Please fill in your Student Number and Name.

Student Number : _____

Name:

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Student Number:

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University of Cape Town ~ Department of Computer Science

Computer Science 1016S ~ 2008

Supplementary Test 2

Question	Max	Mark	Internal	External
1	8			
2	14			
3	8			
TOTAL	**30**			

Marks : 30

Time : 40 minutes

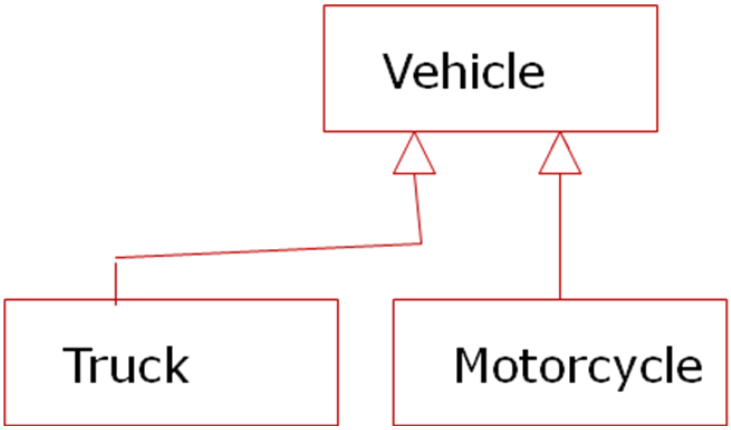
Instructions:

a) Answer all questions.

b) Write your answers in the space provided.

c) Show all calculations where applicable.

Question 1: UML, Inheritance, and Polymorphism [8]



Use the above UML diagram to answer the following questions

a) How are the classes related? [2]

b) Which statements below are valid? [2]

i) Truck t = new Vehicle();

ii) Vehicle v = new Truck();

iii) Motorcycle m1 = new Vehicle();

iv) Motorcycle m2 = new Truck();

c) What is Polymorphism and why do we need it? [2]

d) Using Polymorphism, define a method, called ride() with an array argument that can accept both Truck and Motorcycle. [2]

Question 2: Sort and Interface [14 marks]

Use the following code snippet to answer question 2

```
1.public class SelectionSort2
2.{
3.    public static void sort(double[] a, int numberUsed)
4.     {
5.        int index, indexOfNextLargest;
6.        index=numberUsed-1;
7.        while (index > 0)
8.        {   indexOfNextLargest = indexOfLargest(index, a, numberUsed);
9.            interchange(index,indexOfNextLargest, a);
10.                    index = index -1;
11.       }
12.    }
13.    private static int indexOfLargest(int startIndex,
14.                                      double[] a, int numberUsed)
15.    {     double max = a[startIndex];
16.          int indexOfMax = startIndex;
17.           int index = startIndex - 1;
18.          while (index > -1) {
19.          if (a[index] > max)
20.             {
21.                 max = a[index];
22.                 indexOfMax = index;
23.             }
24.             index = index -1;
25.          }
26.          return indexOfMax;
27. }
28. private static void interchange(int i, int j, double[] a)
29. {     double temp;
30.       temp = a[i];
31.       a[i] = a[j];
32.       a[j] = temp; //original value of a[i]
33.}
34.       public static void main(String[] args)
35.{      double[] b = {4, 17, 5.4, 21, 15, 14, 43};
36.       System.out.println("Array content before sorting:");
37.       int i;
38.       for (i = 0; i < b.length; i++)
```

```
39.             System.out.print(b[i] + " ");
40.         System.out.println("");
41.         sort(b, b.length);
42.         System.out.println("Array content after sorting:");
43.         for (i = 0; i < b.length; i++)
44.             System.out.print(b[i] + " ");
45.}

46.}
```

a) What output is generated by running this class? [4]

b) What is the complexity of the sort (i.e. on average, how many comparisons does the sort need to arrange an array of N elements?) [2]

c) How would you change the program so that it can sort an array of objects of a class that implements the Comparable interface? (i.e. State the steps then name the lines of code that need to be changed?) [4]

d) Give a code example of how to define a class that implements the Comparable interface [4]

Question 3: Data Structures [8]

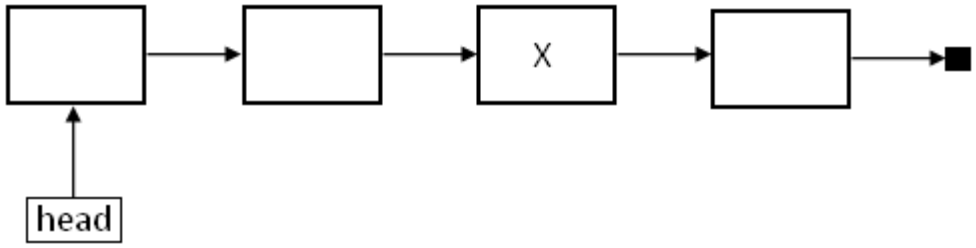
Consider the following partial definition of a linked list.

```
public class LinkedList
{
    private class Node
    {
        private String item;
        private Node link;

        public Node(String newItem, Node linkValue)
        {
            item = newItem;
            link = linkValue;
        }
     }//End of Node inner class

    private Node head;
...

}
```



a) Using code snippets and diagrams show the following.

i) how to add the data "apples" to the head of the list [2]

ii) how to remove the head node from the list [2]

iii) how to remove the third element of a list (X in the diagram) [2]

b) State what changes need to be made to convert such a linked list into a queue. [2]