1. All classes below are in the same Java file *(3 questions, total 13 points)*

```
 1  class Province {
 2      static String name;
 3      private String region;
 4      public int area;
 5
 6      Province(String n, String r, int a) { name = n; region = r; area = a; }
 7
 8      void compareReport(Province other) {
 9          if (isSameRegion(other)) {
10              System.out.printf("%s, same region \n", name);
11          }
12          else {
13              int diff = area - other.area;
14              if (diff > 0)
15                  System.out.printf("%s, bigger by %d\n", name, diff);
16              else if (diff < 0) {
17                  int reverse = diff * (-1);
18                  System.out.printf("%s, smaller by %d\n", name, reverse);
19              }
20              else {
21                  System.out.printf("%s, equal size\n", name);
22                  // System.out.printf("diff = %d\n", diff);
23                  // System.out.printf("temp = %d\n", reverse);
24              }
25          }
26      }
27      private boolean isSameRegion(Province other) {
28          return region.equals(other.region);
29      }
30  }
31
32  public class Midterm_1 {
33      public static void main(String[] args) {
34          testProvinces();
35      }
36      static public void testProvinces() {
37          Province p1 = new Province("Bangkok", "Central", 1560);
38          Province p2 = new Province("Phuket", "Southern", 570);
39          Province p3 = new Province("Lampang", "Northern", 12600);
40          p2.compareReport(p1);
41          p3.compareReport(p1);
42          swap(p1, p3);
43          p2 = new Province("Lopburi", "Central", 12600);
44          p2.compareReport(p1);
45      }
46      static public void swap(Province pv1, Province pv2) {
47          Province temp = pv1;
48          pv1 = pv2;
49          pv2 = temp;
50      }
51  }
```

1.1 Show the output of this program. Only the first 3 lines of your answered output will be graded, the rest will be ignored *(3 points)*

1.2 In line 8, suppose that we add the following prefix to the header of method `compareReport`. Will the program still be compiled without any error? If the answer is NO, explain reason for the error. Note that only 1 prefix is added at a time *(2 points)*

Prefix	Compiled without error? (YES/NO)	In case of NO, reason for error
`protected`		
`private`		

1.3 Consider variable `temp` and variable `region` that keeps value `"Southern"`: *(4 points)*

- In which parts of the program's address space (i.e. memory) will they be created?
- Give the first times they are created, i.e. when this program executes which lines?
- Give the earliest times they can be destroyed, i.e. when/after this program executes which lines?

Variable	Program's memory	Created when (which line)?	Destroyed when (which line)?
`temp`			
`Region` (that keeps `"Southern"`)			

1.4 If we uncomment lines 22 and 23, will the program still be compiled without any error? If the answer is NO, explain the reason for the error. Note that only 1 line is uncommented at a time. *(2 points)*

Prefix	Compiled without error? (YES/NO)	In case of NO, reason for error
`protected`		
`private`		

1.5 In line 36, suppose that we remove <u>static</u> from the header of method <u>testProvinces()</u>. Make change to line 34 such that the program <u>must still call</u> testProvinces() without any compilation error and give the same result as before. (2 points)

2. All classes and interfaces below are in the same source file. *(5 questions, total 16 points)*

```java
1  import java.util.*;
2
3  interface Eatable       { public void eaten(); }
4
5  final class Fruit implements Eatable {
6      private String name;
7      private int vitC;
8      public Fruit(String n, int v)  { name = n; vitC = v; }
9      public void eaten() {
10         System.out.printf("%s >> vitamin C = %d \n", name, vitC);
11     }
12 }
13
14 abstract class Seafood implements Eatable {
15     private String name = "Seafood";
16     protected int omega3;
17     protected String level = "not good";
18     public void setName(String n) { name = n; }
19     public String getName() { return name; }
20     abstract void check();
21 }
22
23 class Fish extends Seafood {
24     public Fish() { }
25     public Fish(int om) { omega3 = om; }
26     public void check() { if (omega3 > 1000) level = "very good"; }
27     public void eaten() {
28         this.check();
29         System.out.printf("%s >> omega3 = %d, %s \n", getName(), omega3, level);
30     }
31 }
32
33 class Mollusk extends Fish {
34     private Mollusk() { }
35     private Mollusk(int om) { super(om); }
36     static Mollusk create(int om) { return new Mollusk(om); }
37     public void check() {if (omega3 > 500) level = "very good"; }
38     public void eaten() {
39         this.check();
40         System.out.printf("Mollusk >> omega3 = %d, %s \n", omega3, level);
41     }
42 }
43
```

```
44  public class Midterm_2 {
45      public static void main(String[] args) {
46          // Your code for question 2.1
47
48          for(int i = A.size() - 1; i >= 0; i--) A.get(i).eaten();
49      }
50  }
```

	Expected output for 2.1
1	Herring >> omega3 = 1700, very good
2	Orange >> vitamin C = 50
3	Mollusk >> omega3 = 700, very good

2.1 Add your code that should be at line 46 in method main to do the following: *(5 points)*

- Create an <u>ArrayList called A</u> that can keep Fruit, Fish, and Mollusk objects
- Create Fruit, Fish, and Mollusk objects. Use given methods to set object values. Add them to ArrayList in the correct order, so that the output from the program is as expected

Don't change any other class or interface.

2.2 If we remove prefix <u>public</u> from the header of method <u>check</u> in line 26 and line 37, will the program still be compiled without any error? If the answer is NO, explain the reason for the error. Note that public is removed from 1 line at a time. *(2 points)*

Remove public	Compiled without error? (YES/NO)	In case of NO, reason for error
Only line 26		
Only line 37		

2.3 If we change <u>this.check()</u> in line 28 and line 39 to <u>super.check()</u>, will the program still be compiled without any error? If the answer is NO, explain the reason for the error. But if the answer is YES, show the new output lines(s) that will be different from the original output – if the new output will be exactly the same as before, cleary state "same output". Note that only 1 line is changed at a time. *(2 points)*

-- answer in the next page

Change to super.check()	Compiled without error? (YES/NO)	In case of NO, reason for error In case of YES, output lines that change
Only line 28		
Only line 39		

2.4 If we create a new class `MyFood` that extends the following classes, will the program still be compiled without any error? If the answer is NO, explain reason for the error. Note that `MyFood` extends only 1 class at a time. *(3 points)*

	Compiled without error? (YES/NO)	In case of NO, reason for error
MyFood extends Fruit		
MyFood extends Fish		
MyFood extends Mollusk		

2.5 Suppose we have another `ArrayList` called `AF` that keeps only `Fruit` objects. We want the program to execute the following lines and get the output sorted in decreasing order of `vitC`. But in case that 2 `Fruits` have equal `vitC`, sort them by alphabetical order of `name`.

```
1 | // In main method, suppose we already have an ArrayList of Fruit objects
2 | Collections.sort( AF );
3 | For(Fruit f : AF) f.eaten();
```
Expected output
```
1 | guava >> vitamin C = 200
2 | apple >> vitamin C = 40
3 | mango >> vitamin C = 40
```

Write only new header of class Fruit and full method that must be added in this class to get the expected output. *(4 points)*

3. All classes below are in the same source file. *(4 questions, total 11 points)*

```
1   class TypeException extends Exception { }
2   class PaymentException extends RuntimeException { }
3
4   class Employee {
5       String type, name;
6       int payment;
7
8       public Employee(String line) {
9           reset();
10          String [] cols = line.split(",");
11          try {
12              type = cols[0].trim();
13              name = cols[1].trim();
14              payment = Integer.parseInt( cols[2].trim() );
15          }
16          catch (NumberFormatException e) { System.err.println("Err >> 1"); }
17          catch (NullPointerException e)  { System.err.println("Err >> 2"); }
18          catch (RuntimeException e) {
19              System.err.println("Err >> 3 >> " + e.getClass().getName());
20              reset();
21          }
22          catch(Exception e) {
23              System.err.println("Err >> 4 >> " + e.getClass().getName());
24              reset();
25          }
26      }
27
28      public void reset() { type = "c"; name = "someone"; payment = 0; }
29
30      public boolean report() {
31          try { verify(); }
32          catch (Exception e) {
33              System.err.println("Err >> 5 >> " + e.getClass().getName());
34              return false;
35          }
36          finally {
37              System.out.printf("Out >> name %s, type = %s, payment = %d \n",
38                                  name, type, payment);
39          }
40          return true;
41      }
42
43      public void verify() throws TypeException, PaymentException {
44          if (type.equals("s")) type = "salary+";
45          else if (type.equals("c")) type = "commission";
46          else throw new TypeException();
47
48          if (payment < 0) throw new PaymentException();
49      }
50  }
51
```

```
52  public class Midterm_3 {
53      public static void main(String[] args) {
54          String line1 = "s, annie,  100K";
55          String line2 = "x, betty, -2000";
56          String line3 = "   carol,  3000";
57
58          //Employee em1 = new Employee(line1); em1.report();
59          //Employee em2 = new Employee(line2); em2.report();
60          //Employee em3 = new Employee(line3); em3.report();
61      }
62  }
```

Consider when we uncomment lines 58-60 by uncommenting only 1 line at a time:

- Show exception message printed by System.err. Only the first line of your answered message will be graded, the rest will be ignored. If no exception message is printed, explicitly state "no exception".
- Which instruction throws the exception that leads to the above exception message?
- Show normal output printed by System.out. Only first line of your answered output will be graded, the rest will be ignored. If no output is printed, explicitly state "no output".

3.1 When only line 58 is uncommented. *(3 points)*

Exception message by System.err	
Instruction line that throws the exception	
Normal output by System.out	

3.2 When only line 59 is uncommented. *(3 points)*

Exception message by System.err	
Instruction line that throws the exception	
Normal output by System.out	

-- last questions in the next page

3.3 When only line 60 is uncommented. *(3 points)*

Exception message by `System.err`	
Instruction line that throws the exception	
Normal output by `System.out`	

3.4 Consider the header of method <u>verify()</u> in line 43. Suppose that there is only exception after <u>throws</u>. Will the program still be compiled without any error? If the answer is NO, explain reason for the error. *(2 points)*

Change to	Compiled without error? (YES/NO)	In case of NO, reason for error
`throws TypeException`		
`throws PaymentException`		