

FOR OFFICIAL USE



National
Qualifications

Mark

--

CS(H)21A

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

D	D
---	---

M	M
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Y	Y
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Scottish candidate number

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Total marks - 80

SECTION 1 - 55 marks

Attempt ALL questions.

SECTION 2 - 25 marks

Attempt questions from **either** Part A or Part B **only**.

Part A - Database Design and Development Page 15

Part B - Web Design and Development Page 21

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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SECTION 1 - 55 MARKS

MARKS

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Attempt ALL questions

1. Convert the 8-bit two's complement number 1010 0011 to a denary number.

1

2. Read the following code.

```
Line 68 FUNCTION numberKey(INTEGER lower, INTEGER upper) RETURNS INTEGER
Line 69     SET numberValue TO RANDBETWEEN(lower, upper)
Line 70     RETURN numberValue
Line 71 END FUNCTION
Line 72
```

```
... ...
Line 92 DECLARE randomValue AS INTEGER INITALLY 0
Line 93 SET randomValue TO numberKey(1,100)
... ...
```

- (a) State one formal parameter in the code above.

1

- (b) State one actual parameter in the code above

1

3. Describe how a tracking cookie may be a potential security risk.

2

4. A program is used to create simple coded messages. The program takes a string from the user, converts each character to an ASCII code, adds 5 to the code value and then converts this back to an ASCII character in a new string. For example, the string "Lost" would become "Qtyx"

```
Line 200 FUNCTION encodeMessage (STRING message) RETURNS STRING
Line 201
Line 202     DECLARE char AS STRING
Line 203     DECLARE charValue AS INTEGER
Line 204     DECLARE newChar AS STRING
Line 205     DECLARE newMessage AS STRING INITIALLY ""
Line 206
Line 207     FOR position FROM 0 TO length(message)-1 DO
Line 208         SET char TO <get 1 character substring from position>
Line 209         SET charValue TO <ASCII code value of char>
Line 210         SET charValue TO charValue + 5
Line 211         SET newChar TO <convert ASCII charValue to string>
Line 212         SET newMessage TO newMessage & newChar
Line 213     END FOR
Line 214     RETURN newMessage
Line 215 END FUNCTION
Line 216
Line 217 DECLARE message AS STRING INITIALLY "This is a Test"
Line 218 DECLARE newMessage AS STRING
Line 219 DECLARE userText AS STRING
Line 220
Line 221 RECEIVE userText FROM KEYBOARD
Line 222 SET newMessage TO encodeMessage (userText)
```

- (a) Using a programming language of your choice, write code for line 208. 2

- (b) Using a programming language of your choice, write code for line 211. 2

- (c) During testing an error involving global and local variables is identified in the program. Read the code above and explain why this error has occurred. 2

[Turn over

5. An instruction to be executed is in memory address 1028.

Complete the steps of the fetch-execute cycle shown below.

2

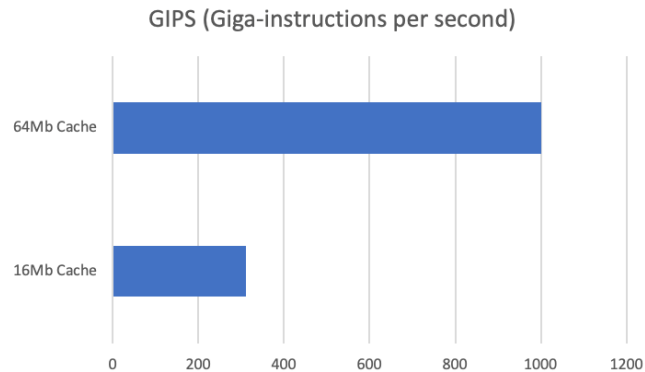
Step 1

Step 2 The processor activates the read line on the control bus.

Step 3

Step 4 The instruction in the instruction register is then interpreted by the decoder and carried out.

6. Two identical processors with different sizes of cache memory are compared.



Explain why the processor with a larger cache is able to process more instructions per second.

2

7. The details of competitors in a snowboard competition are held in two 1D arrays. Some sample data is shown below.

Name: Yuka Fujimori
Time: 32.125

Name: Lesley McKenna
Time: 33.625

Name: Nimisha Popatia
Time: 38.875

Name: Liu Jiayu
Time: 34.50

There are 32 competitors in the competition.

- (a) Using a recognised design technique, design an algorithm to display the competitor who took the least amount of time to complete the course.

For example, the output based on the data above would be “Fastest competitor: Yuka Fujimori”.

5

[Turn over

7. (continued)

- (b) The values for Time are stored using floating point representation. The processor uses 16-bits for the mantissa (with the sign bit) and 8-bits for the exponent.

Convert 32.125 (100000.001 in binary) to floating point representation.

3

Space for working

sign	mantissa

exponent

- (c) The program uses two parallel 1D arrays. Explain why this data structure may have been used rather than an array of records.

2

- (d) During development and testing breakpoints and watchpoints are used to debug the program.

- (i) Describe how breakpoints can be used to debug a program.

2

7.(d) (continued)

MARKS

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THIS
MARGIN

- (ii) Describe how watchpoints can be used to suspend the execution of a program for debugging.

1

- (e) A traffic control system is in use to manage the vehicles attending the competition.

Describe one environmental benefit of using a traffic control system.

1

[Turn over

8. A company have a sweepstake for their customers. Each customer enters their name, telephone, and three numbers between 1 and 100. These details, for all the customers, are read from a csv file and stored in an array of records.

An extract from the file is shown below.

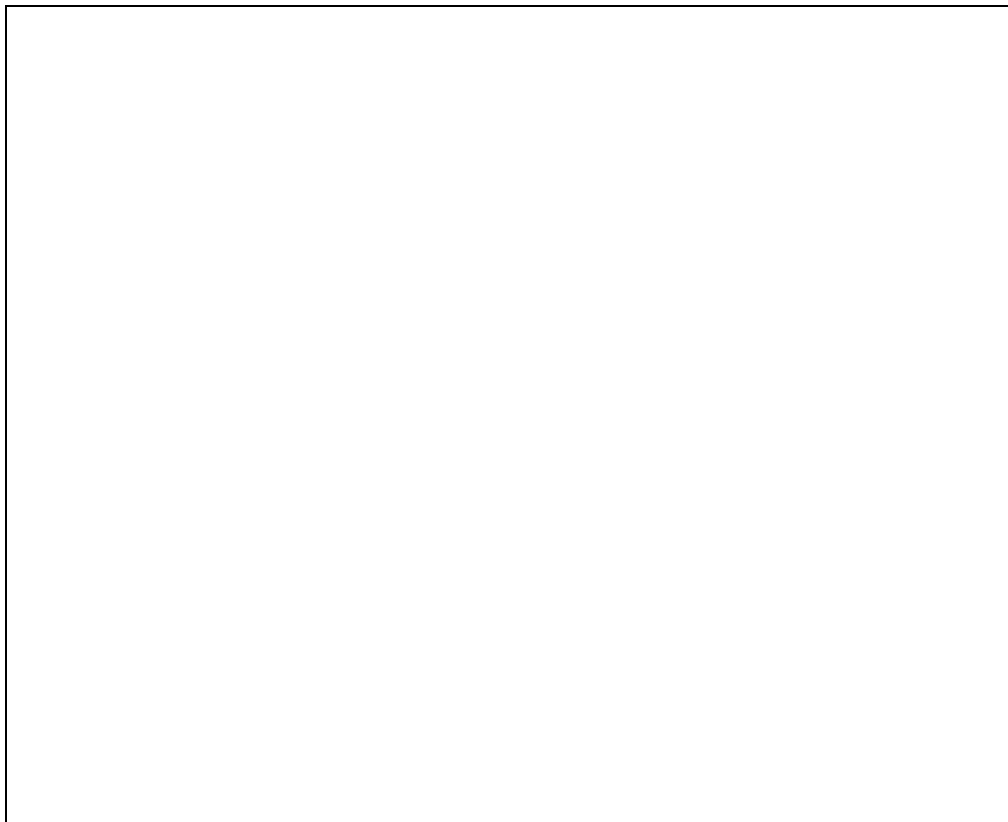
Yigol Mayer, 0772 827 718, 24,100,97
Tobie Laurens, 0744 000 023, 92, 24, 1
Robbie Smith, 0722 828 811, 25, 26, 27

Each month, three numbers are drawn at random and a program is required to check these three numbers against the customer numbers in the file.

All customers with three matching numbers, **in any order**, are winners and share a prize of £500.00.

- (a) Using a wireframe, design a user interface for entering the drawn numbers, matching and displaying the winners. Ensure you include any design features and necessary validation.

3



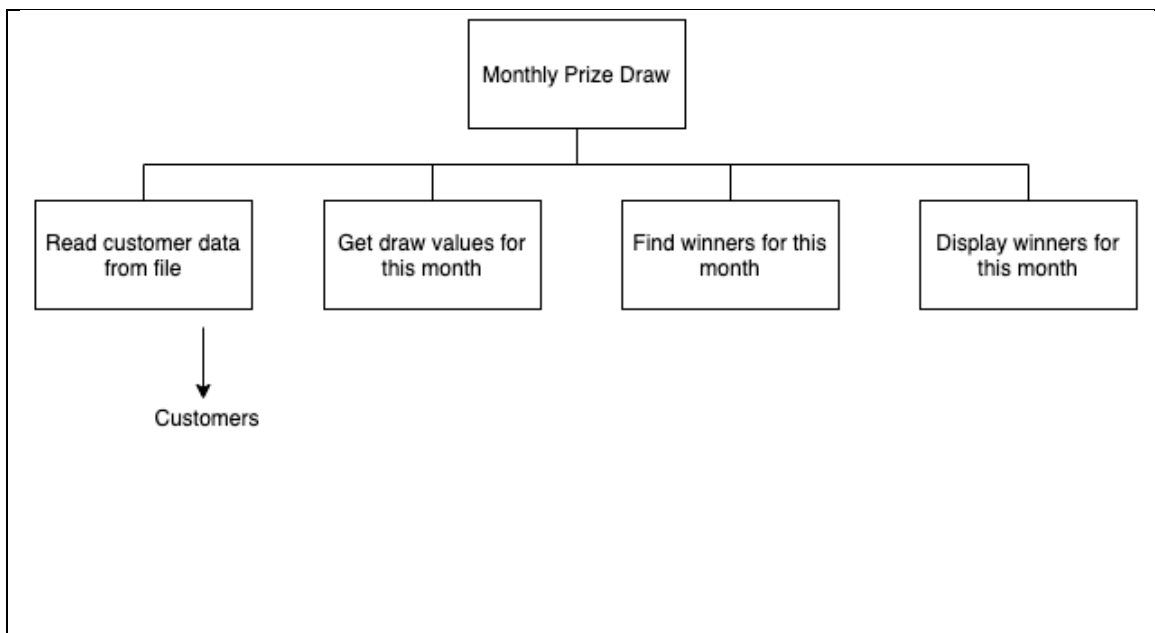
8. (continued)

(b) The program will store data in the following arrays.

- Customers: an array of records containing the customer details from the file.
- drawValues: a 1D array holding the three numbers drawn for the month
- winNames: a 1D array of the winning names
- winPhones: a 1D array of the winning phone numbers

Complete the diagram below to show the missing data flows.

4



(c) The data will be read from the file and stored in a record structure.

```

RECORD customer IS { STRING name, STRING phone,
                     INTEGER num1, INTEGER num2,
                     INTEGER num3 }
  
```

Using a programming language of your choice, declare an array, called Customers, to store the information of 500 customers, using this record structure.

2

[Turn over]

8. (continued)

- (d) Using a programming language of your choice and the data structure from (c), write code to read and store the contents of a csv file, "customers.csv".

5

9. Logie Community Council want a program to help manage community council meetings. Interviews with some community council members are shown below.

"We have members and residents that attend meetings. For meetings to be allowed to proceed, we need 8 of our 15 members to be present. Our meeting room has a limited capacity so if more than 15 people attend, we prioritise members over residents."

Soha Azzam, Chairperson

"When people arrive, I give them a number and I make a note of this and if they are members or residents. If there are more than 15 people, I count the number of members and then allocate any remaining seats to the residents with the lowest numbers first. Once the room is full, I ask anyone not allocated a seat to leave."

Ron Barclay, Secretary

- (a) State two boundaries for the system described above that would be identified during the analysis phase.

2

- (b) The following code has been developed to count attendees.

```

Line 10 DECLARE attendee AS ARRAY OF STRING
Line 11 DECLARE atNumber AS INTEGER INITIALLY 0
Line 12 DECLARE mCount AS INTEGER INITIALLY 0
Line 13 DECLARE rCount AS INTEGER INITIALLY 0
Line 14
Line 15 WHILE response = "Y" DO
Line 16     SEND "Member (M) or Resident (R)? X to Exit" TO DISPLAY
Line 17     RECEIVE type FROM KEYBOARD
Line 18     SET attendee[atNumber] TO type
Line 19     SET atNumber TO atNumber + 1
Line 20     IF type = "M" THEN
Line 21         SET mCount TO mCount + 1
Line 22     ELSE
Line 23         SET rCount TO rCount + 1
Line 24     END IF
Line 25 END WHILE

```

A logic error in the code means rCount is always incorrect. Identify the cause of this error and how it can be corrected.

2

[Turn over

9. (continued)

- (c) Using a recognised design technique, design a solution to allocate seats at meetings. Assume the error in (b) has been corrected.

5

9. (continued)

- (d) The community council members provide some feedback on the program.

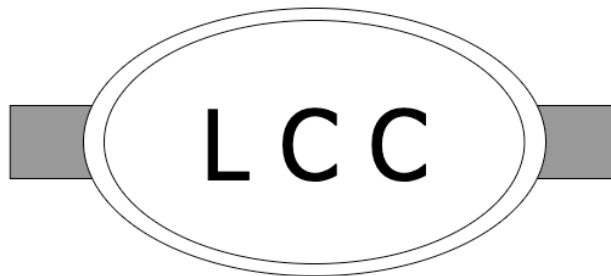
“If I enter ‘m’, ‘x’, ‘r’ or any other letter other than the ones asked for the program seems to do something and then asks me for another letter. Is this supposed to happen?”

“When I run the program at the start of the meeting, the first thing it displays is “Member (M) or Resident (R)? X to Exit”.

Describe two ways that the usability of the program could be improved.

2

- (e) The logo for the community council can be stored as either a bit-mapped or vector graphic.



Describe two advantages of storing this graphic as a vector rather than as a bit-mapped graphic.

2

Advantage 1 _____

Advantage 2 _____

[Turn over

SECTION 2

You must complete **EITHER** Part A or Part B

Part A - Database Design and Development - Page 15

OR

Part B - Web Design and Development - Page 21

SECTION 2 PART A - Database Design and Development

MARKS

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MARGIN

Attempt ALL questions

10. A database for teams in a sports club has the following tables.

Player	TeamMember	Team	Manager
<u>playerid</u> pname pmobile pemail	<u>playerid*</u> <u>teamid*</u> position captain	<u>teamid</u> tname managerid*	<u>managerid</u> mname

A player can be a member of several teams. A team can only have one manager. A team has one or more players.

Draw a labelled entity-relationship diagram for this database. Attributes are not required on the diagram.

3

11. A database table is shown below.

Table: Skateboard				
ItemNo	Manufacturer	Style	Length	Cost
187	Birdhouse	Cruiser	29	119.95
188	D-Street	Longboard	39	74.95
189	Lush	Longboard	42	135.50
190	Loaded	Cruiser	30	99.99
191	Santa Cruz	Cruiser	31	149.95
192	Lush	Longboard	41	199.95

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

2

```
SELECT Style, MAX(Length) AS "Longest Item"
FROM Skateboard
GROUP BY Style
```

Style	Longest Item

[Turn over

12. State the feature of SQL that allows the calculation to be called “Bonus Days”.

```
SELECT (membership_days + 50) AS "Bonus Days"
FROM membership, transaction
WHERE membership.mid = transaction.mid
```

1

13. Some sample data from a database is shown below.

Table: Ticket				
TicketNo	FromStation	ToStation	Valid From	AnyRoute
271981	GLQ	DEE	15/03/2020	☒
271982	KNT	INR	23/03/2020	☐
271982	WCK	INV	05/04/2020	☒

Table: Station	
Code	Station
GLQ	Glasgow
DEE	Dundee
KNT	Kintore
INR	Inverurie

Complete this data dictionary.

3

Entity	Attribute	Key	Type	Size	Validation
Ticket	TicketNo	A			
Ticket	FromStation	B			C
Ticket	AnyRoute		D		
Station	Code	E			

A _____

B _____

C _____

D _____

E _____

14. A database has been developed for a tourist agency. It provides details of landmarks to visit around Scotland.

Landmark

SiteNo	Location	Cost	Access	Rating
01	Edinburgh Castle	18.00	Accessible	4.8
02	Loch Ness Visitor Centre	12.00	Accessible	4.5
03	Royal Mile	0.00	Accessible	4.6
04	Loch Lomond	0.00	Restricted	4.8
05	Arthur's Seat	0.00	Varies	4.7
...	...	...	...	...

- (a) Urquhart Castle is to be added to the Landmark table. An SQL statement for this purpose is show below.

```
INSERT INTO Landmark (Location) VALUES ("Urquart Castle")
```

Evaluate this query in terms of fitness for purpose.

1

- (b) This query will have an impact on the accuracy of the data produced from the database.

Describe what could be done to prevent the query in (a) from updating the database.

2

[Turn over

15. Events Hire is a company that provide services for special occasions such as birthdays and weddings. They have a stock of equipment, such as bouncy castles, hot tubs etc. that customers can hire.

RentalItem		
itemid	itemname	notes
71	Bliss	Inflatable hot tub, supplied with lights, cover and gazebo
72	Scandic	Rigid hot tub, Access width: 85cms, Height: 205cms
73	Cube Castle	5m x 5m space required. Toddler safe bouncy castle
74	Pep Piggie	4.5, x 6m space required. Toddler safe bouncy castle
75	OctoPool	3m x 3m ball pool. Supplied with 500 plastic balls.
76	Assault Course	12m x 40m inflatable assault course for adults.
...	...	

Rental					
rentalid	itemid	date	deliverytime	duration	customerid
135	71	05/02/2021	14:00	5	25
136	71	11/02/2021	10:00	3	28
137	72	03/02/2021	16:00	7	26
138	73	10/02/2021	18:00	4	27
139	74	02/02/2021	12:00	3	25
140	76	06/02/2021	08:00	1	28
141	75	05/02/2021	10:00	2	28
...	...				

Customer					
customerid	fname	lname	mobile	address	postcode
25	Toni	Vosser	0719 827189	31 West Wall	DD12 9YY
26	Ian	Jones	0728 928111	19 Doomstaid	AT88 1UT
27	Colin	Walker	0719 827711	99 Janey Lane	FY16 8AY
28	Jamie	Scullion	0777 928982	11 North St	FY12 1TT
...	...				

- (a) Design a query to show customer names with the number of items on hire to each one from 05/02/2021 to 11/02/2021.

3

Field(s) and calculation(s)	
Table(s)	Customer, Rental, RentalItem
Search criteria	
Grouping	
Sort order	

15. (continued)

MARKS

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MARGIN

- (b) Design a query to show the name of each item, with its itemID, and the total duration of rentals for the item. This table should have the longest rental total at the top.

3

Field(s) and calculation(s)	
Table(s)	
Search criteria	
Grouping	
Sort order	

- (c) The “Bliss” hot tub has been replaced with a new model called, “Paradise”. The notes remain as they are.

Write the SQL statement to make this change.

3

[illegible]

[Turn over

15. (continued)

- (d) Hot tubs are charged at £100 per rental, plus £25 multiplied by the duration. The following table is a list of fees that customers will pay for hot tub rentals, generated for each rental for a hot tub.

Hot Tub Fees
225
175
275
...

- (i) Write SQL that will generate the result above from the data in the tables Rental and RentalItem.

3

- (ii) Explain how the example table of data could be used in testing.

1

[END OF SECTION 2 - PART A]

SECTION 2 PART B - Web Design and Development

MARKS

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Attempt ALL questions

16. An image and text from a web site are shown below.

CLAUDIO

And what have I to give you back, whose worth May counterpoise this rich and precious gift?

DON PEDRO

Nothing, unless you render her again.

CLAUDIO

Sweet prince, you learn me noble thankfulness. There, Leonato, take her back again: Give not this rotten orange to your friend; She's but the sign and semblance of her honour. Behold how like a maid she blushes here! O, what authority and show of truth Can cunning sin cover itself withal! Comes not that blood as modest evidence To witness simple virtue? Would you not swear, All you that see her, that she were a maid, By these exterior shows? But she is none: She knows the heat of a luxurious bed; Her blush is guiltiness, not modesty.

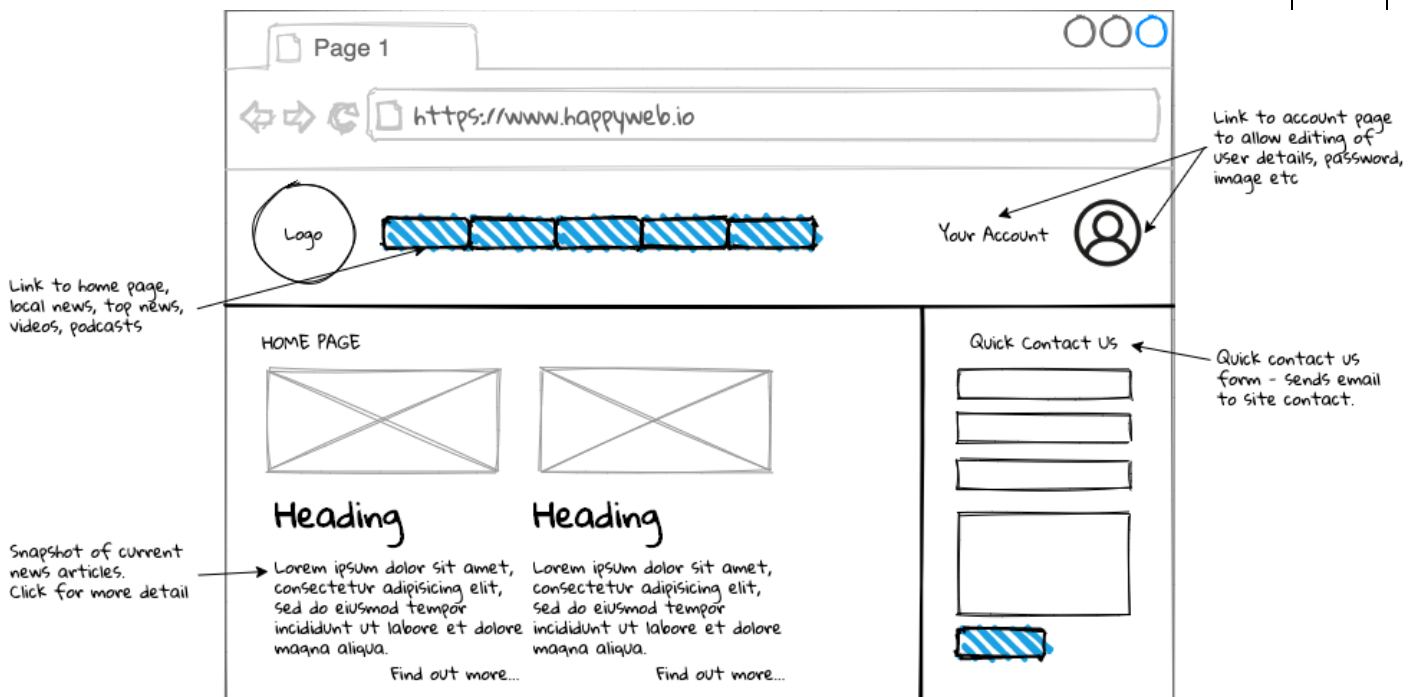


State the CSS property and value that has been used to place the image.

2

17. Describe which areas of this wireframe would be suitable to implement in a low fidelity prototype.

2



Area 1

Area 2

[Turn over

18. A web page contains the following form element.

☒ Option 1

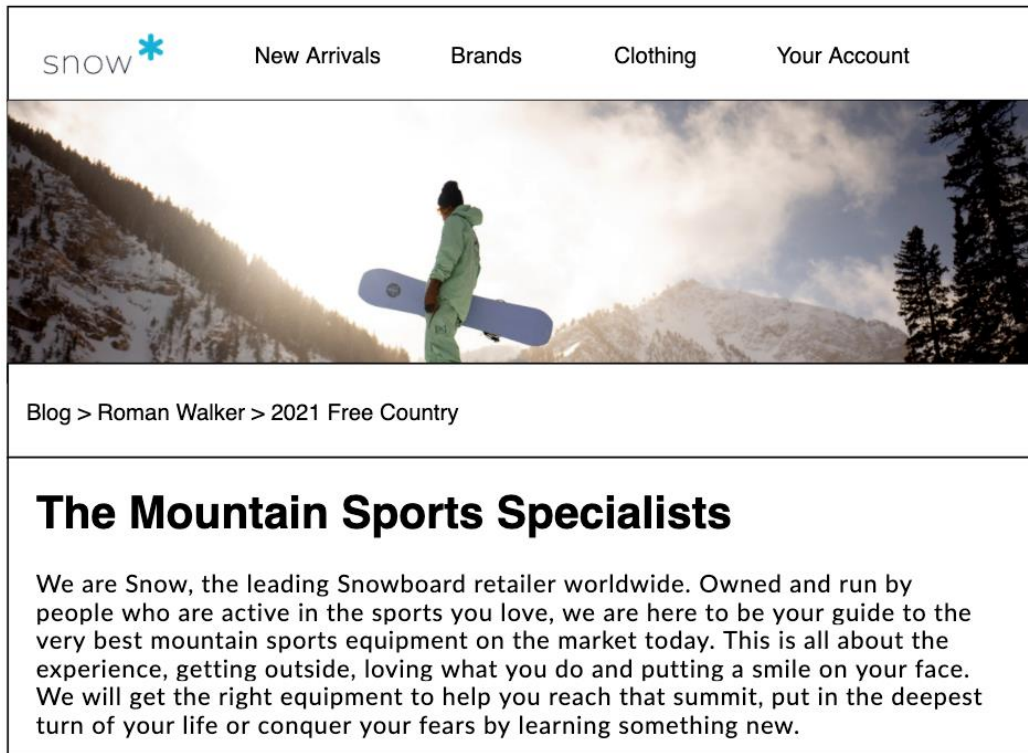
Write HTML for this element which is named "UserOpt".

3

19. Describe the role of a persona when carrying out usability testing.

2

20. A web site is being developed for a Snowboard Shop. The site will allow them to sell online and keep in touch with customers. The homepage is shown below.



- (a) The navigation under the image has the following HTML.

```
<nav class="breadnav">
  <ol>
    <li class="breadcrumb"><a href="blog">Blog</a></li> &gt;
    <li class="breadcrumb"><a href="blog/rwalker">Roman
Walker</a></li> &gt;
    <li class="breadcrumb">2021 Free Country</li>
  </ol>
</nav>
```

Write the CSS styles to implement this navigation.

3

[Turn over

20. (continued)

MARKS

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- (b) The header and the main element of the home page have the similar CSS styles. Both styles are shown here.

```
header {                                main {
  background-color: white;              background-color: white;
  margin-top: 30px;                    margin-top: 30px;
  padding-left: 20px;                 padding-left: 20px;
  margin-bottom: 20px;               margin-bottom: 20px;
  height:120px;                      font-family: Arial;
}
```

Use grouping selectors to make these CSS rules more efficient.

2

20. (continued)

- (c) A page on the site has the following headings.

Snow Adventures - 2021

Snow Park Text

font-style: normal;
font-size: small;

font-style: italic;

The HTML for these headings is shown below.

```
<h1>Snow Adventures - 2021</h1>
<section class="maintext">
  <h1>Snow Park Text</h1>
</section>
```

Write CSS rules to implement the styles shown making use of descendant selectors.

2

[Turn over

21. Bob's Sweets is developing a web site. The web site will have a multi-level structure, consisting of a home page that links to four web pages: Candy, Toffee, Chocolate and Contact Us.

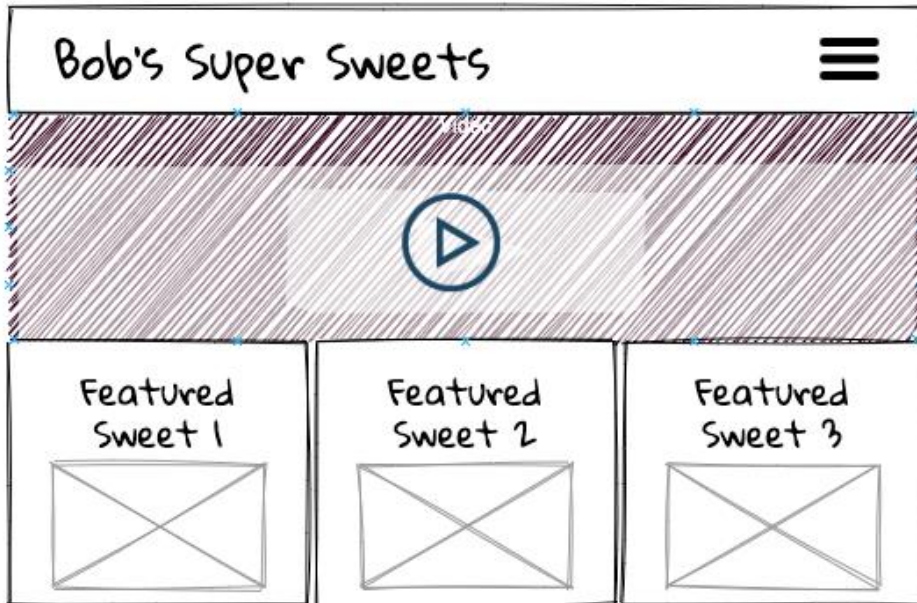
The Toffee web page will have links to two subpages showing Fudge and Tablet. The Chocolate web page will have links to two subpages showing Dark Chocolate and Milk Chocolate.

- (a) Design a multi-level structure for this web site.

2

21. (continued)

(b) A wireframe for the home page is shown below.



Redraw this layout so that it is suitable for a mobile device.

1

A large empty rectangular box provided for the student to redraw the layout for a mobile device.

[Turn over

MARKS

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21. (continued)

- (c) A wireframe for a page in the site is shown below.

Bob's Super Sweets

Membership No. (enter your 7 digit membership number)

Special Sweet Choose from:
Honey Toffee
Mint Fudge
Nut Surprise

Bag Size (Sizes 1 to 5 available)

Some of the code to implement this is shown below with placeholders for any missing code.

```
<form action="process.html" method="post">
  <p>Membership Number
    <input type="text" minlength="7" maxlength="7" name="memno" /></p>
</p>
  <p>Special Sweet
    <HTML for special sweet>
  </select></p>
  <p>Bag Size
    <HTML for bag size>
  </p>
  <p><input type="submit" value="Submit" /></p>
</form>
```

Enter the HTML code below to correctly validate the form.

3

HTML for special sweet

21.(c) (continued)

HTML for bag size

- (d) (i) Describe how the wireframes, developed during the design phase, can be used the testing phase.

2

- (ii) Explain how form validation, such as that in (c), improves usability.

1

[END OF SECTION 2 - PART B]

ADDITIONAL SPACE FOR ANSWERS

MARKS

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ADDITIONAL SPACE FOR ANSWERS

ADDITIONAL SPACE FOR ANSWERS