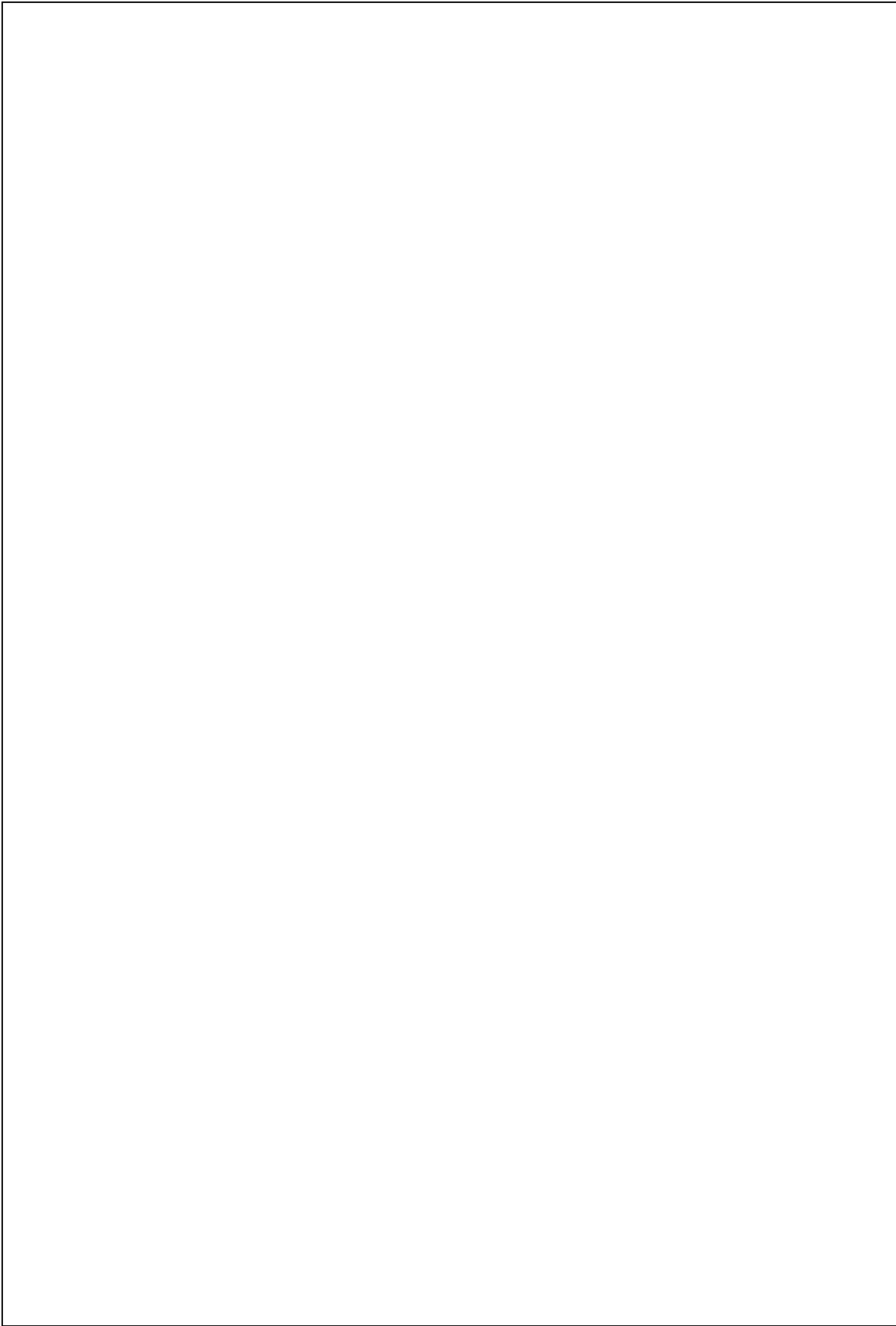
1. Write a class that implements the Queue interface, as shown below. A queue is a data structure that accepts data and then returns it in the order in which it was received (first-in, first-out order). Items are added to the tail of the queue and removed from the head.

```
public interface Queue {  
  
    public int size(); //Returns number of objects in queue  
    public boolean isEmpty(); //Returns true if queue is empty  
  
    //Adds an item to the tail of the queue  
    public void enqueue(Object o);  
  
    //Removes and returns the item from the head of the queue  
    public Object dequeue();  
  
}
```

Your queue implementation must be accessible and usable from **any** package. However, any attempt to extend your class should produce a compile-time error. Your methods must not throw any exceptions.

A queue may be used as follows:

<i>Sample main method</i>	<i>Output</i>
<pre>public static void main(String[] args) {     Queue line = new AITQueue();     line.enqueue("Hello");     line.enqueue("World");     System.out.println(line.dequeue());     System.out.println(line.dequeue()); }</pre>	<pre>Hello World</pre>



## Exceptions (25 points)

The first two questions refer to the program `Exceptional` below.

```
public class Exceptional {  
    public static void divide(String x, String y) {  
        String ans = "";  
        try {  
            int dx = Integer.parseInt(x);  
            int dy = Integer.parseInt(y);  
            ans = String.valueOf(dx/dy);  
        } catch (NumberFormatException nfe) {  
            ans = "bad input";  
        } catch (NullPointerException npe) {  
            ans = "null input";  
        } finally {  
            System.out.print("answer: ");  
        }  
        System.out.println(ans);  
    }  
  
    public static void main(String[] args) {  
        divide(args[0], args[1]);  
    }  
}
```

1. (12 pts) Write the output of the following commands or, if the program terminates abruptly, write the name of the exception that is printed to the console:

Command	Output
<code>java Exceptional 4 2</code>	
<code>java Exceptional 3 null</code>	
<code>java Exceptional 1 0</code>	
<code>java Exceptional 2</code>	

2. (3 pts) Write a command that will cause a `NullPointerException` to be thrown inside `divide` or write "none" if a `NullPointerException` can never be thrown.

3. (10 pts) Circle True or False

True / False `RuntimeException` is a subclass of `Exception`.

True / False A method cannot throw both checked and unchecked exceptions.

True / False `Exception` is a subclass of `Error`.

True / False An error-free class and all of its clients will continue to compile if the clause "`throws RuntimeException`" is added to the signature of its constructor.

True / False An error-free class and all of its clients will continue to compile if the clause "`throws Exception`" is added to the signature of its constructor.



## APPENDIX: Specifications of Selected Java Classes

public abstract class InputStream extends Object	
int	<u><a href="#">available()</a></u> Returns the number of bytes that can be read (or skipped over) from this input stream without blocking by the next caller of a method for this input stream.
void	<u><a href="#">close()</a></u> Closes this input stream and releases any system resources associated with the stream.
void	<u><a href="#">mark(int readlimit)</a></u> Marks the current position in this input stream.
boolean	<u><a href="#">markSupported()</a></u> Tests if this input stream supports the <code>mark</code> and <code>reset</code> methods.
abstract int	<u><a href="#">read()</a></u> Reads the next byte of data from the input stream.
int	<u><a href="#">read(byte[] b)</a></u> Reads some number of bytes from the input stream and stores them into the buffer array <code>b</code> .
int	<u><a href="#">read(byte[] b, int off, int len)</a></u> Reads up to <code>len</code> bytes of data from the input stream into an array of bytes.
void	<u><a href="#">reset()</a></u> Repositions this stream to the position at the time the <code>mark</code> method was last called on this input stream.
long	<u><a href="#">skip(long n)</a></u> Skips over and discards <code>n</code> bytes of data from this input stream.

public abstract class OutputStream extends Object	
void	<u><a href="#">close()</a></u> Closes this output stream and releases any system resources associated with this stream.
void	<u><a href="#">flush()</a></u> Flushes this output stream and forces any buffered output bytes to be written out.
void	<u><a href="#">write(byte[] b)</a></u> Writes <code>b.length</code> bytes from the specified byte array to this output stream.
void	<u><a href="#">write(byte[] b, int off, int len)</a></u> Writes <code>len</code> bytes from the specified byte array starting at offset <code>off</code> to this output stream.
abstract void	<u><a href="#">write(int b)</a></u> Writes the specified byte to this output stream.

public abstract class Reader extends Object	
abstract void	<a href="#"><u>close()</u></a> Close the stream.
void	<a href="#"><u>mark(int readAheadLimit)</u></a> Mark the present position in the stream.
boolean	<a href="#"><u>markSupported()</u></a> Tell whether this stream supports the mark() operation.
int	<a href="#"><u>read()</u></a> Read a single character.
int	<a href="#"><u>read(char[] cbuf)</u></a> Read characters into an array.
abstract int	<a href="#"><u>read(char[] cbuf, int off, int len)</u></a> Read characters into a portion of an array.
boolean	<a href="#"><u>ready()</u></a> Tell whether this stream is ready to be read.
void	<a href="#"><u>reset()</u></a> Reset the stream.
long	<a href="#"><u>skip(long n)</u></a> Skip characters.

public class BufferedReader extends Reader	
void	<a href="#"><u>close()</u></a> Close the stream.
void	<a href="#"><u>mark(int readAheadLimit)</u></a> Mark the present position in the stream.
boolean	<a href="#"><u>markSupported()</u></a> Tell whether this stream supports the mark() operation, which it does.
int	<a href="#"><u>read()</u></a> Read a single character.
int	<a href="#"><u>read(char[] cbuf, int off, int len)</u></a> Read characters into a portion of an array.
<a href="#"><u>String</u></a>	<a href="#"><u>readLine()</u></a> Read a line of text.
boolean	<a href="#"><u>ready()</u></a> Tell whether this stream is ready to be read.
void	<a href="#"><u>reset()</u></a> Reset the stream to the most recent mark.
long	<a href="#"><u>skip(long n)</u></a> Skip characters.

public class InputStreamReader extends Reader	
public class FileReader extends InputStreamReader	
void	<a href="#"><u>close()</u></a> Close the stream.
<a href="#"><u>String</u></a>	<a href="#"><u>getEncoding()</u></a> Return the name of the character encoding being used by this stream.
int	<a href="#"><u>read()</u></a> Read a single character.
int	<a href="#"><u>read(char[] cbuf, int offset, int length)</u></a> Read characters into a portion of an array.
boolean	<a href="#"><u>ready()</u></a> Tell whether this stream is ready to be read.

public abstract class Writer extends Object	
abstract void	<a href="#"><u>close()</u></a> Close the stream, flushing it first.
abstract void	<a href="#"><u>flush()</u></a> Flush the stream.
void	<a href="#"><u>write(char[] cbuf)</u></a> Write an array of characters.
abstract void	<a href="#"><u>write(char[] cbuf, int off, int len)</u></a> Write a portion of an array of characters.
void	<a href="#"><u>write(int c)</u></a> Write a single character.
void	<a href="#"><u>write(String str)</u></a> Write a string.
void	<a href="#"><u>write(String str, int off, int len)</u></a> Write a portion of a string.

public class OutputStreamWriter extends Writer	
public class FileWriter extends OutputStreamWriter	
void	<a href="#"><u>close()</u></a> Close the stream.
void	<a href="#"><u>flush()</u></a> Flush the stream.
String	<a href="#"><u>getEncoding()</u></a> Return the name of the character encoding being used by this stream.
void	<a href="#"><u>write(char[] cbuf, int off, int len)</u></a> Write a portion of an array of characters.
void	<a href="#"><u>write(int c)</u></a> Write a single character.
void	<a href="#"><u>write(String str, int off, int len)</u></a> Write a portion of a string.

public class StringTokenizer extends Object implements Enumeration	
<a href="#"><u>StringTokenizer(String str)</u></a> Constructs a string tokenizer for the specified string.	
<a href="#"><u>StringTokenizer(String str, String delim)</u></a> Constructs a string tokenizer for the specified string.	
<a href="#"><u>StringTokenizer(String str, String delim, boolean returnDelims)</u></a> Constructs a string tokenizer for the specified string.	
int	<a href="#"><u>countTokens()</u></a> Calculates the number of times that this tokenizer's nextToken method can be called before it generates an exception.
boolean	<a href="#"><u>hasMoreElements()</u></a> Returns the same value as the hasMoreTokens method.
boolean	<a href="#"><u>hasMoreTokens()</u></a> Tests if there are more tokens available from this tokenizer's string.
Object	<a href="#"><u>nextElement()</u></a> Returns the same value as the nextToken method, except that its declared return value is Object rather than String.
String	<a href="#"><u>nextToken()</u></a> Returns the next token from this string tokenizer.
String	<a href="#"><u>nextToken(String delim)</u></a> Returns the next token in this string tokenizer's string.