FOR OFFICE USE

National Qualifications 2024

Mark

CS(H)24A

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.

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MARKS | DO NOT WRITE IN THIS MARGIN

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

Attempt ALL questions

1. Convert the 8-bit two's complement number 1101 1101 into denary. **1**

2. A string variable called `warehouse` has been assigned the value 'Dalkeith' and another string variable called `postcode` has been assigned the value 'EH23 8TQ' as shown below.

```
Line 1 DECLARE warehouse INITIALLY "Dalkeith"
Line 2 DECLARE postcode INITIALLY "EH23 8TQ"
Line 3
```

The variable `warehouseCode` is to be assigned the value 'Dal8TQ' using substring operations.

Using a programming language of your choice write line 3. **2**

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

[Turn over

4. (a) Convert the binary number below into floating point representation.

−0.0001 0111 0010 1100

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

Space for working

sign	mantissa	exponent

5. (a) Complete the missing steps of the fetch-execute cycle. **2**

1.	
2.	
3.	The instruction is transferred via the data bus from memory/to processor
4.	The instruction in the instruction register is then interpreted by the decoder and carried out.

5. (continued)

(b) Other than the Data bus width, several factors can improve the performance of the fetch-execute cycle.

State one of these factors and explain why it improves performance. **2**

Factor _____

Explanation _____

_____

_____

_____

6. Describe the role of the client when developing software using agile methodologies. **2**

_____

_____

_____

_____

_____

_____

[Turn over

MARKS | DO NOT WRITE IN THIS MARGIN

7. A function has been written to generate numbers until a `limit` value is reached. The function receives three parameters and calculates an array of integers by adding the previous two numbers to create the next one. Numbers are generated while they are less than the `limit` given. For example, if the parameters are `first = 3`, `second = 6` and `limit = 31`.

Then the numbers generated will be:

3, 6, 9, 15, 24

All numbers in the sequence must be smaller than the `limit`. The function is shown below.

```
…
Line 16   FUNCTION sequence(first, second, limit) RETURNS ARRAY OF INTEGERS
Line 17    DECLARE seqArray AS ARRAY OF INTEGER INITIALLY [0] * 7
Line 18    SET seqArray[0] TO first
Line 19    SET seqArray[1] TO second
Line 20    SET index TO 2
Line 21    WHILE seqArray[index-1] < limit DO
Line 22      SET seqArray[index] TO seqArray[index-1] + seqArray[index-2]
Line 23      SET index TO index + 1
Line 23    END WHILE
Line 24    RETURN seqArray
Line 25  END FUNCTION
…
Line 86  SET 1stVal TO 3
Line 87  SET 2ndVal TO 6
Line 88  SET myLimit TO 31
Line 89  SET mySequence TO sequence(1stVal,2ndVal,myLimit)
…
```

(a) A logic error in the code means an incorrect array of numbers if generated. The trace table below shows the line numbers where a variable has changed.

Line Number	seqArray	index	limit	first	second
16			31	3	6
17	[0, 0, 0, 0, 0, 0, 0]				
18	[3, 0, 0, 0, 0, 0, 0]				
19	[3, 6, 0, 0, 0, 0, 0]				
20		2			
22	[3, 6, 9, 0, 0, 0, 0]				
23		3			
22	**A**				
23		4			
22	**B**				
23		5			
22	**C**				
23		6			

7. (a) (continued)

State the missing values at **A**, **B** and **C**. **3**

A _____

B _____

C _____

(b) Re-write Line 21 of the code to generate the correct sequence. **2**

(c) Identify one formal parameter and its associated actual parameter. **2**

Formal parameter _____

Actual parameter _____

(d) Describe the operation of Line 89 during the execution of this program. **2**

_____

_____

_____

(e) Programmers have control over the scope of a variable when writing code.

Describe how the position of the declaration of a variable, within code, determines its scope. **2**

_____

_____

_____

_____

_____

[Turn over

8. A car dealership sells from a stock of 150 cars. Sample data about the cars is shown below.

Make	Model	Engine size	Fuel type	Price (£)	Number in stock
Toyota	Corolla	1.6L	Petrol	18,995	10
Ford	Fiesta	1L	Diesel	13,995	15
Vauxhall	Corsa	100kw	Electric	12,995	20
Volkswagen	e-Golf	100kw	Electric	20,995	5
Audi	A3	1.4L	Petrol	24,995	3

A program is designed to help with car sales.

(a) (i) Using a programming language of your choice, define a suitable record data structure for the car data above.

The record data structure should be called `car`. **2**

(ii) Using a programming language of your choice, declare a variable called `carstock` which can store the details of 150 cars. Your answer should use the record data structure created in part (i). **2**

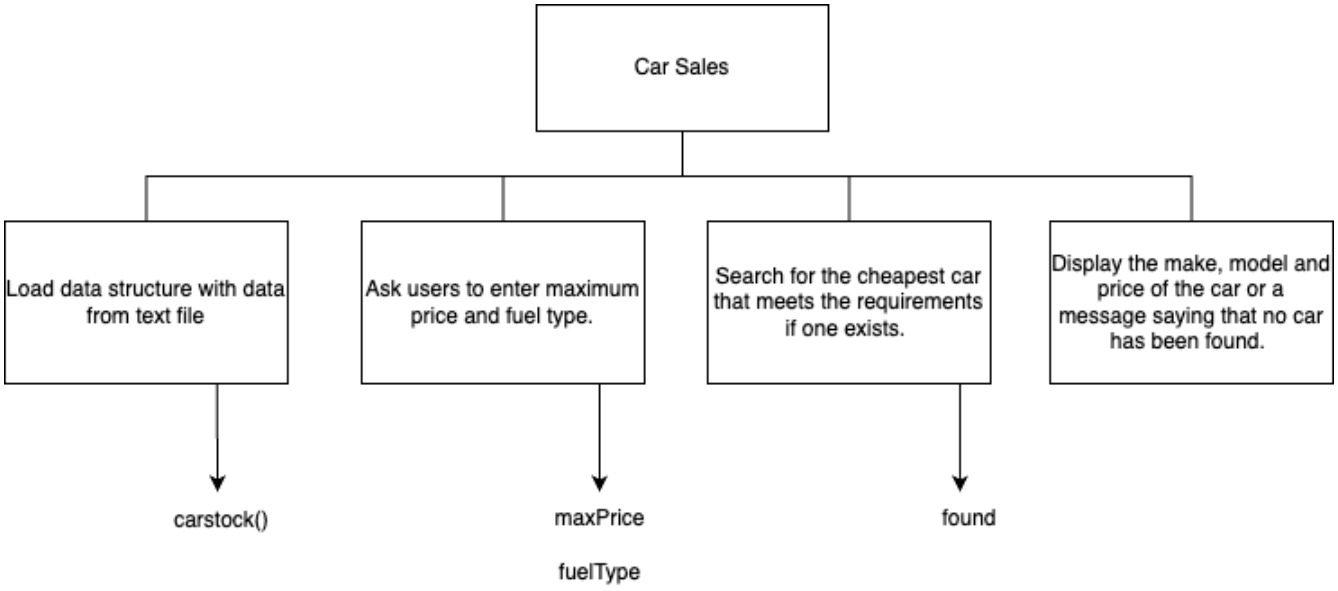
8. (continued)

(b) Customers often have questions of the salespeople at the car dealership. For example:

'Which is the cheapest electric car that is under £20,000'.

The top-level design for the algorithm to answer this question is shown diagram below.

Complete the diagram below to show the missing data flows for the last two modules. **3**



[Turn over

8. (continued)

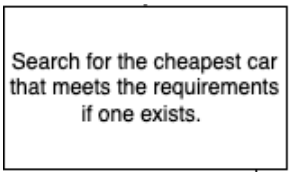
(c) The third module of the program searches for the cheapest car that meets the requirements.

A variable `cheapestPrice` is initially set to the price of the most expensive car.

(i) Using a design technique of your choice, design a solution to initially set the variable `cheapestPrice`. **4**

8. (c) (continued)

(ii) Using a programming language of your choice, write the code for the remaining part of module 3.



If no car is found then a variable called `found` is set to `false`.

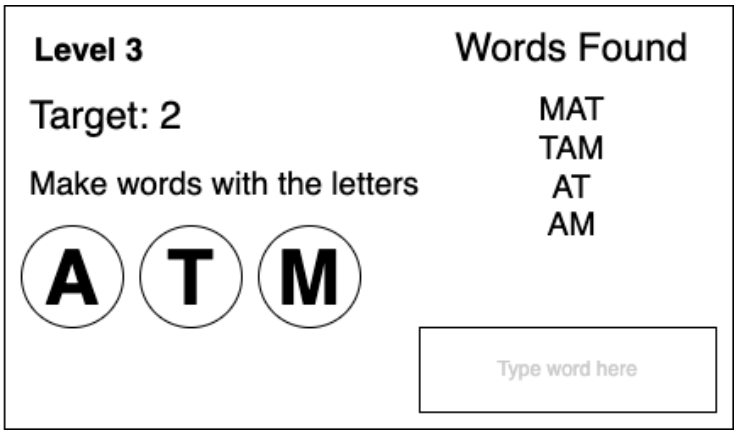
Your answer should use the data structure created in part(a). Assume that `cheapestPrice` has been set to the price of the highest priced car. **6**

[Turn over

9. A game displays several letters and then asks the player to create words using some or all of the letters. For each set of letters displayed, a target number of words is requested.

When a correct word is entered, the word is displayed on screen. Guessing the word again, displays an error message. As each correct word is entered, the target number of words is reduced.

When the number of words requested has been reached, the next set of letters is displayed with a new target.



(a) Describe two processes of this game. **2**

Process 1 _____

_____

Process 2 _____

_____

9. (continued)

(b) Each set of letters is read from a file. The files are named according to the level e.g. `level1.txt`, `level2.txt`, `level3.txt` etc.

The first entry in each file contains the letters to be displayed to the player for the level. The remaining entries contain all the valid words for the combination of letter e.g.

Text file: `level3.txt`

File Contents

```
ATM
MAT
TAM
AM
AT
MA
TA
```

Using a design technique of your choice, design a program to read in this file, store the letters to be shown to the player and then store the valid words. **4**

[Turn over

9. (continued)

(c) Part of the quiz program is shown below.

```
Line 37  SET target TO LENGTH(words)
Line 38  DECLARE guessed AS ARRAY OF BOOLEAN
Line 39  FOR index = 0 TO LENGTH(words)-1
Line 40    SET guessed[index] TO false
Line 41  END FOR
Line 42  SEND letters TO DISPLAY
Line 43  WHILE target > 0 DO
Line 44    RECEIVE guess FROM KEYBOARD
Line 45    SET valid TO false
Line 46    FOR index = 0 TO LENGTH(words)-1 DO
Line 47      IF guess = words[index] THEN
Line 48        IF guessed[index] = false
Line 49          SET target TO target - 1
Line 50          SEND words[index] TO DISPLAY
Line 51          SET guessed[index] TO true
Line 52        ELSE
Line 53          SEND "Word guessed already" TO DISPLAY
Line 54        ENDIF
Line 55        SET valid TO true
Line 56      END IF
Line 57    END FOR
Line 58    IF valid = false THEN
Line 59      SEND "Please enter a valid word" TO DISPLAY
Line 60    END IF
Line 61  END WHILE
```

Describe how lines 46 to 57 could be amended to make the code more efficient. **2**

9. (continued)

(d) Describe how the arrays `words` and `guessed` are used in this code to ensure that a valid word can only be guessed once. **2**

(e) The program is implemented using modular code.

Describe one benefit of implementing modular code. **1**

(f) The program uses Unicode for the level text files.

Describe an advantage of using Unicode over ASCII, referring to the number of bits used to represent a character in each format. **2**

[END OF SECTION 1]

[Turn over

SECTION 2 – DATABASE DESIGN AND DEVELOPMENT – 25 marks

MARKS

DO NOT WRITE IN THIS MARGIN

Attempt ALL questions

10. A snowboard rental shop uses a relational database to store information about the equipment they have for rent, the customers who rent equipment, the rentals that are made, and the rental items that are associated with each rental. The four tables in the database are as follows:

Customer	**Equipment**	**Rental**	**RentalItem**
customer_id	equipment_id	rental_id	rental_item_id
name	equipment_type	customer_id*	rental_id*
address	brand	rental_date	equipment_id*
phone_number	model	return_date	
email_address	size		
	condition		

Draw an entity-relationship diagram to show the relationships that exist in this database.

Your answer should show the entity names and cardinality.

Attributes are not required on the diagram. **3**

11. An ice hockey league uses a database to store details of players and their stats. A sample of the data stored in the Player table is shown below.

Player				
PlayerNo	**PlayerName**	**Team**	**Goals**	**Assists**
1	Aaliyah Jackson	Edinburgh Oilers	50	72
2	Aisha Patel	Glasgow Maple Leafs	60	46
3	Hana Chen	Avalanche Dundee	55	55
4	Jasmine Garcia	Aberdeen Lightning	28	58
5	Leila Williams	Dundee Penguins	10	44
6	Maya Jones	Avalanche Dundee	38	43
7	Nadia Khan	Aberdeen Lightning	42	56
8	Olivia Lopez	Wild Stirling	42	48
9	Priya Patel	Dundee Penguins	42	62
10	Ruby Singh	Aberdeen Lightning	39	12
11	Zara Ali	Edinburgh Rangers	36	13
12	Zoe Anderson	Inverurie Predators	36	19
…	…	…	…	…

The national coach would like to produce a report displaying the lowest and highest number of `Assists` for each team with "Dundee" in their name as shown below.

Team	**Lowest Assists**	**Highest Assists**
Avalanche Dundee	23	55
Dundee Penguins	44	62
Dundee Pilgrims	15	50

The following SQL statement is executed.

```
SELECT Team, MAX(Assists) AS [Lowest Assists], MIN(Assists) AS
[Highest Assists]
FROM Player
WHERE Team LIKE "Dundee*"
```

When tested, the actual output did not match the expected output.

Identify the three errors in the above SQL statement. **3**

Error 1 _____

_____

Error 2 _____

_____

Error 3 _____

_____

[Turn over

MARKS | DO NOT WRITE IN THIS MARGIN

12. A tour company uses a relational database to store the following information in three tables as shown below.

Tour	Booking	Customer
tourID	bookingID	customerID
Title	tourID*	firstname
departsFrom	customerID*	lastname
endsAt	reserved	emailAddress
duration	discount	
tourPrice	tourDate	
	tourTime	
	guideName	

(a) When the Booking table was originally designed, it was suggested that a compound key could have been used.

Explain why a compound key would not have been suitable for the Booking table. **1**

12. (continued)

(b) Some data from the `booking` table is shown below.

booking ID	tour ID	customer ID	reserved	discount	tourDate	tourTime	guideName
1	1	11	4	15%	2023-10-28	15:00	Ruby Singh
2	1	12	5	28%	2023-10-28	15:00	Ruby Singh
3	1	17	2	15%	2023-10-28	15:00	Ruby Singh
4	5	3	1	0%	2023-10-29	14:00	Michael Williams
5	5	16	2	0%	2023-10-29	14:00	Michael Williams
6	5	5	5	25%	2023-10-29	14:00	Michael Williams
7	5	7	1	39%	2023-10-29	14:00	Michael Williams
8	5	4	1	0%	2023-10-29	14:00	Michael Williams
9	5	10	2	10%	2023-10-29	14:00	Michael Williams
10	3	11	1	15%	2023-10-29	16:00	Bob Brown
11	3	12	5	0%	2023-10-29	16:00	Bob Brown
12	1	6	1	18%	2023-10-30	17:00	Olivia Lopez
13	1	15	2	45%	2023-10-30	17:00	Olivia Lopez
14	1	1	1	6%	2023-10-30	17:00	Olivia Lopez
15	1	11	4	24%	2023-10-30	17:00	Olivia Lopez

Complete the table below showing the expected output from the following SQL statement.

```
SELECT tourDate, SUM(reserved) as 'Number in Group'
FROM booking
WHERE tourID = 1
GROUP BY tourDate
```

2

tourDate	Number In Group

[Turn over

12. (continued)

(c) The database is improved by adding a table for guides.

guide	
guideID	**guideName**
1	Ruby Singh
2	Michael Williams
3	Bob Brown
4	Olivia Lopez
…	…

The design of the `booking` table is changed as a result.

Complete the data dictionary below for the changes to the `booking` table. **2**

Entity	Attribute	Key	Type	Validation
booking				

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[Turn over for Question 13

13. A company sells a variety of products, such as clothes, electronics, and home goods. The company offers a warranty on all its products, ranging from 1 year to 5 years in duration.

The company wants to track the warranty status of each product, including the purchase date, the warranty period in years, and when it expires. The company also wants to track the customers who purchased each product.

The company uses a database with four tables for this purpose. The four tables used are shown below.

Customer					
custID	**firstname**	**lastname**	**address**	**postcode**	**mobile**
7	Nguyen	Ngo	133 Oak Street	M1 7AA	07712345678
8	Aisha	Khan	144 Elm Street	EH1 8AA	07489012345
9	Sarah	Cohen	155 Maple Street	SO1 9AA	07956789012
10	David	Singh	166 Pine Street	B1 1AA	07623456789
…	…	…	…	…	…

warranty				
warrantyID	**saleID**	**purchased**	**years**	**expires**
102	827	22/10/2023	1	22/10/2024
122	828	23/10/2023	2	23/10/2025
133	829	22/10/2023	5	22/10/2028
134	830	22/10/2023	3	22/10/2026
…	…	…	…	…

product				
productID	**product_name**	**description**	**category**	**price**
14	T-shirt	Black cotton	Clothes	15.00
34	Jeans	Blue denim jeans	Clothes	25.00
3	Laptop	Apple Macbook Air	Electronics	889.00
12	TV	Samsung 55” Smart TV	Home Goods	499.00
…	…	…	…	…

sale					
saleID	**productID**	**custID**	**sale_date**	**sale_quantity**	**sale_price**
827	14	7	22/10/2023	1	10.00
828	34	7	23/10/2023	2	39.98
829	3	8	22/10/2023	1	799.00
830	12	9	22/10/2023	1	459.00
…	…	…	…	…	…

13. (continued)

(a) Design a query to display the number of warranties that the customer with `custID` of 10 has that expire in 2024. **2**

Field(s) and Calculation(s)	
Table(s)	
Search Criteria	
Grouping	
Sort order	

(b) A product with `productID` 3, sold with a `sale_date` before `01/10/2023` is to be recalled because it is unsafe. A list of all customers who purchased the product is required.

Complete the design of a query to display the full name and mobile number of every customer affected. **2**

Field(s) and Calculation(s)	
Table(s)	Customer, Sale
Search Criteria	
Grouping	
Sort order	

[Turn over

13. (continued)

(c) Customers who purchased any Smart TV with a warranty for 5 or more years, are to have an extra year added to their warranty.

Write the SQL statement that will implement this. **4**

(d) The company want to calculate the average `sale_price`.

(i) Write the SQL statement to display the average sale price as shown below. **2**

Average Sale Price
325.5

13. (continued)

(ii) The query from part (i) is saved as 'AvgSalePrice'. Using this query, complete the SQL statement to display customers who have spent more than the average sale price, in any sale, from highest to lowest as shown below. **4**

firstname	lastname	sale_price	product_name
Sarah	Cohen	799.00	Laptop
Danny	Olive	649.97	Laptop
David	Singh	459.00	TV
Blake	Xavier	449.99	TV
…	…	…	…

```
SELECT firstname, lastname, sale_price, product_name
```

[END OF SECTION 2]

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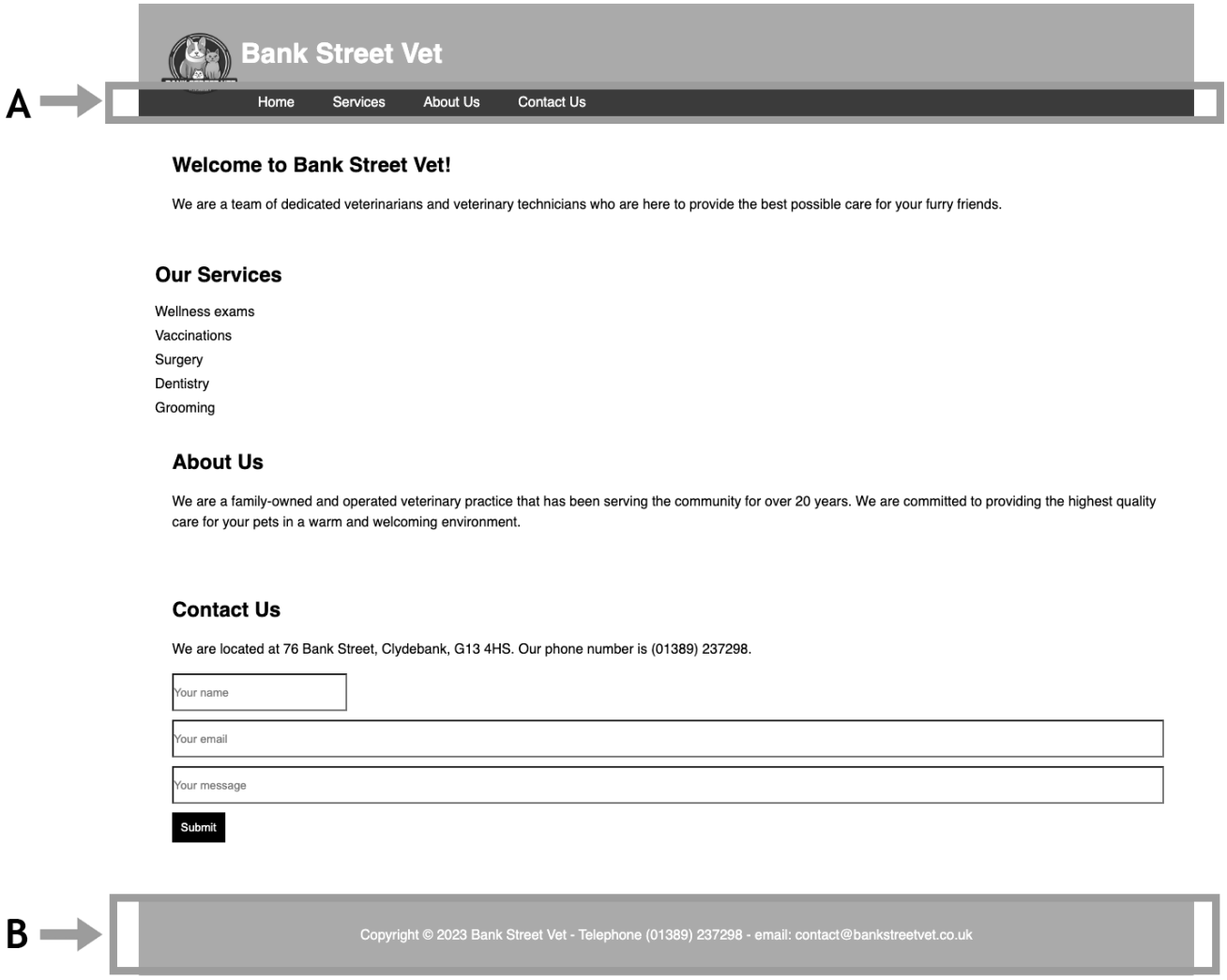
SECTION 3 — WEB DESIGN AND DEVELOPMENT — 25 marks

Attempt ALL questions

14. HTML 5 elements have been used to define the parts of a web page which is shown below.



State which elements should be used for the parts labelled A and B. **2**

A _____

B _____

[Turn over

15. A digital "escape room" contains challenges which are completed by participants to gain a code which allows them to leave the room and receive a prize.

One of the codes is displayed when a hidden area of a web page is clicked. When the participant moves the mouse over the clickable area of the web page, text appears which says "Click me". Clicking displays a code. The "Click me" text and code disappears when the mouse moves off the hidden area.

An example of the intended effect is shown below.

Hidden area when mouse pointer moves over it

Clicked Hidden Area

The code used to implement this feature is shown below.

JavaScript code

```
function hideMessage() {
  document.getElementById("message").style.display = "none";
}
function showMessage() {
  document.getElementById("message").style.display = "block";
}
```

CSS Code

```
#button {width: 122px; height: 120px; background-color: white;
         color: white; border: 0px white;}

#button:hover { background-color: blue;}

.message {display: none; width: 100px; background-color: white;
border: 1px solid black; padding: 10px;}
```

HTML Code

```
<button id="button">Click Me!</button>
<div id="message" class="message">Your Code is "Z21"</div>
```

15. (continued)

(a) State two reasons why this code is not fit for purpose. **2**

(b) Explain why the area changes colour when the mouse moves over it. **2**

[Turn over

16. A new web site is being developed. This site will allow users to upload and share documents, program code, images and other types of files. Once uploaded, these files can be used in collaborative projects that can be shared with other users. Within each project, users can discuss and exchange ideas with others and track the progress of the project. Users should sign into the site using a username and password.

Once signed in, users should be able to access one of four pages – an explore page, a profile page, a "my projects" page and a settings page.

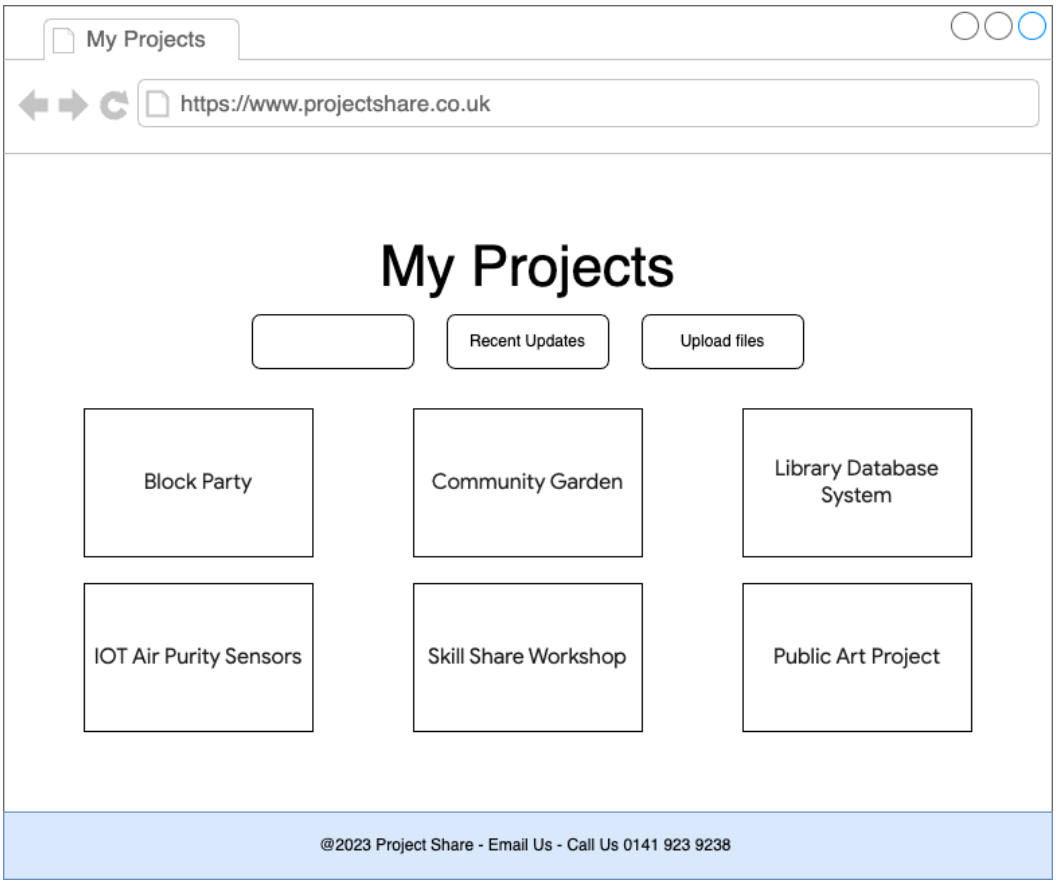
From the explore page, users can view a page showing projects created by others and a join page that allows them to join project. On the "my projects" page, users can view the projects they have joined and they can view a page with "recent updates" from their projects and another page where they can upload files to projects. From the profile page they can access a page to edit their profile.

(a) State one functional requirement of this website. **1**

(b) Draw the navigational structure of this website. **2**

16. (continued)

(c) The developers proposed an initial design for the "my projects" page. The design is shown below.



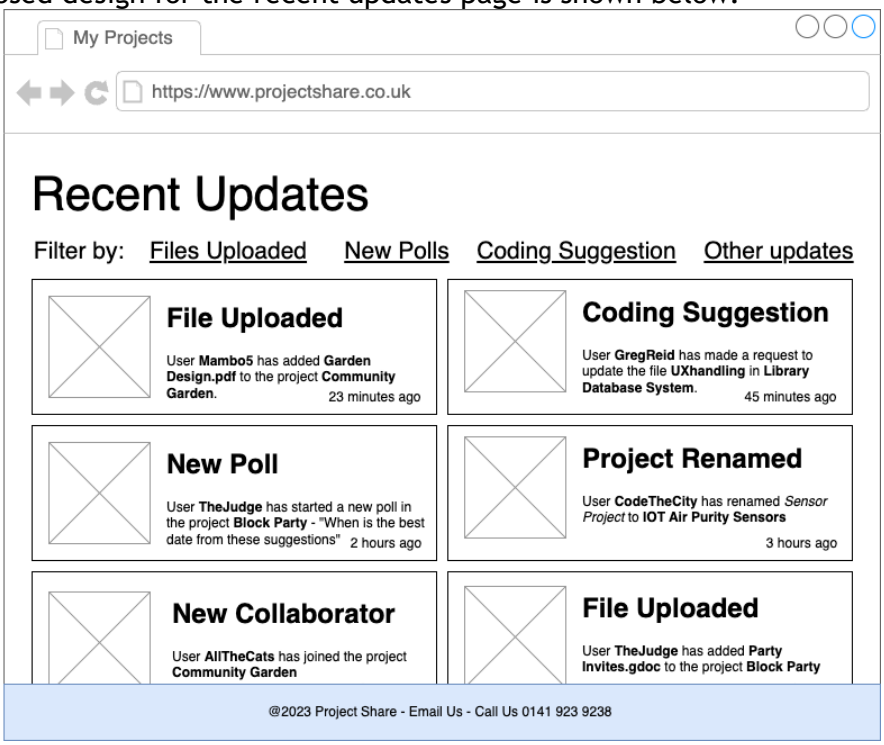
A low fidelity prototype was created from the wireframe above.

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

[Turn over

16. (continued)

(d) A proposed design for the recent updates page is shown below.



(i) The style rule for h1 headings is shown below.

```
h1 {  font-family: Verdana;
      text-align: left;}
```

All `h2` and `h3` elements should also be formatted using the rule above. All h2 elements should also have a 15 pixel padding.

Making use of a grouping selector where appropriate, write the CSS rules to format the headings. **2**

16. (d) (continued)

The navigation bar shown makes use of the following CSS.

```
nav ul{
      list-style-type:none;
      background-color:lightgrey;
      font-family: Verdana;
}

#filter {
      margin: 10px;
      padding: 10px;
}

nav ul li{
      float:left;
}
nav ul li a{
      color:darkblue;
      text-align:center;
      margin: 10px;
      padding: 10px;
      display:block;
}
nav li a:hover{
      background-color:black;
      color:white;
}
```

(ii) Explain why descendant selectors are used here. **2**

(iii) The hyperlinks work if the user clicks on or near the text.

Identify the line of code that allows this to happen. **1**

[Turn over

17. A web site is used by users to find jobs in their local community. Users complete a search profile which matches them to jobs on the site.

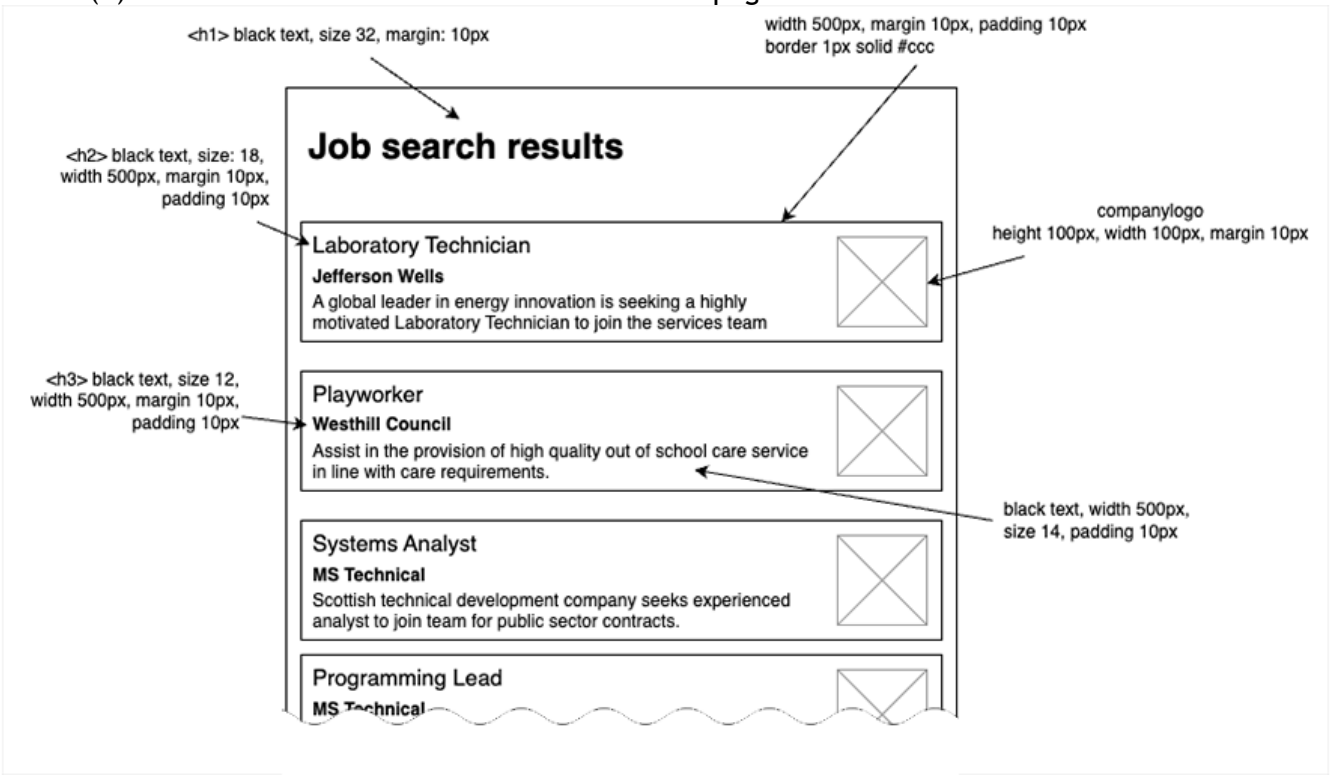
The search profile page allows users to enter the following details.

- firstname
- lastname
- email address
- phone number
- type of work – part-time, full-time, volunteering
- interested in - retail, hospitality, customer service, other

(a) Using the information above, draw a wireframe design for this web page. **3**

17. (continued)

(b) Part of a wireframe for the search results page of the web site is shown below.



(i) Part of the HTML for this page is shown below.

```
<div class="job-listing">
      <img class="logo" src="placelogo.png" />
      <h2>Laboratory Technician</h2>
      <h3>Jefferson Wells</h3>
      <p>A global leader in energy innovation is
seeking a highly motivated Laboratory Technician to
join the services team.</p>
</div>
```

Write the CSS rule for `.job-listing p` so that it is efficiently formatted. **2**

[Turn over

17. (b)(continued)

(ii) Write a CSS rule to display the company logos to match the design wireframe. **2**

(c) Once the website has been completed, compatibility testing is carried out. During compatibility testing several comments were made.

Sample User Comment 2	Sample User Comment 2
The pages were laid out differently than I thought they would be, and I had to scroll a lot to reach the bottom.	Some of the styling on the pages was not applied correctly.

Give two reasons why users may have different experiences when testing the same website. **2**

Reason 1 _____

Reason 2 _____

[END OF SECTION 3]

[END OF QUESTION PAPER]

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ADDITIONAL SPACE FOR ANSWERS

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