Object-oriented software engineering
Re-Examination

Object-oriented analysis, design and programming
Re-examination

BSc in Medialogy 4th Semester, Aalborg

23 August 2013, 9.00 - 12.00

Instructions

READ THE FOLLOWING INSTRUCTIONS CAREFULLY!

You have 3 hours to complete the examination.

Neither written material nor electronic equipment may be brought into the examination room.

There are 12 questions and the maximum number of marks for each question is 10.

Write your answers in blue or black ink. Answers written in pencil or any other colour of ink will be ignored by the examiner.

Submit no more than one answer to each question. If multiple answers are submitted for a single question, only one of your answers to the question will be marked.

Write your answers on the writing paper provided. Do not write your answers on the question paper. Anything written on the question paper will not be marked.

If you are taking the examination as a re-examination for the "Object-oriented software engineering" course, you must get at least **60** marks in order to pass (i.e., 50% of the maximum possible number of marks).

If you are taking the examination as a re-examination for the discontinued course, "Object-oriented analysis, design and programming" (OOADP), then you must get at least **45** marks in order to pass. Questions 1-9 test knowledge of material that was presented in the OOADP course. If you are sitting a re-exam for OOADP, you are therefore not expected to be able to answer questions 10-12. However, any marks you gain on questions 10-12 will be counted towards your total mark, so you are encouraged to attempt these questions.

DO NOT TURN OVER UNTIL TOLD TO DO SO!

Question 1

a. Briefly explain why Fred Brooks considered the concept of the “man-month” to be “mythical”. [4 marks]

b. Which one of the following is **not** typically an advantage of software written using the object-oriented paradigm:

1. Code is shorter.
2. Code is more modular
3. Code is encapsulated.
4. Code is easier to re-use.

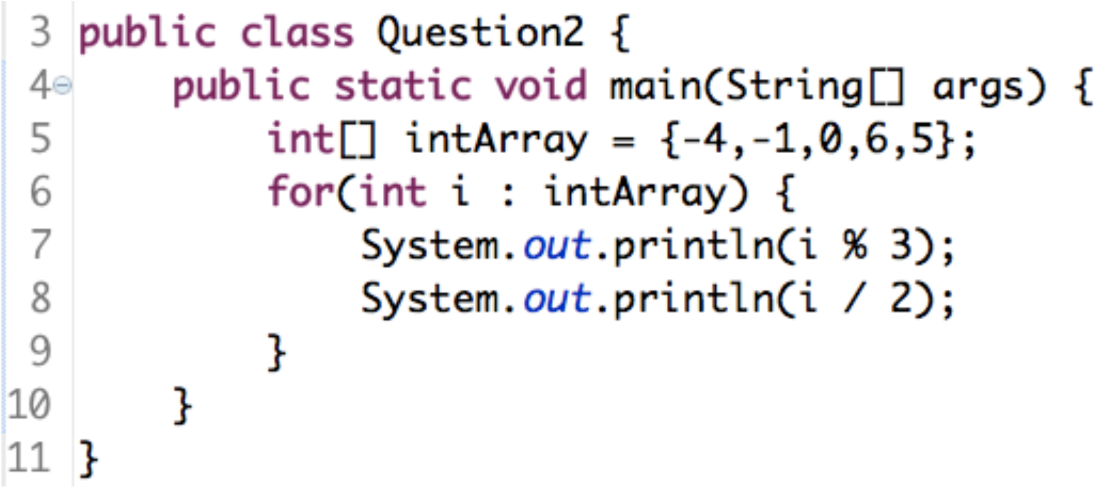
[1 mark]

c. In Java, how many superclasses is a class permitted to extend? How many interfaces is a class permitted to implement? [2 marks]

d. “A good software system is constructed from cohesive, loosely-coupled components.” Briefly explain what this means. [3 marks]

Question 2

Write down the output of the following Java program. [10 marks]



```
public class Question2 {
    public static void main(String[] args) {
        int[] intArray = {-4,-1,0,6,5};
        for(int i : intArray) {
            System.out.println(i % 3);
            System.out.println(i / 2);
        }
    }
}
```

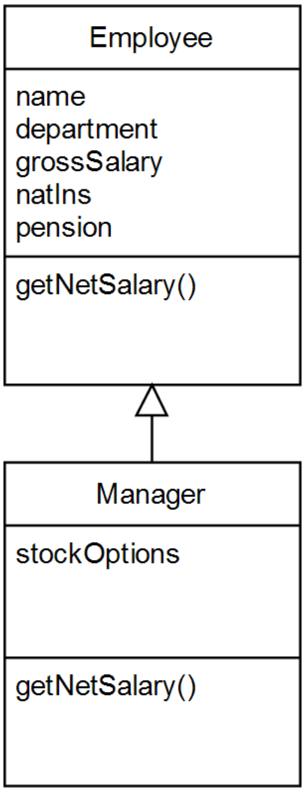
Question 3

a. Suppose the following method has been defined in UML:

– calcX(y : int) : float

Write down the *signature,* the *selector,* the *return type*, the *visibility* and the *parameter* of the calcX method. [5 marks]

b. Consider the following UML diagram and answer the questions that follow it.



i. Is Employee a superclass or a subclass of Manager? [1 mark]

ii. Which one of the following statements is true:

1. The Employee class's getNetSalary() method is overridden in the Manager class.
2. The Manager class's getNetSalary() method is overridden in the Employee class.
3. The Employee class's getNetSalary() method is overloaded in the Manager class.
4. The Manager class's getNetSalary() method is overloded in the Employee class.

[2 marks]

c. Does inheritance increase or decrease coupling? Explain your answer.
[2 marks]

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Question 4

a. For each of the following types of UML diagram, state whether it is a structure diagram or a behaviour diagram:

i. Class diagram

ii. Use case diagram

iii. Activity diagram

iv. Sequence diagram

[4 marks]

b. In the context of a UML use case diagram, define the meanings of the following terms

i. actor [2 marks]

ii. use case [2 marks]

iii. main success scenario [2 marks]

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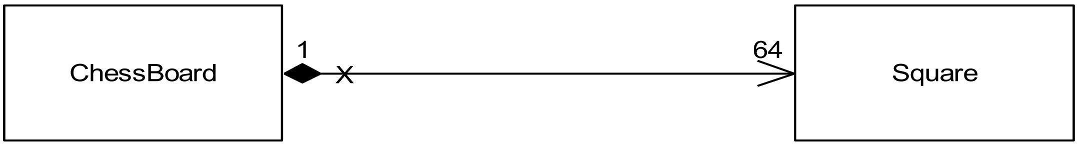
Question 5

Study the following UML diagram and answer the questions that follow it.



a. What does the “X” mean near the left-hand end of the line connecting the boxes labelled “ChessBoard” and “Square”?

b. What does the “64” mean at the right-hand end of the line connecting the two boxes.

c. What does the black diamond mean at the left-hand end of the line connecting the two boxes?

d. What does the arrow mean at the right-hand end of the line connecting the two boxes?

e. Is this an example of aggregation or composition? Explain why this particular type of association is appropriate in this case.

[2 marks each]

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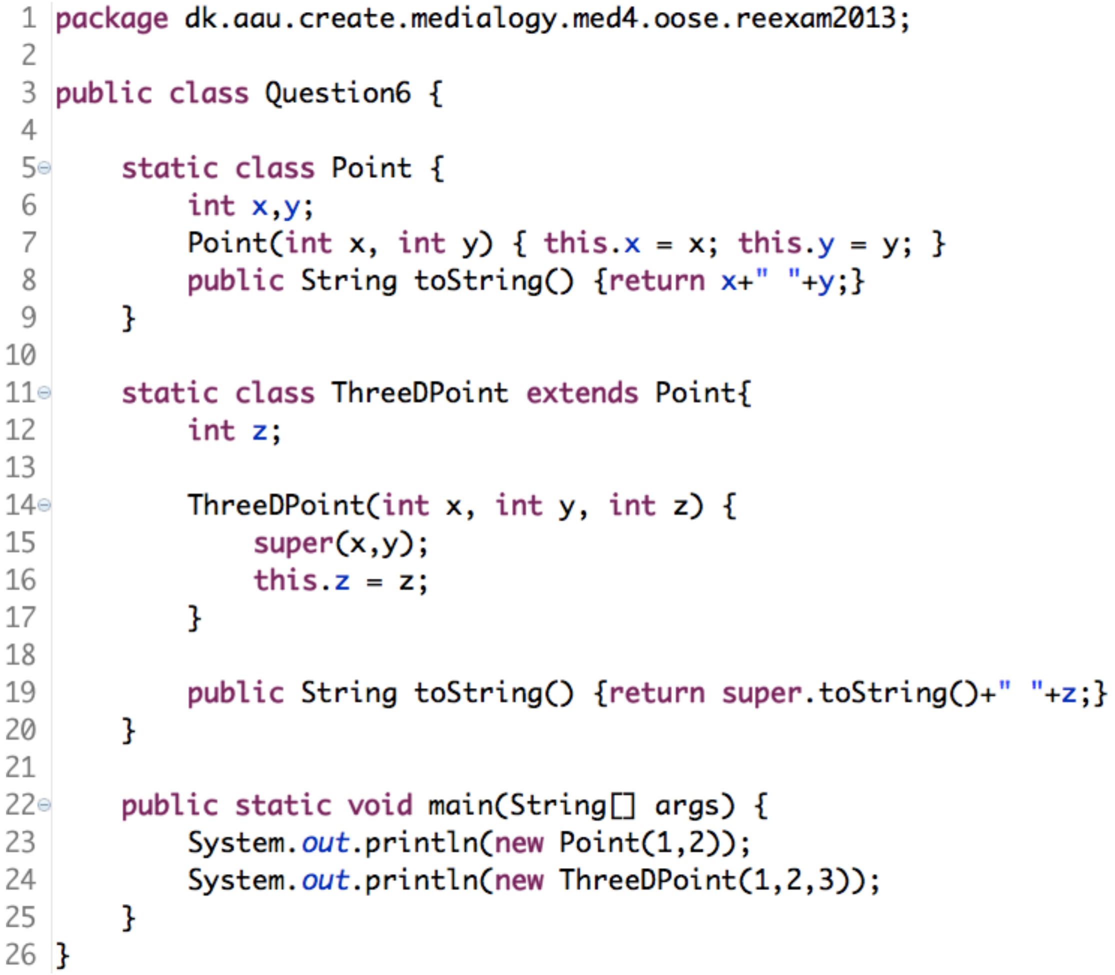
Question 6

Study the following Java code and answer the questions that follow it.



```
 1 package dk.aau.create.medialogy.med4.oose.reexam2013;
 2 
 3 public class Question6 {
 4 
 5     static class Point {
 6         int x,y;
 7         Point(int x, int y) { this.x = x; this.y = y; }
 8         public String toString() {return x+" "+y;}
 9     }
10 
11     static class ThreeDPoint extends Point{
12         int z;
13 
14         ThreeDPoint(int x, int y, int z) {
15             super(x,y);
16             this.z = z;
17         }
18 
19         public String toString() {return super.toString()+" "+z;}
20     }
21 
22     public static void main(String[] args) {
23         System.out.println(new Point(1,2));
24         System.out.println(new ThreeDPoint(1,2,3));
25     }
26 }
```

a. What is the output when this program is run?

b. Why are definitions of the Point and ThreeDPoint classes marked “static” in lines 5 and 11?

c. What is the purpose of line 15?

d. To what do “this.z” and “z” refer in line 16?

e. What is the superclass of Point?

[2 marks each]

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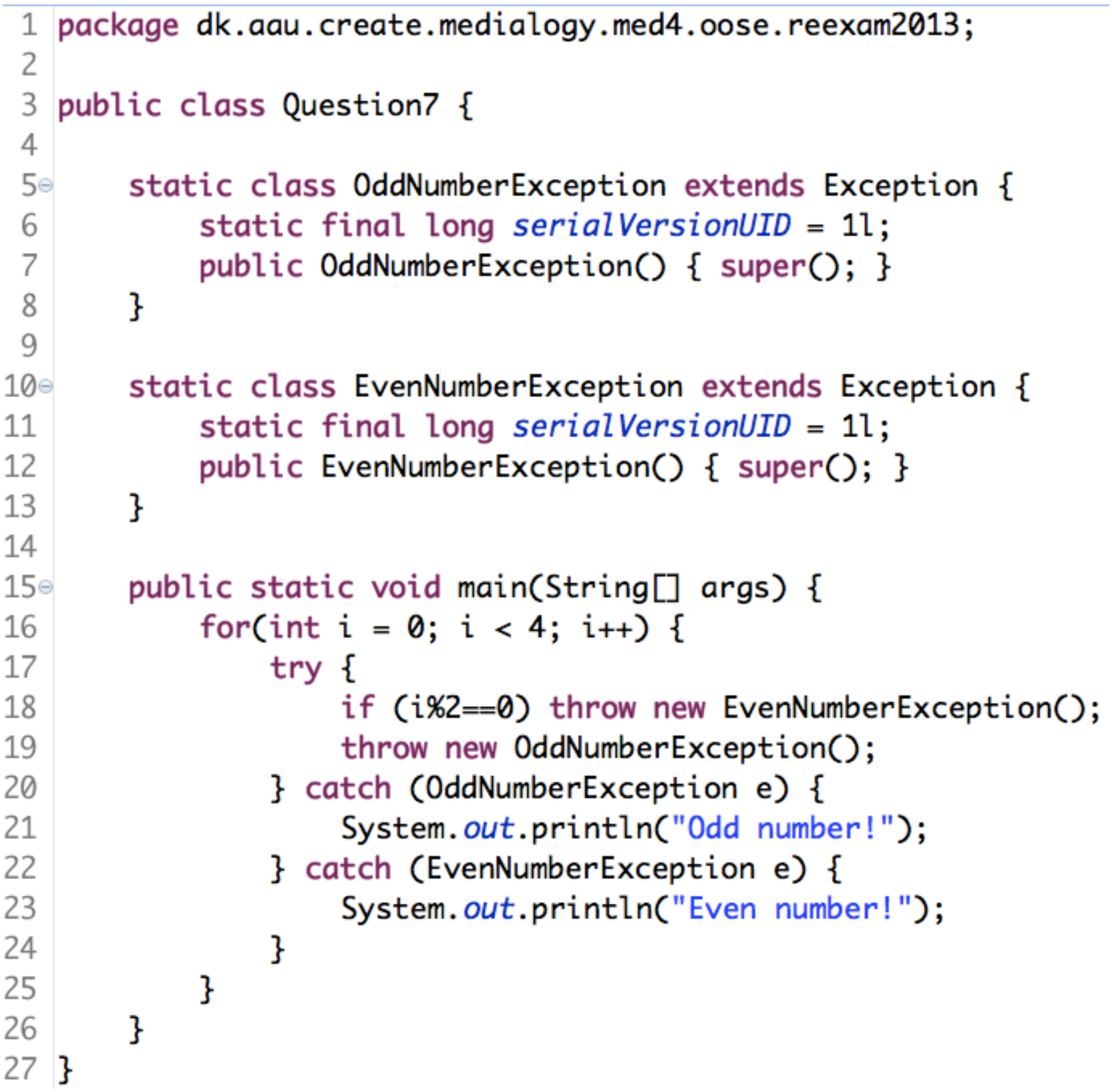
Question 7

Study the Java code below and answer the questions that follow it.



```java
 1 package dk.aau.create.medialogy.med4.oose.reexam2013;
 2 
 3 public class Question7 {
 4 
 5     static class OddNumberException extends Exception {
 6         static final long serialVersionUID = 1l;
 7         public OddNumberException() { super(); }
 8     }
 9 
10     static class EvenNumberException extends Exception {
11         static final long serialVersionUID = 1l;
12         public EvenNumberException() { super(); }
13     }
14 
15     public static void main(String[] args) {
16         for(int i = 0; i < 4; i++) {
17             try {
18                 if (i%2==0) throw new EvenNumberException();
19                 throw new OddNumberException();
20             } catch (OddNumberException e) {
21                 System.out.println("Odd number!");
22             } catch (EvenNumberException e) {
23                 System.out.println("Even number!");
24             }
25         }
26     }
27 }
```

a. What is the output of this program?

b. Why is it necessary to define the “serialVersionUID” variables in lines 6 and 11?

c. Why is it necessary to define constructors for the new Exception classes even though each of these constructors only calls the superclass’s constructor?

d. Why is it not necessary to insert an “else” between lines 18 and 19?

e. What changes would you make to lines 7, 19 and 21 so that the program prints out the value of i along with the message “Odd number!”. You must not use any calls to System.out.println or System.out.print inside the try block!

[2 marks each]

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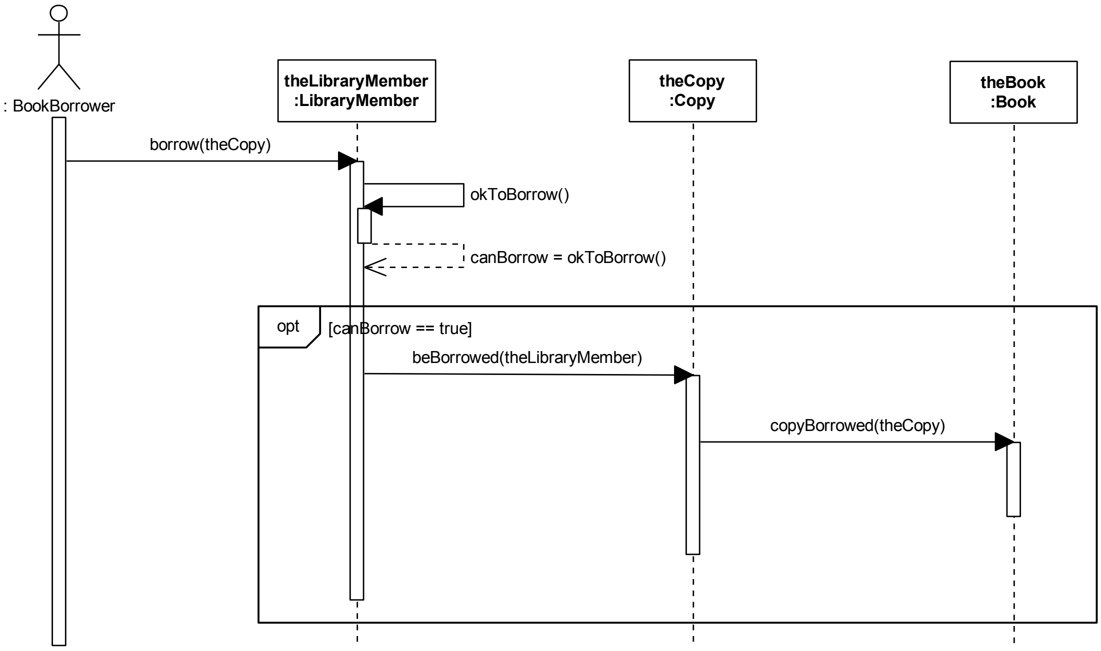
Question 8

Study the following sequence diagram and answer the questions that follow it.



a. Why does the label ": BookBorrower" begin with a colon?

b. In what class of object is the method "borrow(Copy)" defined?

c. Is Copy a class or an object?

d. What is the meaning of the dashed arrow labelled "canBorrow = okToBorrow()"?

e. What is the meaning of the box with the label "opt" in the upper left-hand corner?

[2 marks each]

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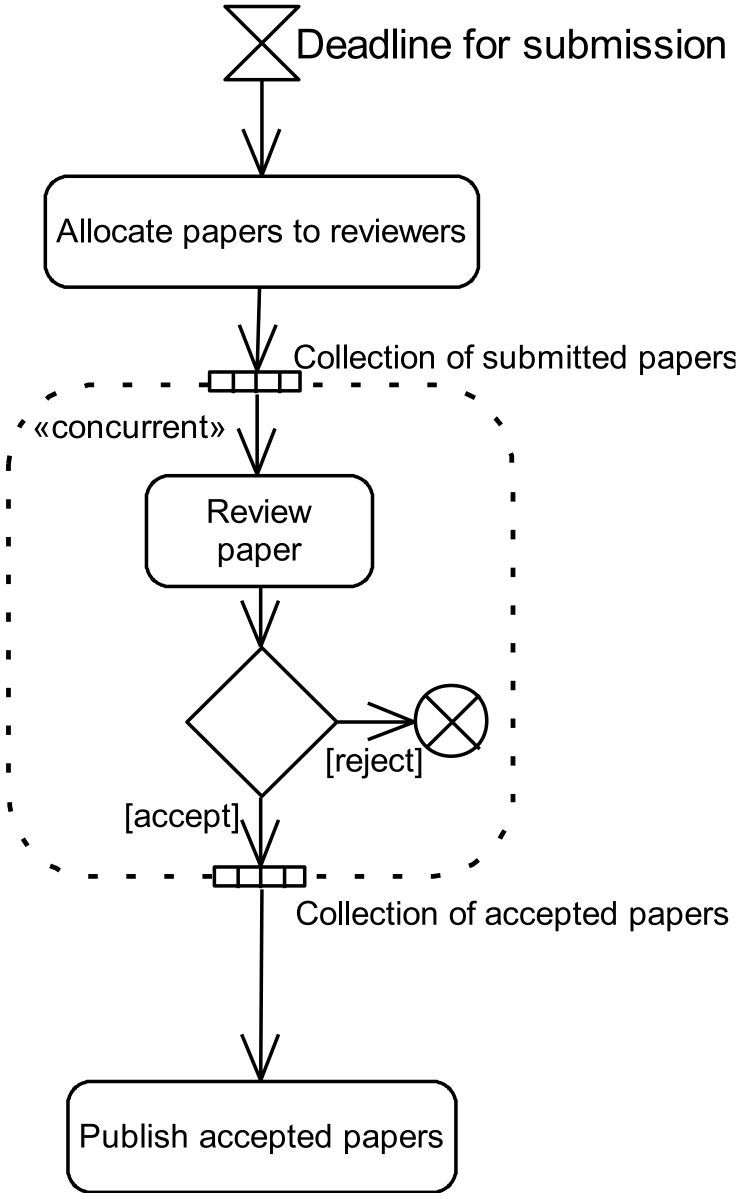
Question 9

Study the following activity diagram and answer the questions that follow it.


Deadline for submission
Allocate papers to reviewers
Collection of submitted papers
«concurrent»
Review paper
[reject]
[accept]
Collection of accepted papers
Publish accepted papers

a. What is the meaning of the dashed box with rounded corners?

b. What is the meaning of the circle with a cross in it at the end of the arrow labelled [reject]?

c. What kind of thing is the row of four boxes labelled “Collection of submitted papers” and what is its function in the diagram?

d. What type of thing is the diagram element labelled “Deadline for submission” and how does it function in the diagram?

e. What is the meaning of the word <<concurrent>> in the context of this diagram?

[2 marks each]

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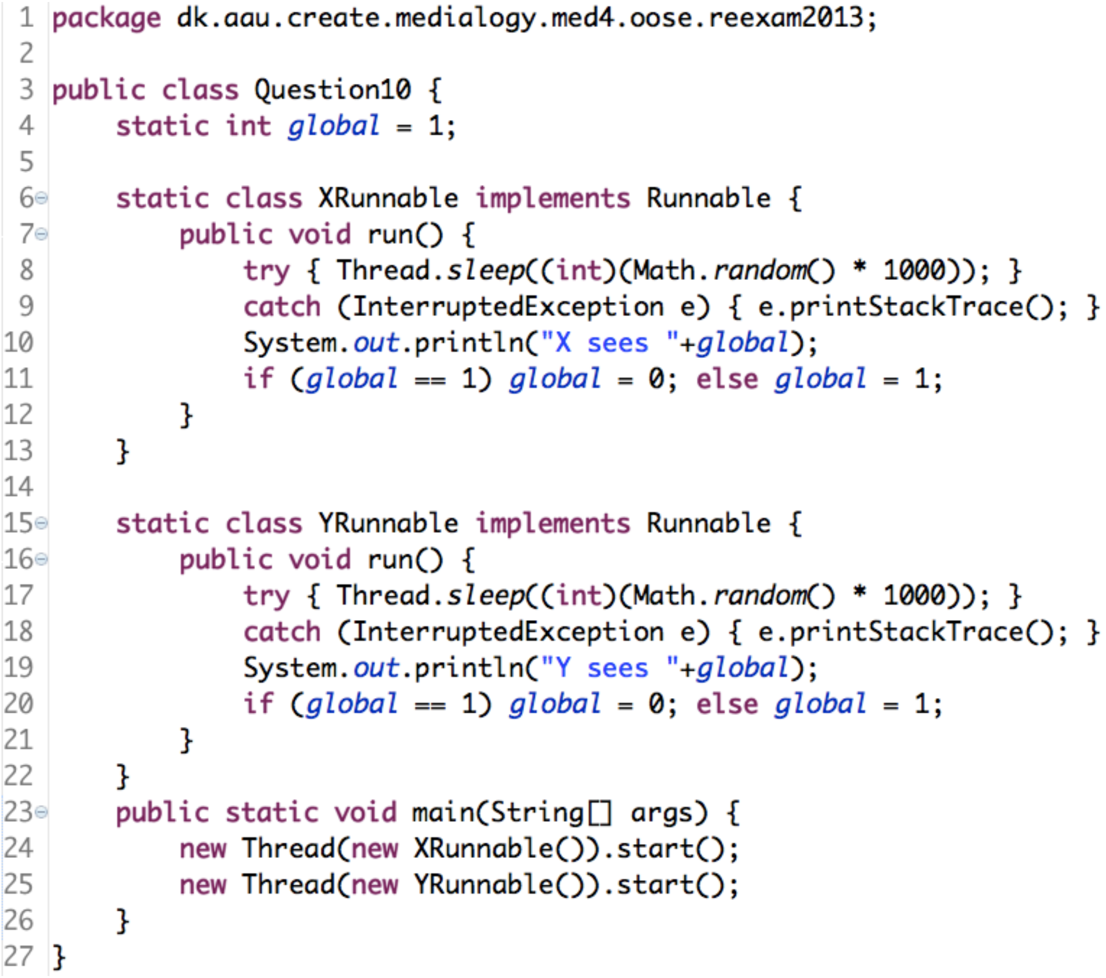
Question 10

Study the following Java code and answer the questions that follow it.



```
1  package dk.aau.create.medialogy.med4.oose.reexam2013;
2
3  public class Question10 {
4      static int global = 1;
5
6      static class XRunnable implements Runnable {
7          public void run() {
8              try { Thread.sleep((int)(Math.random() * 1000)); }
9              catch (InterruptedException e) { e.printStackTrace(); }
10             System.out.println("X sees "+global);
11             if (global == 1) global = 0; else global = 1;
12         }
13     }
14
15     static class YRunnable implements Runnable {
16         public void run() {
17             try { Thread.sleep((int)(Math.random() * 1000)); }
18             catch (InterruptedException e) { e.printStackTrace(); }
19             System.out.println("Y sees "+global);
20             if (global == 1) global = 0; else global = 1;
21         }
22     }
23     public static void main(String[] args) {
24         new Thread(new XRunnable()).start();
25         new Thread(new YRunnable()).start();
26     }
27 }
```

a. What are the two possible outputs of this program? [4 marks]

b. In line 17, which thread is put to sleep? [2 marks]

c. Why does the Thread.sleep method have to be enclosed within a try-catch block? [2 marks]

d. Why does the variable called “global” have to be declared static? [2 marks]

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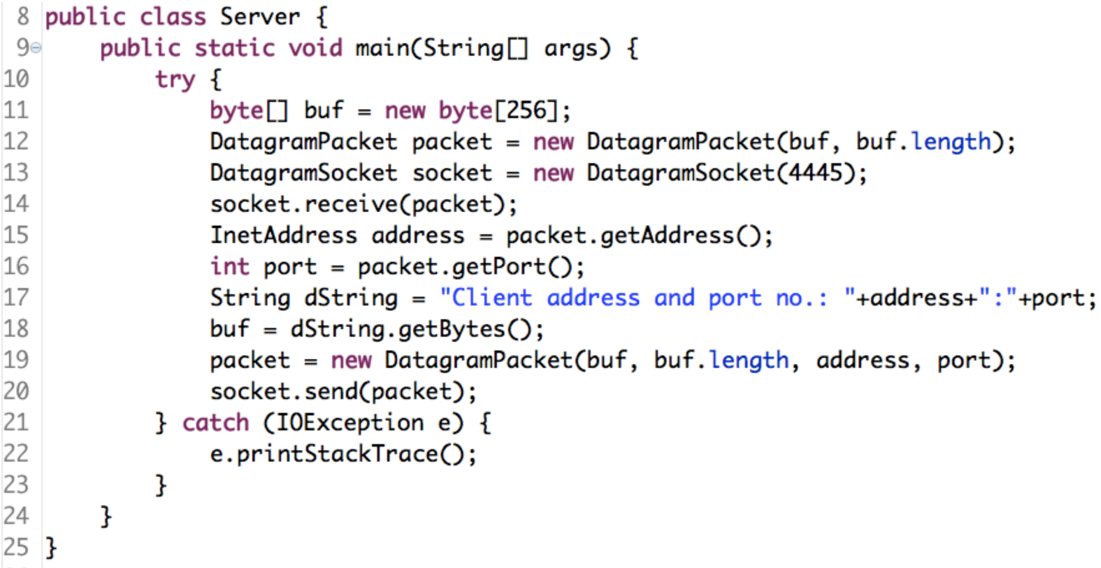
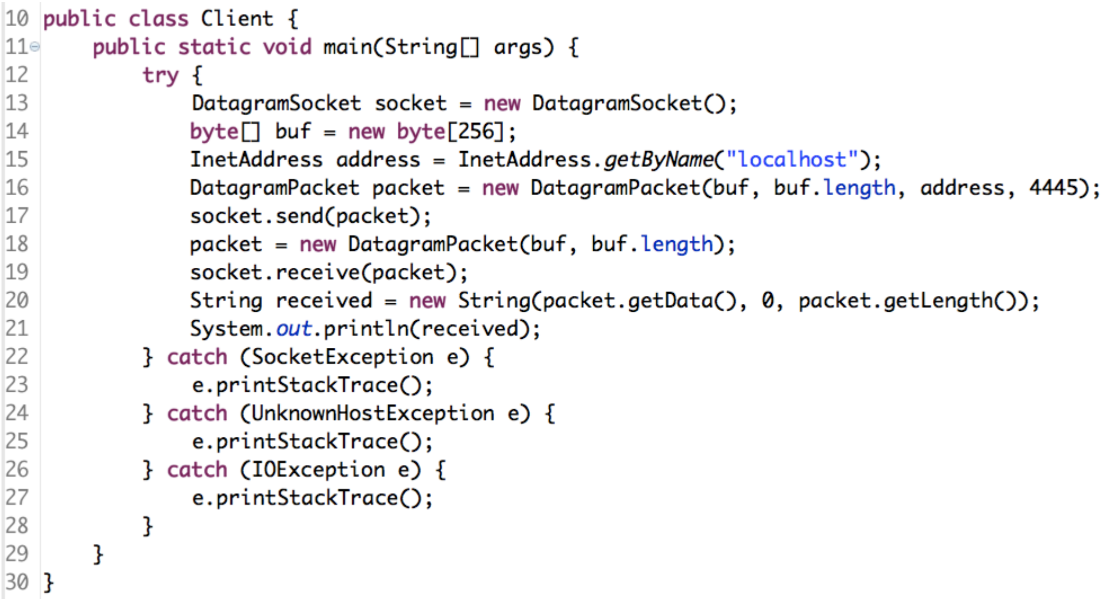
Question 11

a. Explain the difference between TCP and UDP. Give examples of applications that use each protocol and explain why the protocol is appropriate for that application. [4 marks]

b. Study the following Java code which shows two class definitions, Server.java, and Client.java, and answer the questions that follow.



```
 8 public class Server {
 9     public static void main(String[] args) {
10         try {
11             byte[] buf = new byte[256];
12             DatagramPacket packet = new DatagramPacket(buf, buf.length);
13             DatagramSocket socket = new DatagramSocket(4445);
14             socket.receive(packet);
15             InetAddress address = packet.getAddress();
16             int port = packet.getPort();
17             String dString = "Client address and port no.: "+address+":"+port;
18             buf = dString.getBytes();
19             packet = new DatagramPacket(buf, buf.length, address, port);
20             socket.send(packet);
21         } catch (IOException e) {
22             e.printStackTrace();
23         }
24     }
25 }
```



```
10 public class Client {
11     public static void main(String[] args) {
12         try {
13             DatagramSocket socket = new DatagramSocket();
14             byte[] buf = new byte[256];
15             InetAddress address = InetAddress.getByName("localhost");
16             DatagramPacket packet = new DatagramPacket(buf, buf.length, address, 4445);
17             socket.send(packet);
18             packet = new DatagramPacket(buf, buf.length);
19             socket.receive(packet);
20             String received = new String(packet.getData(), 0, packet.getLength());
21             System.out.println(received);
22         } catch (SocketException e) {
23             e.printStackTrace();
24         } catch (UnknownHostException e) {
25             e.printStackTrace();
26         } catch (IOException e) {
27             e.printStackTrace();
28         }
29     }
30 }
```

i. Describe what is output by each of these programs if the Server class is run and then the Client class is run. [2 marks]

ii. How is the port number of the Client program assigned? [2 marks]

iii. On which line in the Server class's main method does the program block and what causes this program to continue? [2 marks]

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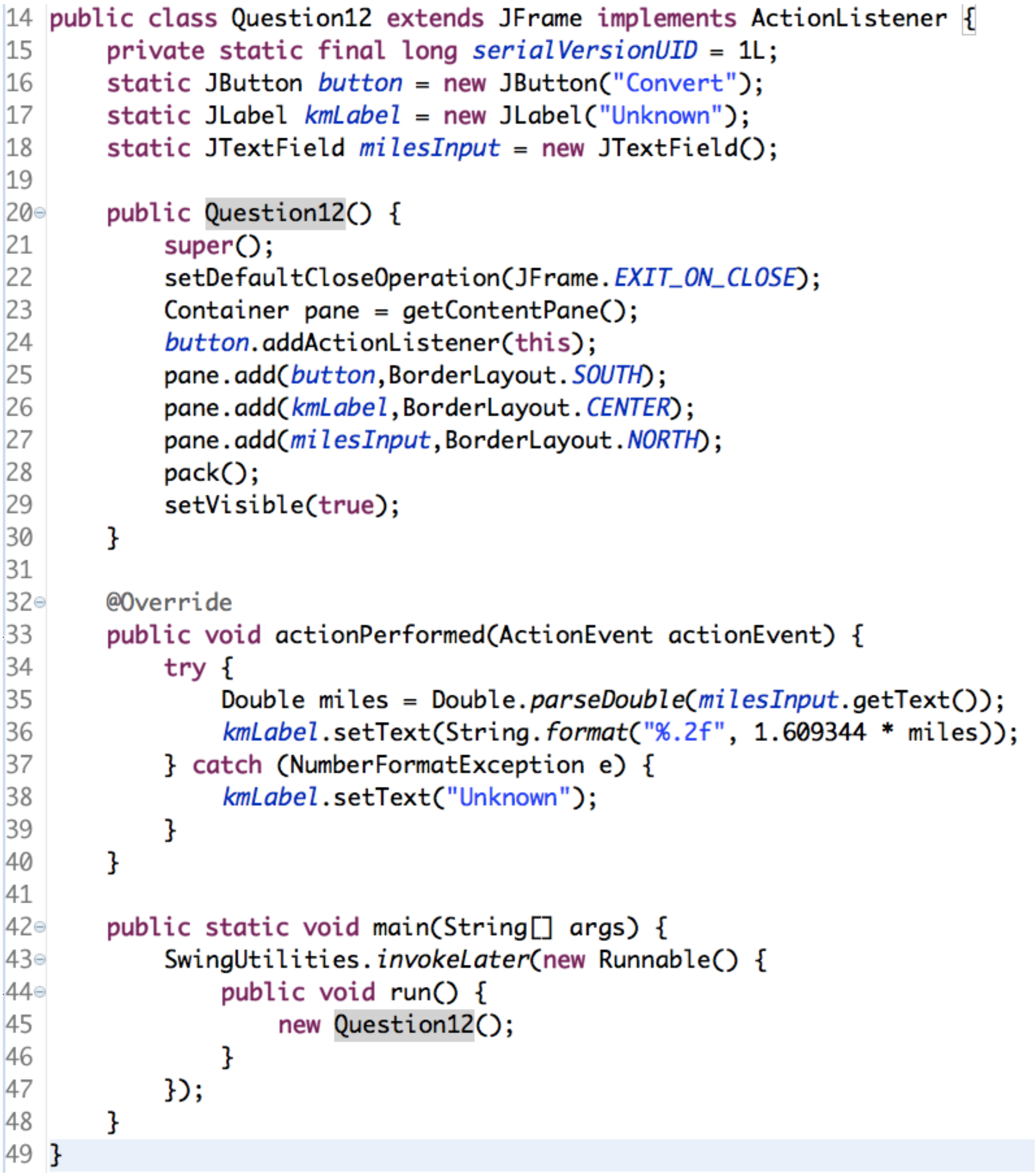
Question 12

Study the following Java code and answer the questions that follow it.



```
14 public class Question12 extends JFrame implements ActionListener {
15     private static final long serialVersionUID = 1L;
16     static JButton button = new JButton("Convert");
17     static JLabel kmLabel = new JLabel("Unknown");
18     static JTextField milesInput = new JTextField();
19
20     public Question12() {
21         super();
22         setDefaultCloseOperation(JFrame.EXIT_ON_CLOSE);
23         Container pane = getContentPane();
24         button.addActionListener(this);
25         pane.add(button,BorderLayout.SOUTH);
26         pane.add(kmLabel,BorderLayout.CENTER);
27         pane.add(milesInput,BorderLayout.NORTH);
28         pack();
29         setVisible(true);
30     }
31
32     @Override
33     public void actionPerformed(ActionEvent actionEvent) {
34         try {
35             Double miles = Double.parseDouble(milesInput.getText());
36             kmLabel.setText(String.format("%.2f", 1.609344 * miles));
37         } catch (NumberFormatException e) {
38             kmLabel.setText("Unknown");
39         }
40     }
41
42     public static void main(String[] args) {
43         SwingUtilities.invokeLater(new Runnable() {
44             public void run() {
45                 new Question12();
46             }
47         });
48     }
49 }
```

a. Sketch what this GUI looks like.

b. Briefly describe what the program does.

c. What is the purpose of the “actionPerformed” method?

d. Why do lines 35 and 36 have to be inside a try-catch method?

e. In what line is the JFrame object that functions as the main window constructed?

[2 marks each]

END OF EXAMINATION