FOR OFFICE USE

National Qualifications 2023

Mark

CS(H)23A

Computing Science

Duration — 2 Hours

Fill in these boxes and read what is printed below.

Full name of centre

Town

Forenames(s)

Surname

Number of seat

Date of birth

Day Month Year

Scottish candidate number

Total marks - 80

SECTION 1 - Software design and development, and Computing systems - 55 marks
Attempt ALL questions.

Attempt EITHER Section 2 OR Section 3
Section 2 - Database Design and Development - 25 marks
Section 3 - Web Design and Development - 25 marks

You may use a calculator

Write your answers clearly in the spaces provided in this booklet. Additional space for answers is provided at the end of this booklet. If you use this space, you must clearly identify the question number you are attempting.

Use **blue** or **black** ink.

Before leaving the examination room you must give this booklet to the invigilator. If you do not, you may lose all marks for this paper.

MARKS | DO NOT WRITE IN THIS MARGIN

SECTION 1 – SOFTWARE DESIGN AND DEVELOPMENT, AND COMPUTER SYSTEMS - 55 Marks

Attempt ALL questions

1. Convert the number -121 into 8 bit two's complement. **1**

2. Write the following binary number using floating point representation.

–10 1110 1101.0111

There are 16 bits for the mantissa (including the sign bit) and 8 bits for the exponent. **3**

Space for working

sign	mantissa	exponent

3. Explain why a processor with a wider data bus would outperform an identical processor with a narrower data bus. **2**

4. MyMovies is an online service where customers pay a fee to watch movies. The service recently suffered a denial of service (DOS) attack.

(a) Security experts investigating the attack believe it was either a result of bandwidth consumption or resource starvation.

(i) Describe how bandwidth consumption would affect the targeted computer system. **1**

(ii) Describe how resource starvation would affect the targeted computer system. **1**

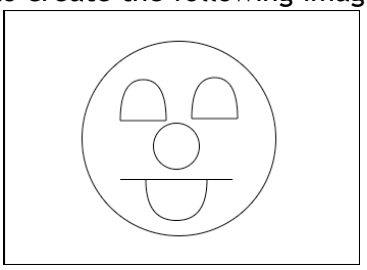
[Turn over

4. (continued)

(b) The security experts investigating and preventing future attacks is one cost associated with the attack.

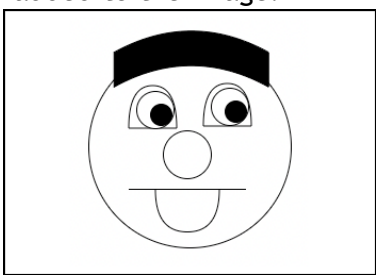
State another cost of the denial of service attack. **1**

5. A designer is using software to create the following image.



(a) Explain why it may be easier to create this image as a vector graphic rather than a bit-mapped graphic. **2**

(b) Some further edits are added to the image.



Describe the effect on the file size of editing the image in (a) to be the image above. Describe this for both a vector graphic and a bit-mapped graphic. **2**

Vector

Bit-mapped

[BLANK PAGE]

[Turn over for Question 6

6. An online store carries out a search and saves the results to a text file. The text file contains the following data.

- Product name
- Star rating
- Price
- InStock

A sample of the data in the text file is shown below.

GameSir X3, 4.5, 79.99, true
StreamDeck, 5.0, 116.95, false
Magic Trackpad, 3.5, 118.95, true
…

A program is required to find the cheapest, five star product which is in stock. A top-level algorithm for this is shown below:

1. Import product data for products in stock
2. Find the position of the cheapest five star product
3. Display the found product

(a) The table below has the data flow completed for steps 1 and 3 of the algorithm.

Complete the missing data flow for step 2. **2**

Step	In/Out	Data flow
1	In	
	Out	productName[], starRating[], price[]
2	In	
	Out	
3	In	position, productName[], starRating[], price[]
	Out	

6. (continued)

(b) The file to be imported is called "products.txt". Code to import the file data is shown below.

```
Line 01 DECLARE products INITIALLY "products.txt"
Line 02 OPEN products
Line 03 SET maxProducts TO length(products)
Line 04 DECLARE productName AS ARRAY OF STRING INITIALLY []
Line 05 DECLARE starRating AS ARRAY OF REAL INITIALLY []
Line 06 DECLARE price AS ARRAY OF REAL INITIALLY []
Line 07 DECLARE productIndex AS INTEGER INITIALLY 0
Line 08 FOR row FROM 0 TO maxProducts - 1 DO
Line 09   RECEIVE product FROM products
Line 10   SET tempName TO <first field in product>
Line 11   SET tempRating TO <second field in product>
Line 12   SET tempPrice TO <third field in product>
Line 13   SET inStock TO <fourth field in product>
Line 14   IF inStock = true THEN
Line 15       SET productName[productIndex] TO tempName
Line 16       SET starRating[productIndex] TO tempRating
Line 17       SET price[productIndex] TO tempPrice
Line 18       SET productIndex TO productIndex + 1
Line 19   END IF
Line 20 END FOR
```

(i) Explain the purpose of variable `maxProducts` assigned in line 03. **2**

(ii) Explain why the variable `inStock` is not written to an array. **1**

[Turn over

6. (continued)

(c) Part of the design for Step 2, Find the position of the cheapest five star product, is shown below.

2. Find the position of the cheapest five star product
```
2.1 SET position = -1
2.2 SET minPrice = 99999
2.3 FIXED LOOP - index from 0 TO length(starRating[])-1 DO


    END FOR
```

Complete the design using a recognised design technique. **4**

MARKS | DO NOT WRITE IN THIS MARGIN

6. (continued)

(d) The incomplete design in (c) includes the line

```
position = -1
```

Explain why this value has been used as the initial value for position. **2**

[Turn over

7. An airline stores the details of customers and operates a reward scheme where customers have their status upgraded, depending on rules set out by the company.

The company have three levels of status: Blue, Silver and Gold

The airline stores the following information for each customer.

Data Stored	**Example**
customerNumber	10299283
customerEmail	david.wood@mymail.me
totalMiles	3750
totalFlights	12
status	Blue

(a) (i) Using a programming language of your choice, define a suitable record data structure to store the data. **2**

(ii) There are currently 35 000 registered customers for the airline.

Using a programming language of your choice, declare a variable that can store the data for the 35 000 customers. Your answer should include the record data structure defined in part (i). **2**

7. (a) (continued)

(iii) The program could have also used parallel 1D arrays to store the data.

Explain why using an array of records is a better solution that parallel 1D arrays for this purpose. **2**

(b) The airline runs a promotion where everyone with Blue status will have their miles doubled.

Using a programming language of your choice, write code to implement this. Your answer should use the record data structure from part(b)(i). **4**

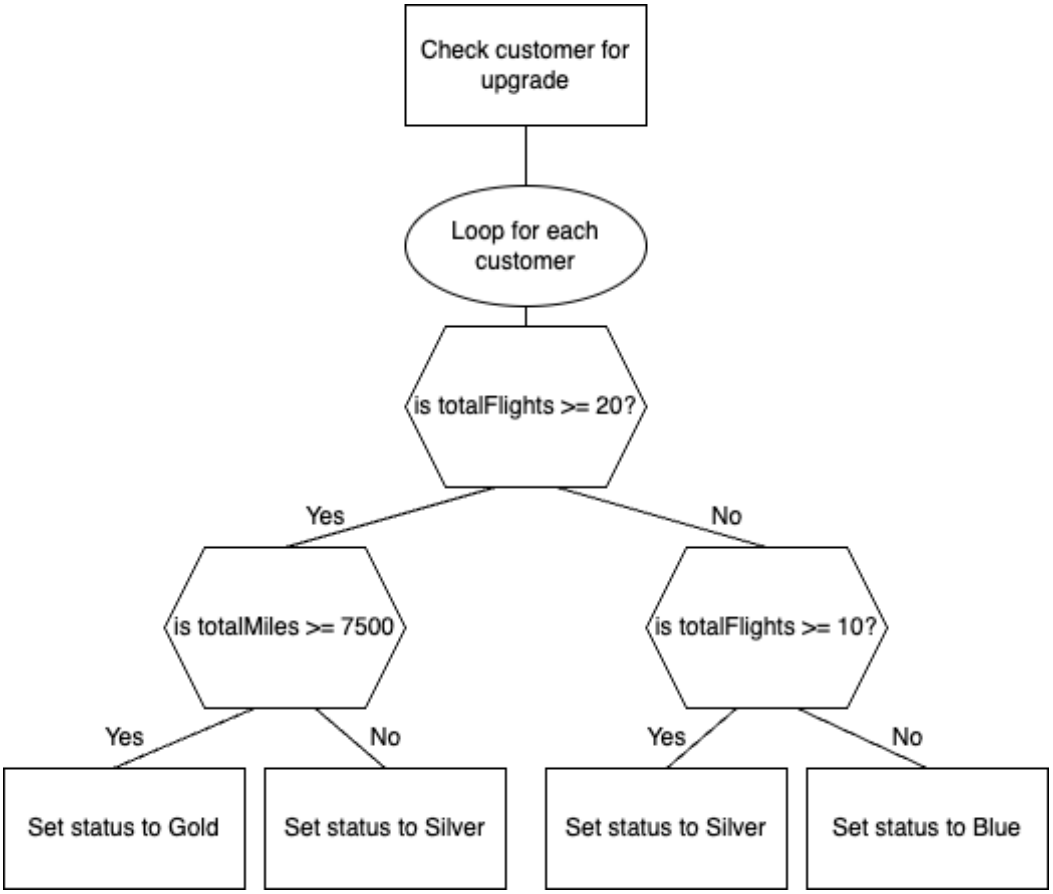
[Turn over

7. (continued)

(c) At the end of each month, the statuses for customers are updated.

- All customers start with Blue as their status.
- To gain Silver, a customer must have flown at least 10 flights and more than 5000 miles.
- To gain Gold, a customer must have flown at least 20 flights and more than 7500 miles.

The design for part of the program is shown below.



Explain why a program produced from this design would not be fit for purpose. **2**

MARGIN

7. (continued)

(d) The program is implemented using modular code which allows the sub-programs which are written to be reused in other programs.

Describe two other benefits of creating modular code. **2**

(e) A comprehensive test plan is used. Explain, with reference to the initial analysis of a problem, what the comprehensive test plan must do. **1**

[Turn over

8 Machine code instructions are fetched from memory and executed by the processor. **MARKS** DO NOT WRITE IN THIS MARGIN

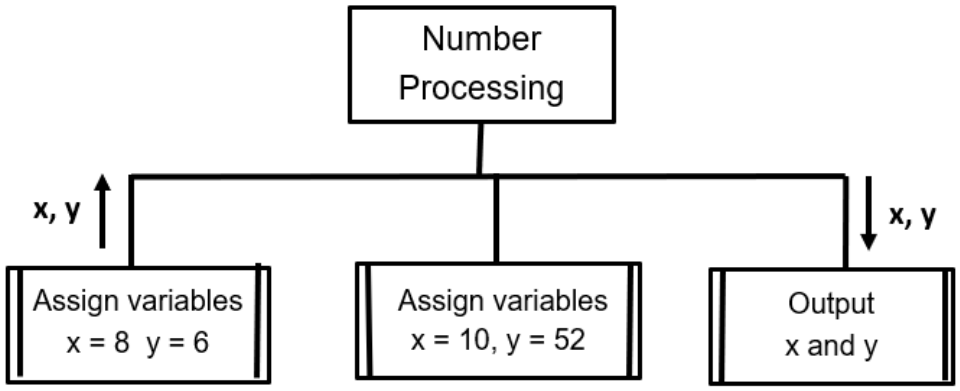
a) Complete the missing steps of the fetch-execute cycle in the table below stating the computer bus used at each stage. **3**

Step 1	
Step 2	
Step 3	
Step 4	Instruction is decoded and executed.

3

b) State the name of the software development methodology that follows a strict plan, with progress measured against timescale set at the beginning of the project. **1**

c) A program design is drawn that consists of three steps as shown below.



State the expected output

	x	y
Output		

2

d) Describe what the modulus predefined function does. **1**

9. An app is being designed to calculate the positions of three teams in an esports competition. The three teams play against each other and the scores for each game played are recorded. The team with the highest score is first, the next highest is second and the lowest is third.

Once three games have been played, the average of the team positions in each game is calculated. The winner has the lowest average. Total points and the final positions are displayed at the end of the competition for each team. Some example data is shown below. Teams will never have identical scores in the same game.

	Game 1		Game 2		Game 3				
Team	Score	Position	Score	Position	Score	Position	Avg Position	Total	Final Position
KT Rollers	11829	2	15029	1	2111	3	2.00	28969	2
Fusion	12028	1	4902	3	17182	1	1.67	34112	1
Vitality	9112	3	8199	2	10554	2	2.33	27865	3

(a) One boundary for this app is that the app is for three games.

State two other boundaries for this app. **2**

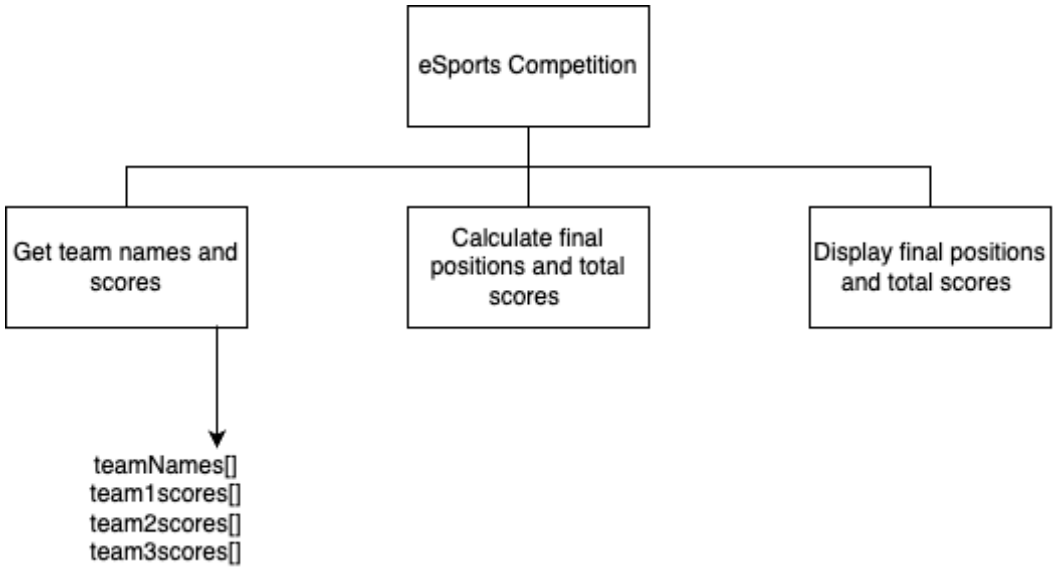
(b) A suitable user interface to capture the scores for each game is required.

Use a wireframe to design a suitable interface for this part of the app. **2**

9. (continued)

(c) The top-level design of the main steps of the program is shown below.

Complete the diagram to show the data flow for the program. **2**



[Turn over

9. (continued)

(d) A function is written to calculate and return the position for each team. The function receives an array of scores and returns an array of positions e.g.

Input: `scores [11829, 12028, 9112]`
Output: `position [2, 1, 3]`

Line The code for the function is:

```
01    FUNCTION positions(ARRAY OF INTEGER scores) RETURNS ARRAY OF INTEGER
02        SET maxval TO scores[0]
03        SET minval TO scores[0]
04        SET maxpos TO 0
05        SET minpos TO 0
06        SET midpos TO 0
07        FOR game FROM 1 TO 2 DO
08           IF scores[game] > maxval THEN
09              temp = maxpos
10              maxpos = game
11              maxval = scores[game]
12              midpos = temp
13           ELSE
14              IF scores[game] < minval THEN
15                  temp = minpos
16                  minpos = game
17                  minval = scores[game]
18                  midpos = temp
19              ELSE
20                  midpos = game
21              END IF
22           END IF
23        END FOR
24        position[maxpos] = 1
25        position[minpos] = 3
26        position[midpos] = 2
27        RETURN position
28    END FUNCTION
```

Complete the following trace table. Enter what the values would be for each row when the indicated line of code (and any preceding) have been executed. **3**

Line	scores [game]	maxval	minval	maxpos	minpos	midpos	game	temp
07		11829	11829	0	0	0	1	
08	12028	11829	11829	0	0	0	1	
12								
08								
18								

[END OF SECTION ONE]

MARKS | DO NOT WRITE IN THIS MARGIN

SECTION 2 — WEB DESIGN AND DEVELOPMENT — 25 marks

Attempt ALL questions

10. The following HTML displays information in a web page.

```
<main>
   My score is
   <section id="myscore">
      110,000.
   </section>
   which is good!
</main>
```

Two styles, shown as option A and option B below, could be used with the web page.

Option A is:
```
#myscore {
  display: inline;
}
```

Option B is:
```
#myscore {
  display: block;
}
```

Show how the HTML would be rendered using each style option. **2**

Option A

Option B

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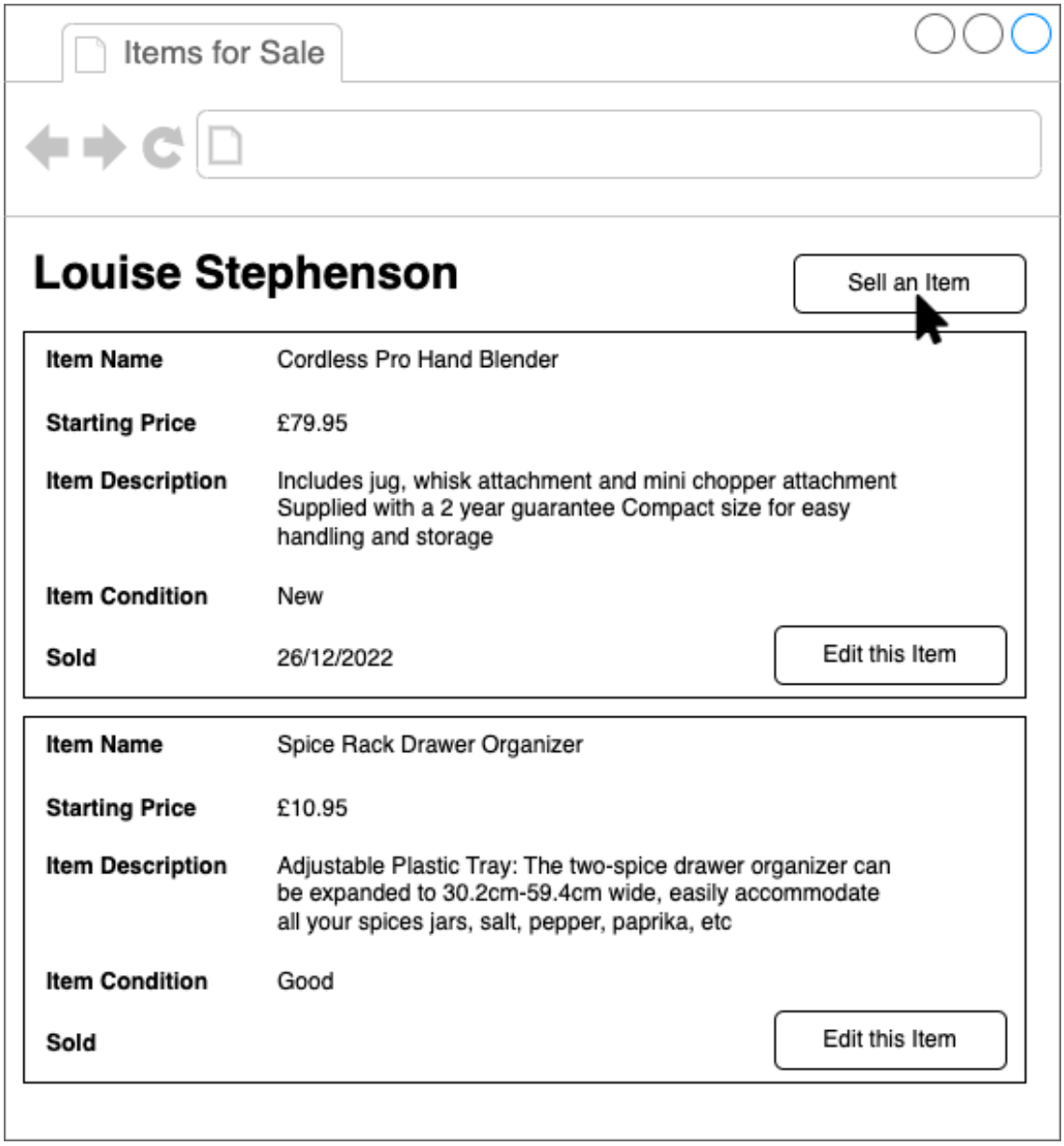
[Turn over for Question 11

11. An online auction site allows users to provide information about the items they wish to sell.

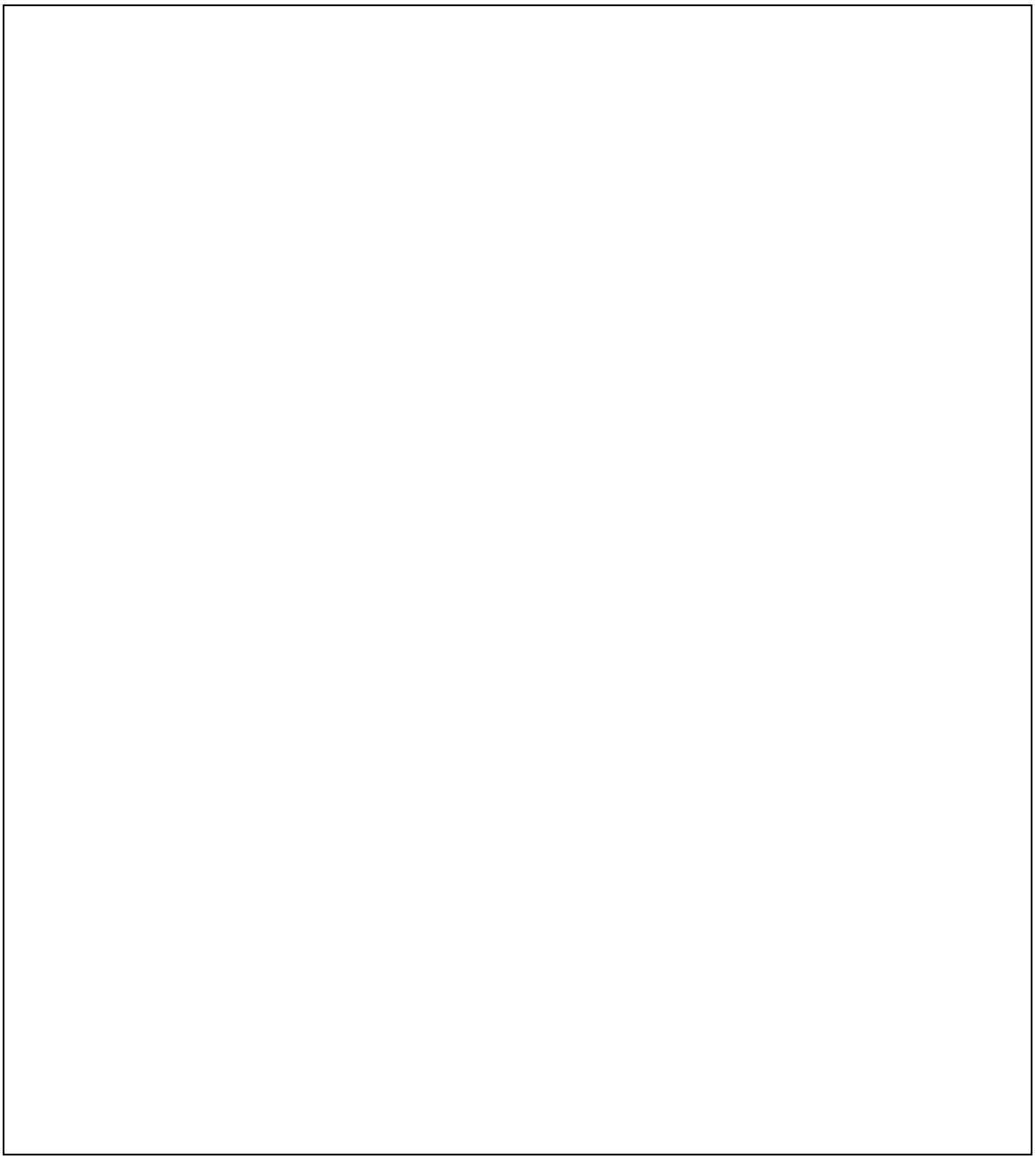
Once a user is logged in, they can update the items they have for sale or add new ones. The fields item are name, starting price, item description, item condition (new, good, fair) and Sold, which is only set when the item has sold online.

An example, editing items for sale page, is shown below.



11. (continued)

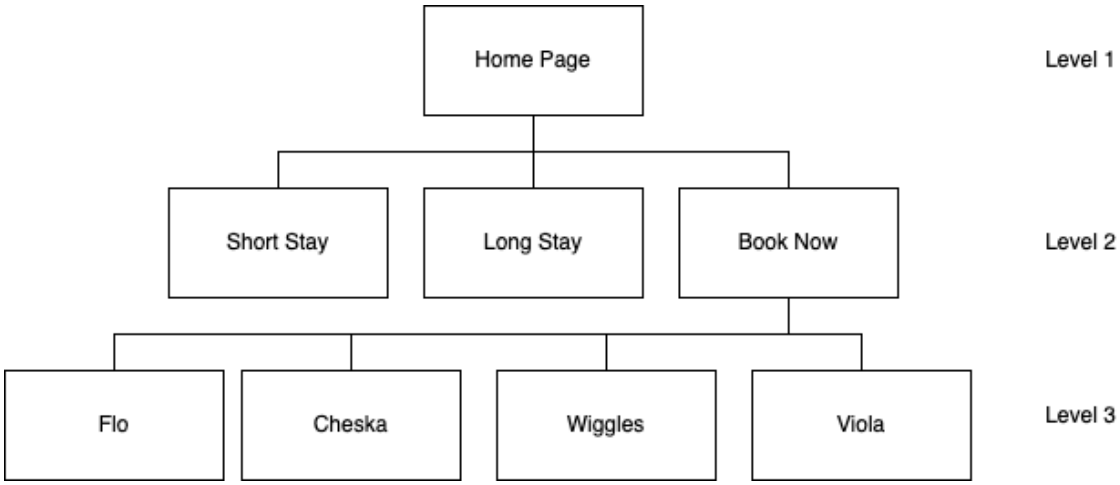
Draw a wireframe for a form that would allow users to edit an existing item or add a new item. **4**



[Turn over

12. Vanessa has a luxury cat care business where she has holiday rooms for cats to stay in while their owners are on holiday. She wants a website where she can show details the types of stays: short stays and long stays and, from the appropriate page, the short-stay rooms (called Wiggles and Viola) and the long-stay rooms (called Cheska and Flo). The website should also include a "book now" page and a contact us page.

The multi-level structure below was proposed.



(a) Explain why this structure did not meet the requirements. **2**

12. (continued)

(b) A menu for the site is in development.

This menu makes use of the following CSS.

```
#menu ul {
  list-style-type: none;
  margin: 0;
  padding: 0;
  background-color: #ccc;
  font-family: Arial;
}

#menu ul li {
  float: left;
}

#menu ul li a {
  display: block;
  color: black;
  text-align: center;
  background-color: #ccc;
  padding: 14px 16px;
  text-decoration: none;
}

#menu ul li a:hover {
  background-color: #aaa;
}
```

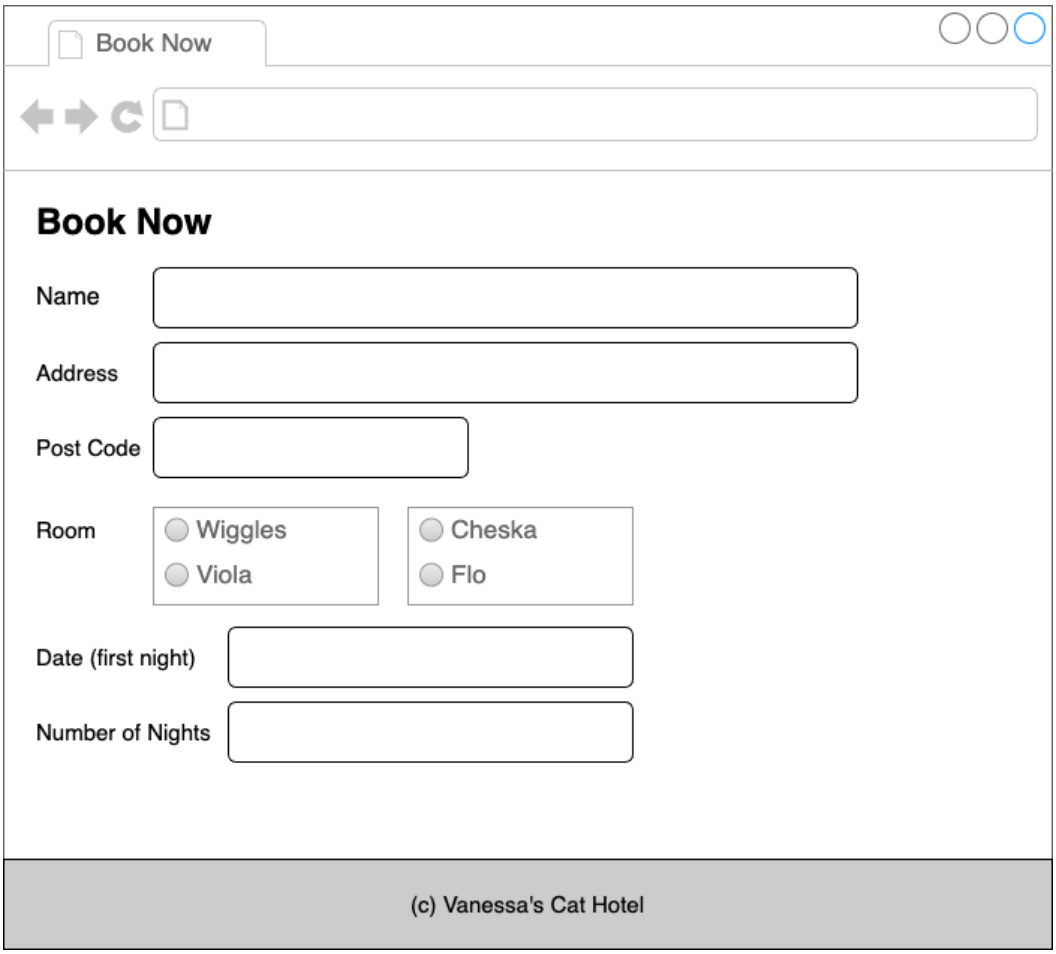
(i) Describe the role of descendant selectors in the CSS code above. **2**

(ii) Add a CSS rule, #active, that can be applied to a menu item to show it with white text and a black background. **1**

[Turn over

12. (continued)

(c) An initial design for the Booking page is shown below.



A low fidelity prototype was created from the wireframe above.

State two issues that should be identified from usability testing. **2**

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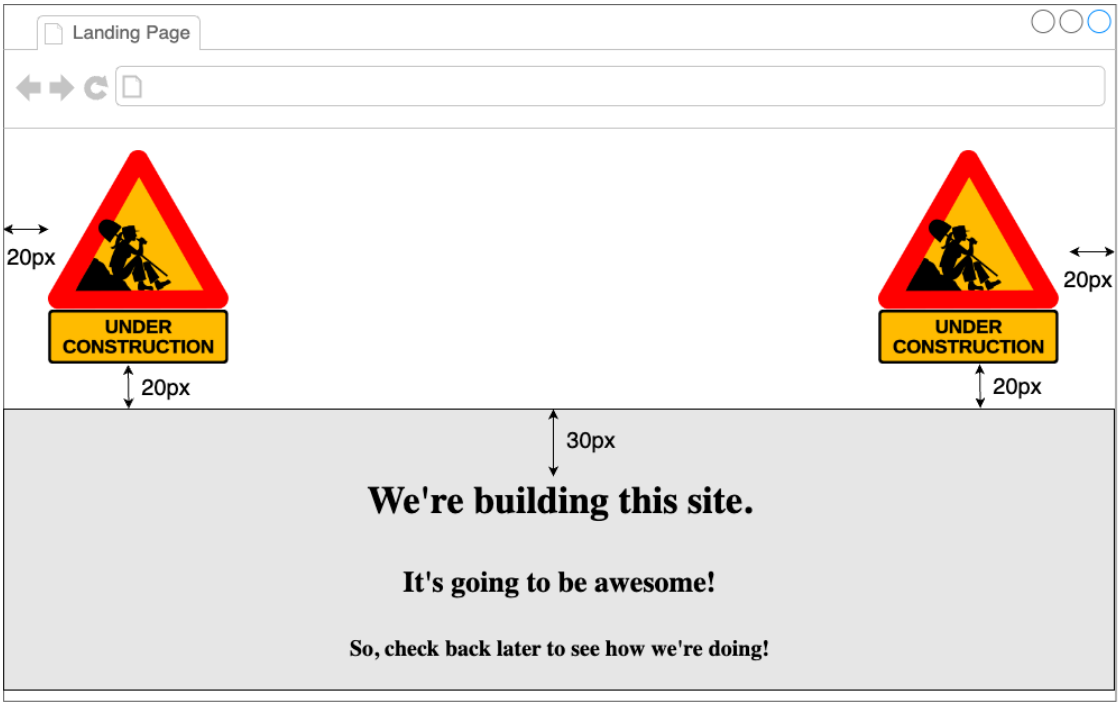
[Turn over for Question 13

13. A web designer is working from the wireframe design shown below.



(a) The page makes use of the following HTML

```
<main>
  <div>
    <img id="image1" src="construction.png" />
    <img id="image2" src="construction.png" />
  </div>
  <div id="construction">
    <h1>We're building this site.</h1>
    <h2>It's going to be awesome!</h2>
    <h3>So, check back later to see how we're doing!</h3>
  </div>
</main>
```

13. (a) (continued)

(i) Complete the CSS below to create the expected layout for the two images in the first . **3**

```
#image1 {
                    _____________________________________
                    _____________________________________
}

#image2 {
                    _____________________________________
                    _____________________________________
}
```

(ii) The CSS rule for the second is shown below.

```
#construction {
  text-align: center;
  background-color:lightgray;
  padding: 30px;
}
```

When implemented, the page does not appear as expected.

Rewrite this rule so that the page displays correctly. **2**

[Turn over

13. (continued)

(b) A button is added to the site.

```
<script>

function buttonText() {
  document.getElementById("button").style.fontSize = "26px";
  document.getElementById("button").innerHTML = "Whoa! We're not
finished yet";
}

</script>


<div style="text-align: center; margin:30px;">
  <button id="button" style="margin: auto">
    Check Back Later
  </button>
</div>
```

Rewrite the line of code which will use a JavaScript event to call the function `buttonText` when the button is clicked. **2**

(c) The developers want to add a form to the site to collect the email addresses of users so they can message them when the site goes live. The code for the form is shown below:

```
<form>
<label>Email Address</label>
<input type="email" name="email" />
<input type="submit" />
</form>
```

Re-write the line of HTML code to ensure that an email address cannot be blank when the form is submitted. **1**

13. (continued)

(d) Once the developers have completed their new web site, they carry out compatibility testing.

(i) Explain why the developers should test their site using different web browsers. **2**

(ii) Describe another type of compatibility testing that the developers should carry out and why this is necessary. **2**

[END OF SECTION TWO]

[END OF QUESTION PAPER]

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