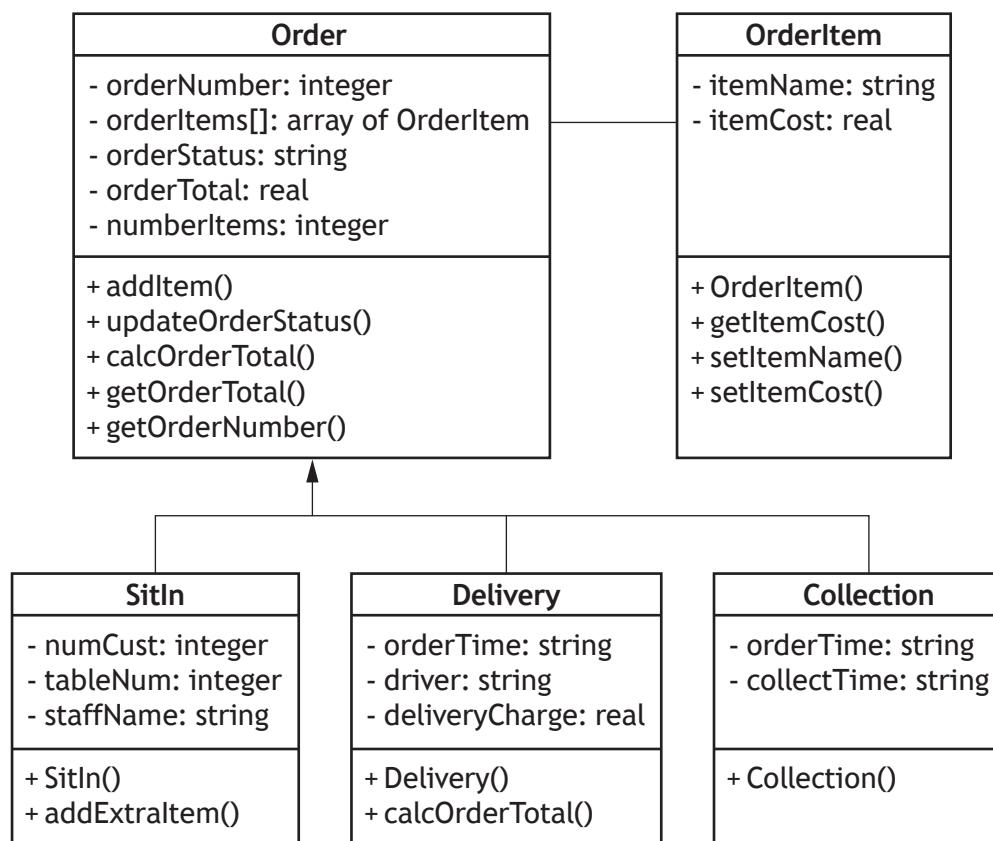


3. FlavourFusion Cafe is creating an ordering system. Customers can make sit-in, delivery and collection orders.

The ordering system will be implemented using an object-oriented programming language. The following constraints will apply to the system:

- An order can contain a maximum of 50 items from the cafe menu.
- All items for delivery and collection orders must be added at the time an order is made.
- Extra items can be added to sit-in orders during the meal — for example, adding a dessert or a drink.
- All orders for delivery will have a delivery charge.

A simplified UML Class diagram of the system is shown below.



Some of the code used to implement the ordering system is shown on the page opposite.

3. (continued)

```
CLASS Order { INTEGER orderNumber, ARRAY OF OrderItem
orderItems[], STRING orderStatus, REAL orderTotal, INTEGER
numberItems }
```

METHODS

```
...
PROCEDURE calcOrderTotal()
    SET THIS.orderTotal TO 0
    FOR i FROM 0 TO THIS.numberItems -1 DO
        SET THIS.orderTotal TO THIS.orderTotal +
            THIS.orderItems[i].getItemCost()
    END FOR
END PROCEDURE
...
END CLASS
```

```
CLASS SitIn INHERITS Order WITH { INTEGER numCust, INTEGER
tableNum, STRING staffName }
```

METHODS

```
CONSTRUCTOR (INTEGER howMany, INTEGER table, STRING staff )
    SET THIS.orderNumber TO <next order number>
    SET THIS.orderItems[0] TO <empty object of type OrderItem>
    SET THIS.orderStatus TO "In Progress"
    SET THIS.orderTotal TO 0.00
    SET THIS.numberItems TO 0
    SET THIS.numCust TO howMany
    SET THIS.tableNum TO table
    SET THIS.staffName TO staff
END CONSTRUCTOR

PROCEDURE addExtraItem(extraName, extraCost)
    SET THIS.numberItems TO THIS.numberItems + 1
    THIS.orderItems[THIS.numberItems].setItemName(extraName)
    THIS.orderItems[THIS.numberItems].setItemCost(extraCost)
END PROCEDURE
```

END CLASS

(a) Explain why the Order class does not need a constructor method.

1

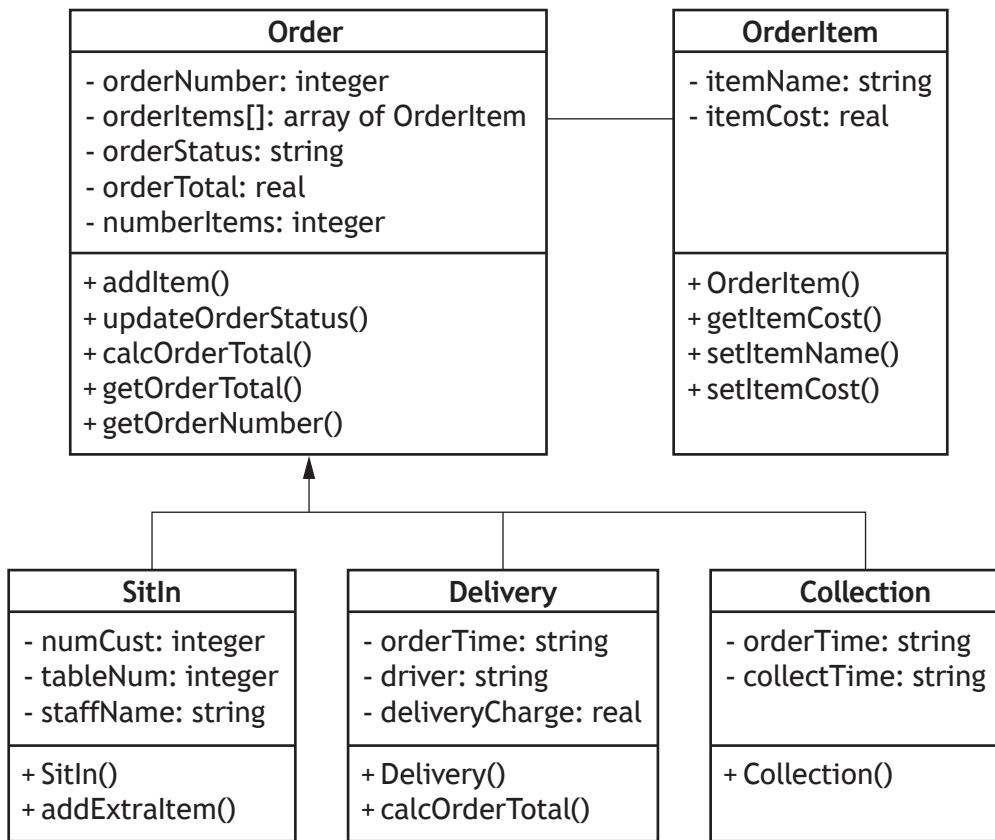
(b) Using appropriate object-oriented terminology, explain why the calcOrderTotal() method appears in both the Order and Delivery classes.

2

[Turn over

3. (continued)

The UML class diagram for the ordering system is repeated below.



The following code is used during ongoing testing to check whether the system is working correctly.

```

Line 1  DECLARE order1 INITIALLY Delivery (1, [<array of
          OrderItem>], "In Progress", 0.0, 4, "18:07",
          "Jemma", 3.50)

Line 2  DECLARE order2 INITIALLY SitIn (2, [<array of
          OrderItem>], "In Progress", 0.0, 5, 2, 7, "Max")

Line 3  DECLARE order3 INITIALLY Collection (3, [<array of
          OrderItem>], "In Progress", 0.0, 7, "18:11",
          "18:31")

Line 4  DECLARE orderList AS ARRAY OF Order INITIALLY
          [order1, order2, order3]

Line 5  SEND order2.orderStatus TO display

Line 6  orderList[1].addExtraItem("Ice cream", 4.99)
  
```

3. (continued)

- (c) At line 4, an array of `Order` objects is created.

Explain how it is possible for this array to store several different types of objects.

2

- (d) Explain why line 5 cannot be executed.

1

- (e) Line 6 has been written to add an extra item to an existing order.

- (i) Explain why line 6 cannot be executed.

2

- (ii) Describe one way that an additional item could be successfully added to `orderList[1]`. Your answer should refer to the variable declarations used during ongoing testing.

1

- (f) At the end of each day, the owners want to view details of the three most expensive orders for that day.

Sample data in the `orderList` array that is processed at the end of a day is shown below.

orderNumber	orderItems	orderStatus	orderTotal	numberItems
...
34	< array of OrderItem >	Complete	45.97	6
35	< array of OrderItem >	Complete	56.87	8
36	< array of OrderItem >	Complete	23.34	3
37	< array of OrderItem >	Complete	73.29	9
...

Using pseudocode, design the procedure `bubbleSort(orderList)`.

This procedure will be used to sort the `orderList` array and display the `orderNumber` and `orderTotal` of the three most expensive orders in the sorted array.

Your procedure should make use of the bubble sort algorithm.

4