| 60 Minutes | 0907342 Object-Oriented Problem Solving | Fall 2017 |
| 3 questions / 6 pages | Midterm Exam | November 13th |

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Question 1: In the following multiple choice questions, identify the choice that represents the correct answer. **(5 points)**

1. **Which of the following is <u>true</u> about Java bytecode?**

    a. It is generated by the JVM.
    b. It is platform-dependent.
    c. It is executed by the JVM.
    d. It is stored in files with .class extension.
    e. b & d.
    f. c & d.

2. **Which of the following variables are assigned default values when they are created in Java?**

    a. Data fields of objects.
    b. Arrays elements.
    c. Methods parameters.
    d. Methods local variables.
    e. a & b.
    f. All of the above.

3. **How many syntax errors are there in the given A.java file?**

    a. There are no syntax errors.
    b. 1.
    c. 2.
    d. 3.
    e. 4.
    f. 5.

```
                    A.java
public class A {
   public B b;

   public A(){
      b = new B();
   }
   public A(int bx){
      b = new B(bx);
   }
   public void print(){
      System.out.println(b.x+" "+b.y);
   }
}
public class B{
   int x=1;
   private double y=5;

   public B(int newX){
      x = newX;
   }
}
```

4. **Which of the following overloads the method: int compute (int x, double y, String s),** <u>**without the possibility of causing ambiguous invocation**</u>**?**

    a. double compute (int x, double y, String s)
    b. int compute (int i, double j, String k)
    c. int compute (int x, double y)
    d. int compute (double x, int y, String s)
    e. c & d.
    f. All of the methods above.

5. **What does the following program print?**

```
public class MainClass {
   public static void main(String [] args){
      MyClass c1 = new MyClass();
      MyClass c2 = new MyClass(2);
      MyClass c3 = new MyClass(3.5);

      print(c1);
      print(c2);
      print(c3);
   }
   public static void print(MyClass c){
      System.out.print(c.getZ()+"\t"+c.getX()+"\t");
   }
}
class MyClass {
   private double x = 1.5;
   private static double z=0;

   public MyClass(){}
   public MyClass(double newX){
      z += newX;
      x = newX;
   }
   public double getX(){return x;}
   public static double getZ(){return z;}
}
```

a.	7	1.5	7	2	7	3.5

b.	5.5	1.5	5.5	2	5.5	3.5

c.	0	0	2	2	5.5	3.5

d.	0	1.5	2	2	5.5	3.5

e.	1.5	1.5	3.5	2	7	3.5

    f. The code will not run since it contains a syntax error.

Question 2: Study the following code, then answer the questions below. **(10 points)**

	Section.java
1.	package school;
2.	
3.	public class Section {
4.	public int grade;
5.	private Teacher mainTeacher;
6.	private static int maxStudentCount=25;
7.	
8.	public Section(int grade, Teacher main){
9.	grade = grade;
10.	mainTeacher = main;
11.	}
12.	public Teacher getTeacher(){return mainTeacher;}
13.	public static int getMaxStudentCount(){return maxStudentCount;}
14.	}
15.	
16.	class Teacher{
17.	private Student [] students;
18.	
19.	public Teacher(Student [] s){
20.	if (_____(a)_____) //check if size of s is less than maxStudentCount
21.	students = s;
22.	else System.out.println("Failed to initialize student info");
23.	}
24.	
25.	public Teacher(Student [] s, boolean copy){
26.	if (_____(b)_____){ //check if size of s is less than maxStudentCount
27.	students = new Student[s.length];
28.	for (int i=0; i<s.length; i++){
29.	if (copy) students[i]=new Student(s[i].ID,s[i].getGrades());
30.	else students[i]=s[i];
31.	}
32.	}
33.	else System.out.println("Failed to initialize student info");
34.	}
35.	
36.	public Student[] getStudents(){return students;}
37.	
38.	public void printStudentsDetails(){
39.	for (int i=0; i<students.length; i++){
40.	System.out.print(students[i].ID+" ");
41.	students[i].printGrades();
42.	}
43.	}
44.	}

Student.java
45. package school;
46.
47. public class Student{
48.   public int ID;
49.   private double [] grades;
50.
51.   public Student(int id, double [] g){
52.   ID=id;
53.   grades=new double[g.length];
54.   for (int i=0; i<g.length; i++)
55.   grades[i]=g[i];
56.   }
57.   public double [] getGrades(){return grades;}
58.   public void printGrades(){
59.   for (int i=0; i<grades.length; i++)
60.   System.out.print(grades[i]+" ");
61.   System.out.println();
62.   }
63. }

1. How many .class files are generated when the files above are compiled? Name them.
(1 point)

_____

2. Which of the classes above are accessible (can be used) by classes in other packages?
(1 point)

_____

3. What is the statement(s) that should be added in the beginning of a file in a different package, in order to use all accessible classes in this package? **(1 point)**

_____

4. Is the Teacher class immutable or not? Justify your answer. **(1 points)**

_____

5. There is one error in the code above. Specify the line where the error occurs, the cause of the error and its type (syntax, run-time, or logical). **(1 point)**

_____

6. **What is the condition that should be filled in blank (a) – line 19 and blank (b) – line 24 in order to check that the size of the passed array (s) is less than or equal the maximum number of students allowed in a section (maxStudentCount)?** (1 point)

_____

7. **Based on the following code:** (3 points)

```
double [][] g = {{95,92,91}, {85,81,80}};
Student [] s = {new Student(113,g[0]), new Student(215,g[1])};

Teacher t1 = new Teacher(s);
Teacher t2 = new Teacher(s, false);
Teacher t3 = new Teacher(s, true);

for (int i=0; i<g[0].length; i++)
    g[0][i]=100;
s[0]=new Student(150, g[1]);
s[1].ID=300;
```

What does each of the following statements print?

Statement	Output
t1.printStudentsDetails();	
t2.printStudentsDetails();	
t3.printStudentsDetails();	

8. **Given an object of type Section named mySection, write one statement that prints the grades of the first student only; student with index 0 of the students array of the teacher of the section; by invoking the printGrades method.** (1 point)

_____

Question 3: You are required to design a model for a factory (مصنع) using object oriented problem solving concepts you learned so far. Each factory has a name, an area, machines (آلات), and operators (عمال) as follows:

-Each operator has a name, social security number (رقم الضمان الاجتماعي), salary (راتب), and maximum increment rate (معدل الزيادة) which is the same for all operators. Each operator is responsible for operating one or more machines. All data fields of the operator should be encapsulated.

-Each machine has an ID, a production rate (معدل الانتاج), a description of its operation, and the time between periodic maintenance (الصيانة الدورية) which is the same for all machines. Note that your system should not allow info of a machine to be changed once it is entered by the user when the machine is added to the factory.

Your design should allow the user to do the following:
- Add and remove operators and machines to the factory, and enter info of an operator and machine when added to the factory
- Apply an increment of a certain amount entered by the user to an operator salary.
- Print the details of a certain operator or machine in the factory.
- Print the details of the machine(s) an operator is responsible for.

Draw the UML diagram of your design. <u>Note that no code writing is required for this question.</u>
<div align="right">(5 points)</div>