

**Computer science
Year 12 Mock Exam
Paper 2**

Higher Level

1 hour 20 minutes

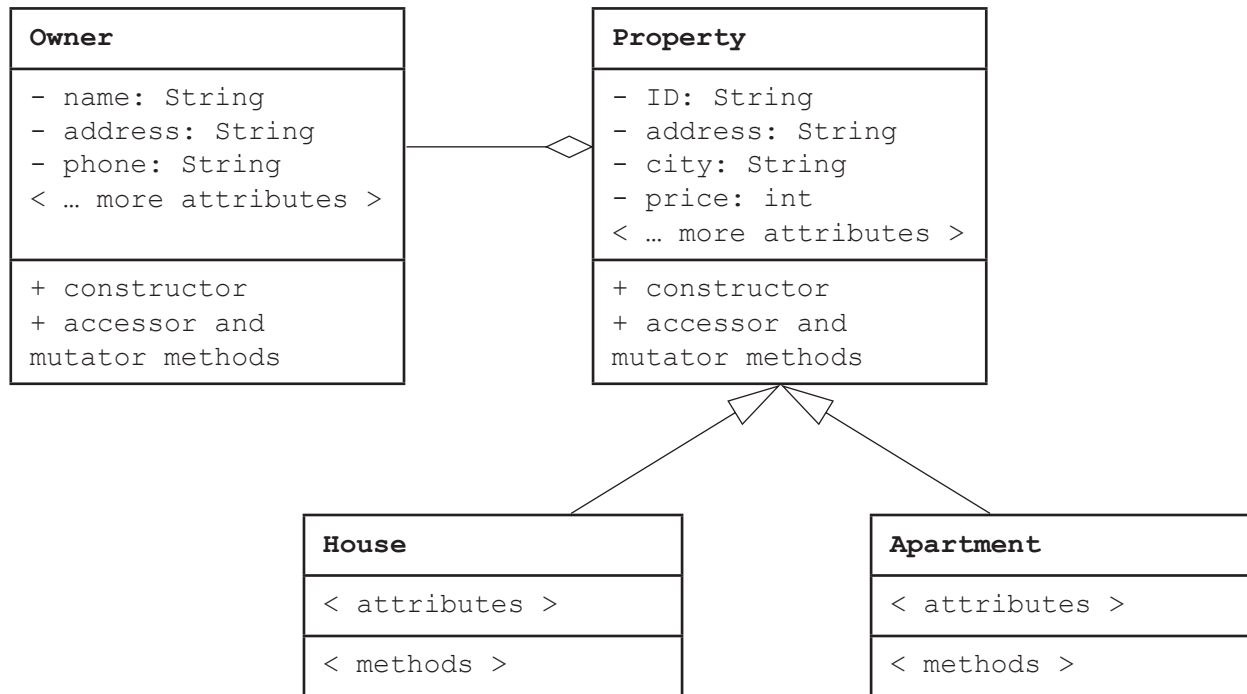
Instructions to candidates

- Do not open this examination paper until instructed to do so.
- Section A: answer all questions.
- Section B: answer all questions.
- The maximum mark for this examination paper is **[65 marks]**.

Option D — Object-oriented programming

1. A real estate business maintains an unsorted database of houses and apartments that it tries to sell for the property owners.

The following UML diagram describes the objects in the current system.



- (a) A *primitive data type* is always assigned a value in memory, unlike a reference type. [1]
State an example of a *primitive data type*.
- (b) State an additional attribute in the class `Property` that would have data type [1]
(i) `Boolean` [1]
(ii) `integer`. [1]
- (c) State the relationship between [1]
(i) `Owner` and `Property` [1]
(ii) `House` and `Property`. [1]
- (d) Distinguish between a class and an instantiation in this scenario. [2]
- (e) Outline one advantage of making all instance variables in the `Owner` class `private`. [2]
- (f) State two types of method that will allow `private` instance variables to be retrieved and modified outside the class. [2]

The finished program may include some open source software.

- (g) Identify one aim of the open source movement. [1]

The object-oriented software solution that implements this system for the real estate business allows a customer to select a maximum of 10 houses that he or she is interested in. These houses are stored in an array `wishList` of type `House`.

- (h) Construct the code needed to instantiate an array `wishList` that can store a maximum of 10 `House` objects. [3]

2. (a) Define the term *polymorphism*. [2]

- (b) Define the term *inheritance*. [2]

The real estate business is planning to expand its database to include student housing. These “houses” are usually single rooms in a privately owned house.

- (c) Explain **one** benefit of using inheritance to create a new class `Room`. [3]

Many of the prospective students have an international background.

- (d) A programmer is considering the way to process object references to the houses and decides to use a library collection.

Identify two advantages of using an existing library collection rather than creating one. [2]

3. All the unsorted `House` objects in the database have been copied to a sufficiently large array `allHouses`. This array is not completely filled with `House` objects.

The array `allHouses` and all methods in this question are declared in the main program class. All methods can access the array `allHouses` directly.

Consider the following method.

```
public void unknown(String x)
{
    for (int i=0; i<allHouses.length; i++)
    {
        if (allHouses[i].getCity().equals(x))
        {
            System.out.println (allHouses[i].getAddress());
        }
    }
}
```

- (a) Define the term *method signature*. [2]
- (b) Describe how the original `String` variable, passed to a method as a parameter, can be assigned a new value by that method. [2]
- (c) State the intended purpose of the method `unknown`. [1]
- (d) (i) Outline the runtime error that is likely to occur if this method is called. [2]
(ii) Outline how this error can be corrected. [2]
- (e) Construct the code for the method `houseSort` that will sort the array `allHouses` in ascending order of `price`. [5]

A method is needed to select from the original unsorted array `allHouses` the three most expensive houses below or equal to a given price.

- (f) Construct the code for the method `selectThree` that will take an integer parameter `budget`. It must return a sorted array of size 3 that contains the three most expensive `House` objects (in ascending order of price) with a price that is less than or equal to `budget`.

You may assume that the array `allHouses` contains at least three `House` objects with a price less than or equal to `budget`. As part of your answer you should use the method `houseSort()` as developed in part (e).

[7]

4. Once a month the real estate business organizes an open day for a particular house.

Interested clients can sign up by giving their name and phone number to the real estate business.

This information is stored in a list node `ClientNode` as follows.

```
public class ClientNode
{
    private String name;
    private String phone;
    private boolean attended;
    private ClientNode next;

    public ClientNode (String aName, String aPhone)
    {
        this.name = aName;
        this.phone = aPhone;
        this.attended = false;
        this.next = null;
    }
    public String getName()
    {
        return this.name;
    }
    public String getClient()
    {
        return this.name+" "+this.phone;
    }
    public void setAttended()
    {
        attended = true;
    }
    public ClientNode getNext()
    {
        return this.next;
    }
    public void setNext(ClientNode nextNode)
    {
        this.next = nextNode;
    }
}
```

- (a) Identify **two** features of an abstract data type (ADT).

[2]

A new class `ClientList` is implemented as outlined below.

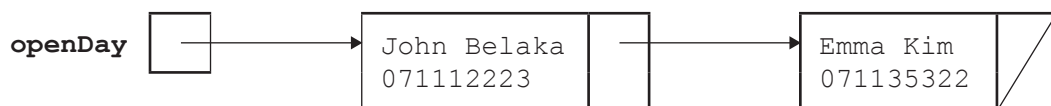
```
public class ClientList
{
    ClientNode root;

    // default constructor

    void enList(ClientNode visitor)
    {
        ... adds visitor to the end of the list - missing code ...
    }

    boolean isEmpty()
    {
        return (root==null);
    }
    ... more methods ...
}
```

A list `openDay` has been instantiated of the type `ClientList`.



- (b) Describe the meaning of the following statement. [3]

```
openDay.enList(new ClientNode("Sophie Bella", "072456721"));
```

- (c) By using object references, construct the method `enList` that allows a client to be added to the end of the list `openDay`. [5]

The attendance of potential buyers is tracked during the open day by changing the `attended` variable to `true` when a potential buyer arrives.

At the end of the day, the list `openDay` is processed so that every potential buyer that attended is added to new list `hasAttended` and every potential buyer that did not attend is added to a new list `notAttended`.

- (d) Without writing code, outline the steps involved in splitting the list `openDay` into a list `hasAttended` and a list `notAttended`. [4]

The real estate business keeps the data of all past owners in a file for future reference. This file is sorted by owner name. When needed, this file is read into a `LinkedList` called `contacts`, which has been instantiated as follows.

```
private LinkedList<Owner> contacts = new LinkedList<Owner>();
```

(e) Construct a recursive binary search method given as

```
public Owner binSearch(String name, int low, int high)
```

where `name` is the search term.

You may assume that `contacts` is accessible to `binSearch` and that it has been filled with many objects.

You may use the following standard `LinkedList` method.

```
.get(int index)
```

This returns the object located in the `LinkedList` at `index`.

[6]

End of Option D
