NATIONAL UNIVERSITY OF SINGAPORE
SCHOOL OF COMPUTING

SEMESTER II (2002-03)
EXAMINATION FOR

CS2103: SOFTWARE ENGINEERING

April 2003 Time Allowed: 2 Hours

INSTRUCTIONS TO CANDIDATES

1. This examination paper consists of **NINE (9)** questions and comprises **TEN (10)** printed pages. Answer **ALL** questions.
2. Write your answers in the **blank spaces** in this answer book only.
3. This is an **OPEN BOOK** examination.
4. Please fill in your **Matriculation Number** below. Also write your matriculation number on the top right hand corner of every page.

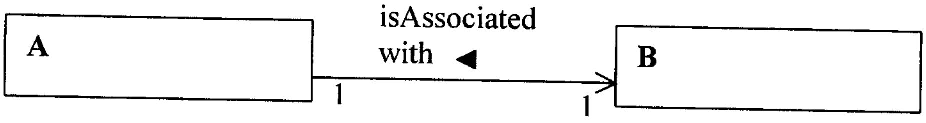
Matriculation Number: □□□□□□□□□□

For Official Use Only :

	Marks
Question 1 (max 5)	
Question 2 (max 12)	
Question 3 (max 15)	
Question 4 (max 18)	
Question 5 (max 10)	
Question 6 (max 10)	
Question 7 (max 10)	
Question 8 (max 10)	
Question 9 (max 10)	
TOTAL:	

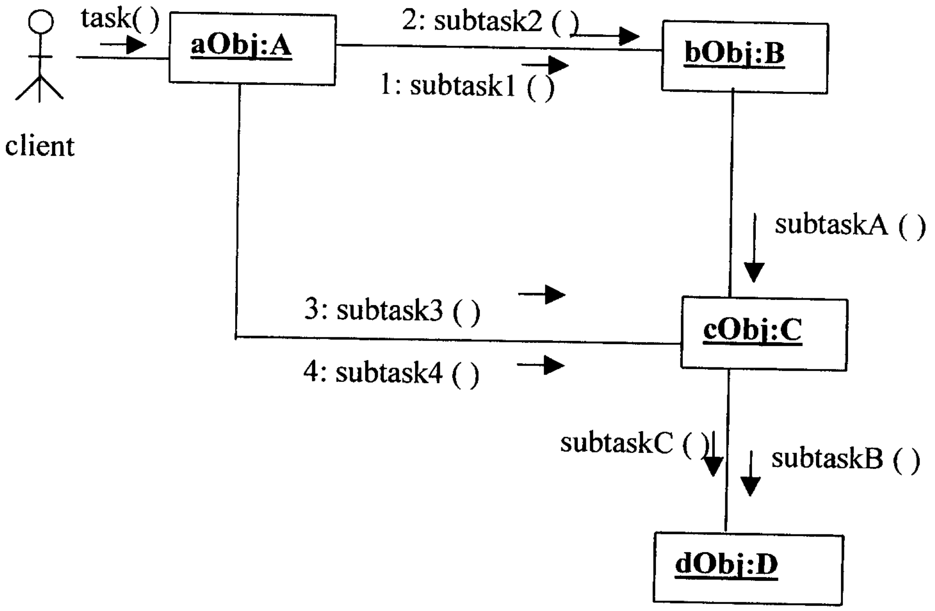
Question 1 Fill in the blanks with appropriate class type A or B **5 marks**

In figure below , objects of class _____ needs to send messages to objects of the class ______ but not vice versa. This particular association may be implemented by placing an attribute to hold the object reference for the class ____ in the class ____ . Thus objects of class ______ have the object reference of _____ object and hence can send messages to the linked ______ object. As the object of class ______ does not have the object reference of ______ object it cannot send messages to the ________ object.



Question 2 **12 marks**

Consider the following **UML collaboration diagram** in which objects of classes A, B, C and D interact to achieve a task as initiated by the client.



Each of the ***subtask*** messages represents an object interaction towards achieving the functionality of task( ).

Note that subTaskA(), subTaskB() and subTaskC() are erroneously illustrated in this diagram since no message numbers are provided for these. **Which of the following statements could be true for a valid collaboration diagram.** Each of the options provided is independent of others, unless stated otherwise.

Choose all the correct options by placing a tick in the box provided against each option in the table provided on next page.

<u>Note : 1 Mark shall be deducted for each incorrect choice.</u>

a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r

(a) For any valid numbers to be given to message subtaskA(), label 3 for subtask3( ) should be changed.

(b) For any valid numbers to be given to message subtaskA(), both label 3 for subtask3( ) and label 4 for subtask4() should be changed.

(c) subtaskA could possibly have a message number 5

(d) subtaskA could possibly have a message number 1.1

(e) subtaskA could possibly have a message number 2.1

(f) subtaskB could possibly have a message number 5

(g) if (d) is true then , subtaskB could possibly have a message number 1.1.1

(h) if (d) is true, then subtaskC could possibly have a message number 1.1.1

(i) if (d) and (g) are true , then subtaskC could possibly have a message number 1.1.2

(j) if (g) is true , then subtaskC could possibly have a message number 2.1.1

(k) subtaskC could possibly have a message number 5

(l) subtaskC could possibly have a message number 6

(m) subtaskA could possibly have a message number 3.1

(n) subtaskB could possibly have a message number 3.1

(o) subtaskC could possibly have a message number 3.1

(p) subtaskA could possibly have a message number 4.1

(q) subtaskB could possibly have a message number 4.1

(r) Assuming all synchronous operations, once all the subtasks are correctly carried out , control shall be with the dObj.

Question 3 **15 marks**

Consider the following (partial) requirements provided by a company for developing a Staff Salary System. Use UML notation to draw an Analysis Class Diagram illustrating classes, attributes, associations and multiplicities of associations. Label the associations appropriately. You may use aggregation, composition , or generalization as appropriate. Write any assumptions you make to support your class diagram. Your class diagram does not need to model beyond the description provided below.

The system records name of the staff, staff employment ID, and the date on which he/ she started work with the company. Company's salary structure is based on distinct grades. Each staff is placed on a grade that determines his / her basic salary. Grade can be changed as a result of performance appraisals. The basic salary for each grade is fixed, usually for a year at a time. It is determined by the grade description recorded by the system. Every year after the final accounts are closed, grade rates are reviewed and are increased roughly in line with the inflation. If the company has performed well, rates are increased by more than the rate of inflation. Information about the rates for all present and past grades and the corresponding dates these rates come into force are recorded by the system.

Question 4 **(13 + 5) marks**

(a) Consider the following class hierarchy: Both ItemStack and ItemVector are subtypes of ItemList . ItemList supports the methods addItem, doesExist, and numItems. In addition ItemStack supports the methods pushItem, and popItem, and ItemVector supports the methods setItem and getItem. Stack is implemented by keeping a private instance of type Vector.

Draw a UML class diagram that describes this hierarchy. You may include attributes, operations, return types of operations, parameters and their respective types for operations, visibility of operations for the classes as appropriate according to the description above.

(b) The implementation of pushItem method of ItemStack gets the number of items from the private instance of ItemVector , then adds the new item to the private ItemVector.

Draw a sequence diagram that illustrates the effect of pushing an item onto ItemStack.

Question 5 **(5 + 5) marks**

(a) Finding software bugs early in the development lowers the cost of development. Explain how waterfall development methodology attempts to find defects early in the development.

(b) After completing a Return Merchandise Management system for Computer Valley, you are hired by them to build a product that helps track their sales across regions. As you discuss the requirements with the Managing Director, you get the feeling that he is not sure of exactly what the software should look like. What software development methodology would you choose for this project ? Give reasons for your choice.

Question 6 **10 marks**

Given the class

```
class Student {
        String name;
        int age;
}
```

Modify the code, if required, to make this class support shallow copy and deep equality.

Question 7 **10 marks**

The following are 2 classes Cab and Driver,

```
public class Driver{
        private Cab theCab;
        public void setCab(Cab c){
                if (c==null) throw NullPointerException;
                c.setDriver(this);
                theCab = c;
        }
}

public class Cab{
        private Driver theDriver;
        public void setDriver(Driver d){
                if (d==null) throw NullPointerException;
                theDriver = d;
        }
}
```

Assuming that all the Cab objects created are stored in cabarray[] and all the Driver objects created are stored in driverarray[]. Write the code to verify that the bidirectional association between these objects is indeed 1-1.

Question 8 **10 marks**

The class CommentWriter has the same API as PrintWriter except that each string *s* to be printed will be printed as a comment:
/*
s
*/
Which design pattern is applicable to the implementation of CommentWriter? Implement this class by assuming that the only method of interest is println(String s).

Question 9 **(6 + 4 marks)**

(a) For **each** of the data declaration statements, indicate whether it is valid or invalid in the blanks provided on the same line. Leaving the field blank will be taken as a wrong answer.

```
class Sub extends Super {
 ...
 public void subToSub (Sub anotherSub) {
  int i = anotherSub.public_Sub_field;                  // [__________]

  int j = anotherSub.protected_Sub_field;               // [__________]

  int k = anotherSub.private_Sub_field;                 // [__________]

  int l = anotherSub.public_Super_field;                // [__________]

  int m = anotherSub. protected _ Super _field;         // [__________]

  int n = anotherSub. private_ Super _field;            // [__________]
  ...
  }
  ...
}
```

(b) What is the following code doing?

```
try {
        int i = 0;
        while(true)
                a[i++].f();
} catch(ArrayIndexOutOfBoundsException e) {}
```

Rewrite it to remove the use of exception.

____END OF PAPER____