FOR OFFICIAL USE

National Qualifications

Mark

CS(H)20A

Computing Science

Duration — 2 hours 30 minutes

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 D D

Month M M

Year Y Y

Scottish candidate number

Total marks – 110

SECTION 1 – 25 marks

Attempt ALL questions.

SECTION 2 – 85 marks

Attempt ALL questions.

Show all workings.

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 – 25 MARKS

Attempt ALL questions

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

1011 0101

2. A foreign key is an example of a key.

Describe what is meant by a foreign key in a relational database. **1**

3. Instructions are fetched and executed by the processor. Complete the missing steps of the fetch-execute cycle for the execution of an instruction at memory address 4817. **2**

Step 1 The processor sets up the address bus with the address 4817.

Step 2

Step 3

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

4. A database table is shown below.

Table: Customer

CustomerID	ContactName	City	PostalCode	Country
2	Ana Trujillo	Berlin	05021	Germany
6	Hanna Moos	Mannheim	68306	Germany
12	Patricio Simpson	Buenos Aires	1010	Argentina
18	Janine Labrune	Nantes	44000	France
19	Ann Devon	Innsbruck	6020	Austria
20	Roland Mendel	Graz	8010	Austria
23	Martine Rancé	Lille	59000	France
41	Annette Roulet	Toulouse	31000	France
54	Yvonne Moncada	Buenos Aires	1010	Argentina

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

```
SELECT Country, Count(*) AS 'Number of Customers'
FROM Customer
WHERE Country = "Germany" OR Country="France"
GROUP BY Country;
```

2

Country	Number of Customers

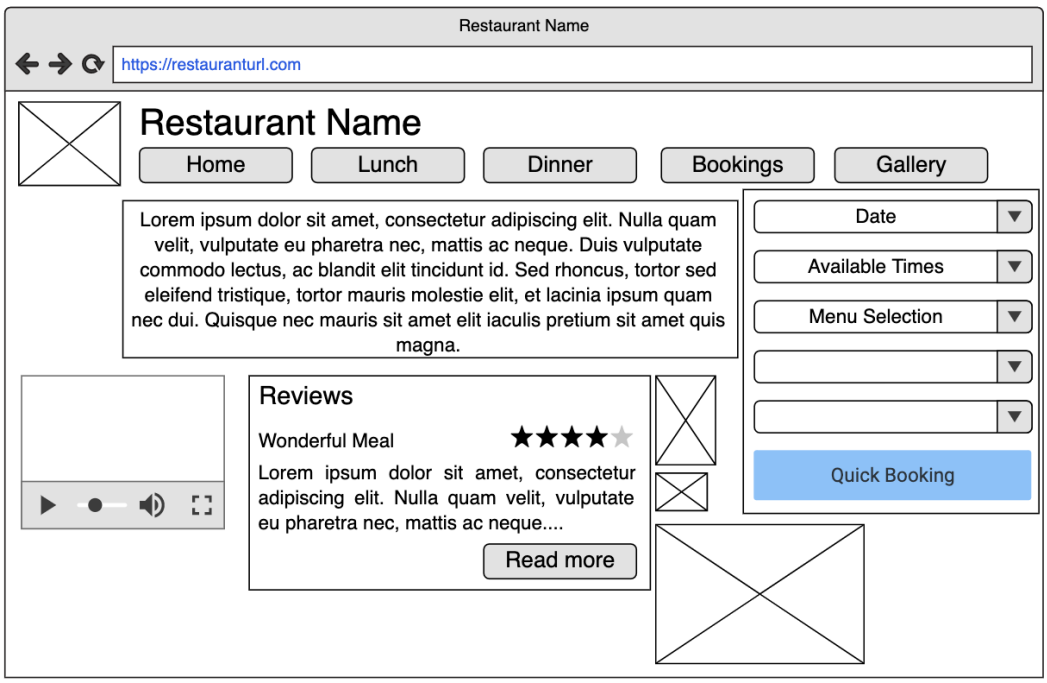
5. Convert binary number 0·0001010111 to floating-point representation. There are 16 bits for the mantissa and 8 bits for the exponent. **3**

Space for working

sign	mantissa	exponent

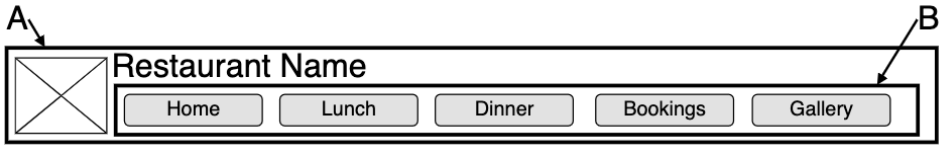
[Turn over

6. A web site is being designed for a restaurant. A wireframe design for the home page is shown below.



(a) State two reasons why this is not an efficient user-interface design. **2**

(b) HTML5 elements have been used to define different parts of this page.



State which elements have been used for the parts labelled A and B. **2**

A _____

B _____

7. Stock codes in a warehouse are generated from the first 5 characters of an item's name, and the aisle and shelf it is found on. These variables have been assigned using the code below.

```
Line 1     DECLARE itemname INITIALLY "Radiator"
Line 2     DECLARE aisle INITALLY "W20"
Line 3     DECLARE shelf INITALLY "3L"
Line 4     ____________________________________________
```

The variable `stockcode` is to be assigned with the value 'RadiaW203L' using substring operations.

Using a programming language of your choice write line 4. **2**

8. Describe why the iterative development process places more emphasis on the initial analysis and design phases of development than the agile development process does. **2**

9. A low-fidelity prototype has been created for a mobile phone app.
Describe how this is used when performing usability testing. **2**

[Turn over

MARKS | DO NOT WRITE IN THIS MARGIN

10. Review the following code.

```
Line 01    FUNCTION calculateTax (income, rate)
Line 02          DECLARE tax INITIALLY 0
Line 03          tax = income * rate
Line 04          RETURN tax
Line 05    END FUNCTION
Line 06
Line 07    DECLARE tax INITIALLY 0
Line 08    SET income TO 35820
Line 09    SET rate TO 0.21
Line 10    SET tax TO calculateTax (income, rate)
```

Describe a potential issue with the code shown above. **2**

11. Data which belongs to a music store is shown below.

Album

ID	Album Name	Released	Label	Singer Name
231	Born to Run	August 25, 1975	Columbia	Bruce Springsteen
782	Purple Rain	June 25, 1984	Warner Bros	Prince
983	Born in the USA	June 4, 1984	Columbia	Bruce Springsteen
989	Madonna	July 27, 1983	Warner Bros	Madonna
999	Ray of Light	July 27, 1983	Maverick	Madonna

Singer

Singer Name	Born	Years Active
Bruce Springsteen	23/09/1949	1964 to present
Prince	07/06/1958	1975 to 2016
Madonna	16/08/1958	1979 to present

Label

Label	Founded	Headquarters
Maverick	1992	California, USA
Columbia	1925	New York, USA
Warner Bros	1923	Burbank, USA

(a) Complete the entity-occurrence diagram below to represent the relation between Album, Singer and Label.

Singer	Album	Label	**2**
Bruce Springsteen	231	Columbia	
Prince	782	Warner Bros	
Madonna	983	Maverick	
	989		
	999		

(b) State the relationship between

(i) Singer and Album **1**

_____

(ii) Label and Album **1**

_____

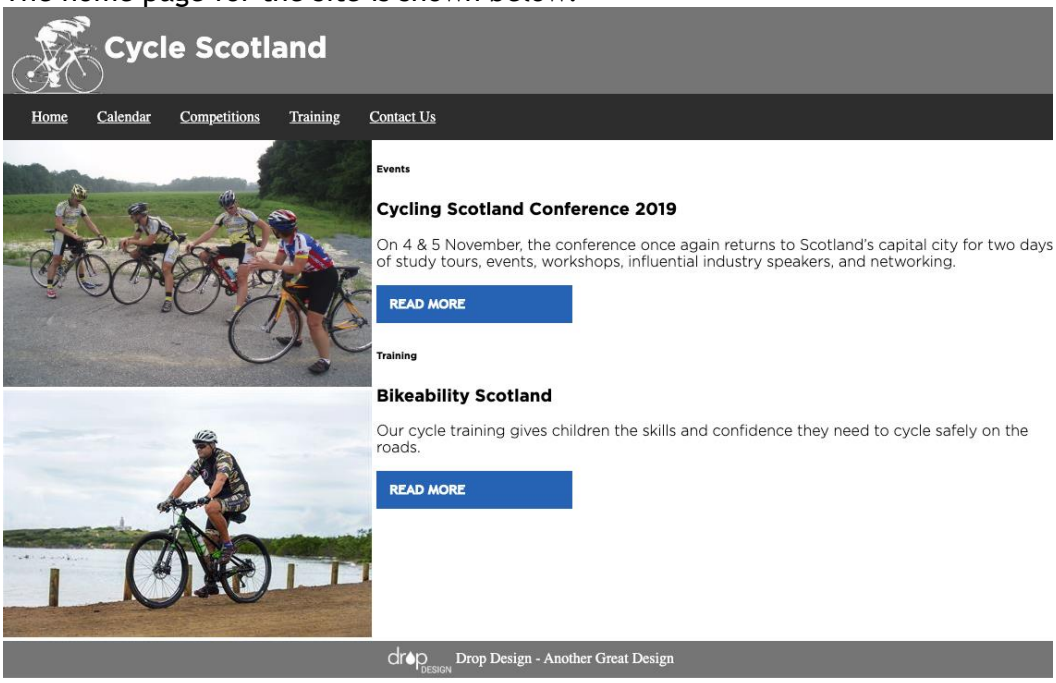
[Turn over

SECTION 2 – 85 MARKS

Attempt ALL questions

12. Cycle Scotland is an organisation which promotes cycling to groups across Scotland. A web site is being created to display information about activities and to provide a way to contact the organisation.

The home page for the site is shown below.



(a) The header and footer elements of the pages have the same CSS styles however the footer requires an additional property to center align text.

The CSS rule applied to the footer element at present is shown below.

```
footer {
      background: gray;
      color: white;
      width: 100%;
      text-align: center;
}
```

Write the new CSS rules required to style both the header and the footer elements in the most efficient way. Your answer should include the use of grouping selectors. **2**

[Turn over

Question 12 (continued)

(b) The buttons on the home page change from "Read more" to "Click for more" when the mouse moves over them.

Part of the HTML code for the home page is shown below.

```
                    …
                  <h6>Training</h6>
                  <h3>Bikeability Scotland</h3>
                  <p>Our cycle training gives children the skills and
                     confidence they need to cycle safely on the
                     roads. </p>
                  <img src="readmore.png" width="212" height="41"
                       alt="READ MORE" onMouseOver="clickmore(this)">
               </div>
            </div>
      </main>
      <footer id="pagefooter">
         <a href="https://www.dropdesign.co.uk" target="_blank">
         <img src="dropdesign-logo.png" ></a>
         <span>Drop Design - Another Great Design</span>
      </footer>
   </body>
   <script>
            function clickmore(buttontext) {
                  buttontext.src = 'clickformore.png';
            }
   </script>
</html>
```

The button should change back to "Read more" when the mouse moves off the image.

(i) Write a new function to display the original image when the mouse is moved off the image. 2

(ii) Re-write the HTML element to call the function created in part (i) when the mouse is moved off the image. 2

[Turn over

Question 12 (continued)

(c) The following HTML is used in another part of the site.

```
<div class="important-text">
     <p>Tour de France 2020 route revealed</p>
     <div>
         <p>All the details about next year's race from the big
unveiling in Paris</p>
     </div>
</div>
```

The following CSS defines the rule for "important-text"

```
.important-text  p {
      background: red;
}
```

Explain why this CSS styles both paragraphs with a red background. 2

(d) The "Contact Us" page allows a message to be sent to the site owners via form. When using the form, a user submits this information.

- Name
- Date of birth
- Email Address
- Local Club (either Aberdeen, Dundee, Inverness or Glasgow)
- Message Content

4

Using this information, draw a wireframe design for the form

Question 12 (continued)

(e) The menu for the site makes use of the following CSS code.

```
Line
1   ul {
2     ____________________________________
3         margin: 0;
4         padding: 0;
5         overflow: hidden;
6         background-color: #333333;
7   }
8
9   li {
10    float: left;
11  }
12
13  li a {
14    display: block;
15    color: white;
16    text-align: center;
17    padding: 16px;
18    text-decoration: underline;
19  }
20
21  li a:hover {
22    background-color: ghostwhite;
23    color: slategrey;
24  }
```

(i) Write the CSS code which is missing from line 2. 2

(ii) Describe how the menu changes when the pointer is moved over one of the hyperlinks. 1

(iii) Explain the purpose of the line 14 of the CSS code. 1

[Turn over

13. Oxford Analysis is a data processing company with has stored the results of an assessment of happiness for every country in the world in a csv file. This data includes country name, unique happiness rank, score for freedom and score for healthy living.

An extract, is show below.

```
…
Norway,3,3,12
Iceland,4,7,13
Netherlands,5,19,18
…
```

There are 195 rows in the csv file. The values are to be read from the csv file and stored in a suitable record structure.

(a) The data from the file is to be read into an array of records.

(i) Using a programming language of your choice, define a suitable records structure. **3**

(ii) Using a programming language of your choice, declare a variable that can store the data for the 195 rows in the csv file. **2**

MARKS | DO NOT WRITE IN THIS MARGIN

13. (continued)

The following code is used to read the contents of the csv file.

```
Line
 1  DECLARE happinessData INITITALLY "happiness.csv"
 2  OPEN happinessData
 3  DECLARE happinessRow AS STRING INITIALLY FROM happinessData
 4  DECLARE happinessArray INITIALLY ["", "", "", ""]
 5
 6  WHILE NOT <end of file happinessData>
 7    SET startValue TO 1
 8    SET arrayPointer TO 1
 9    FOR character = 1 TO length(happinessRow)
10      IF happinessRow[character] = "," THEN
11           SET happinessArray[arrayPointer]
                                TO happinessRow[startValue, character-1)
12           SET startValue TO character + 1
13           SET arrayPointer TO arrayPointer + 1
14      END IF
15    END FOR
16    SET happinessArray[arrayPointer] TO happinessRow[startValue,
    character)
17
18    <use happinessArray to set record values>
19
20    RECEIVE happinessRow FROM happinessData
21
22  END WHILE
```

(b) (i) Explain the purpose of lines 1 to 3. **2**

(ii) Explain the purpose of lines 10 and 11. **2**

[Turn over

13. (continued)

(c) A file with the following values is used to test the program.

Scotland,6,45,23
Ireland,7,67,29
France,8,54,31

A watchpoint has been set which breaks the program at line 14 when `character` has a value of 11.

The variables in the table below are inspected.

Complete the table to show the values stored. **3**

Variable	Value
`arraypointer`	
`startValue`	
`happinessRow[character]`	

(d) A hacker group has carried out a denial of service attack on the Oxford Analysis servers using resource starvation.

Describe two ways that resource starvation may prevent a system from functioning correctly. **2**

13. (continued)

(e) A design is required for a function which will return the position of the lowest value for "healthy living".

Using a recognised design technique, create the design for this function. The function should make use of the data structure from (a)(ii). **5**

MARKS | DO NOT WRITE IN THIS MARGIN

14. A video publishing and sharing site is to be set up. The site will allow video creators to setup channels and publish videos to these channels. The site will record how many people like or dislike a video and how many people have watched each video. Creators will be able to see their total views per channel and for all the videos they create.

(a) State two functional requirements of the relational database. **2**

(b) An initial design for the tables in the database is shown below.

Creator	**Channel**	**Video**
creatorID	channelID	videoID
name	channelName	videoTitle
email	rating	likes
password	creatorID*	dislikes
location		views
		channelID*

Draw an entity relationship diagram (without attributes) to show the relationships that exist in the database. Your answer should show the entity names and cardinality. **2**

[Turn over

14. (continued)

(c) A query is designed which displays all the channels for creators in Scotland.

Query 1 – Channels in Scotland

Field(s) and calculation(s)	channelID, channelName, Creator.*
Table(s) and query	Creator, Channel
Search criteria	Location = "Scotland" AND Creator.creatorID = Channel.creatorID
Grouping	
Sort order	

(i) The answer table from Query 1 can be used in a second query to show the number of channels per creator, in Scotland, sorted from the largest to the smallest number of channels. **4**

Query 2 – Number of Channels in Scotland

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

(ii) Query 1 makes use of a wildcard (*). Describe the purpose of the wildcard operator in Query 1. **1**

(d) Describe what is meant by an "alias" in an SQL statement. **1**

[Turn over

14. (continued)

Some sample data from each of the tables is shown below.

Creator				
creatorID	**name**	**email**	**password**	**location**
203	Zoey Jones	zjay@my.com	z4bLKt9k5dk	Scotland
2316	Sam McKay	smck@live.com	GdR-iTH_f-I	Holland
9877	Amber Rose	ar@clo.org	Wjq7x2d_s1w	France

Channel			
channelID	**channelName**	**rating**	**creatorID**
995	Zoella	3.2	2316
424	Doom-tables	4	203
709	Tyler Williams	4.2	9877
977	CupcakeJemma	5	2316

Video					
videoID	**videoTitle**	**likes**	**dislikes**	**views**	**channelID**
510KQ_	Autumn Makeup	26917	1979	812516	995
A8Scwh	Trailers - Stranger Things	470	104	370638	709
ZwIuff	Corey Mom Talks to Dr. Oz	31892	197	691229	709
1cgK-B	Thank You for Everything	909	52	95085	995
vd4zwI	Live in the now!	24186	3330	214617	424
4FDpjK	Waking Up	258900	33231	541947	709
CR9zYg	Chocolate Orange Cupcakes	21859	7016	62866	977

(e) A report is created to show the channels with the total number of likes for all their videos.

Write the SQL statement to produce the output shown below. **3**

channelID	Total Likes
424	24186
709	291262
977	21859
995	27826

[Turn over

14. (continued)

(f) A report is created for the maximum views for a single video for each creator. The expected results are:

name	views
Sam McKay	812516
Amber Rose	691229
Zoey Jones	214617

The following SQL statement is executed.

```
SELECT name, AVG(views)
FROM Creator, Videos
WHERE Creator.creatorID = Channel.creatorID
AND Channel.channelID = Video.channelID
GROUP BY Video.videoID
```

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

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

Error 1 _____

_____

Error 2 _____

_____

Error 3 _____

_____

14. (continued)

(g) A new user called 'Paul Aman' with the email address 'pa@mymail.com' joins the site. Paul is from Wales and has a password of "mypassword". His creatorID will be 8775.

He is going to take over ownership of the channel "CupcakeJemma".

(i) Using SQL, write the two queries required to complete this task. **5**

SQL Statement 1

SQL Statement 2

(ii) A hacker is able to guess Paul's password and deletes all the videos on his channel. State the law that the hacker has broken and the offence that has been committed. **2**

The law _____

The offence _____

MARKS | DO NOT WRITE IN THIS MARGIN

15. A golf tournament uses a program to collect the players scores. The names of players and their scores are written into two separate 1-D arrays.

On day one there are 140 players. Any player who has a score which is more than the average score doesn't progress to the second day.

The program calculates the average score and then counts how many players will progress to day two. The average is the total of all scores divided by the number of scores.

(a) During the analysis stage boundaries are identified.

State two boundaries for this program. **2**

(b) Using a recognised design technique, create a solution to display the number of players who will take part in the second day of the tournament. **4**

[Turn over

15. (continued)

(c) When testing the program a dry run is used to resolve some errors.

Explain how a "dry run" is used to test a computer program. **2**

(d) Some code from another part of the program is shown below. This code is intended to find any player of the first 140, who has beaten the course record and display his or her details.

```
Line
204  SET coursecounter TO 0
205  SET counter TO 0
206  FOR EACH score IN scorearray DO
207     RECEIVE courserecord FROM <keyboard>
208     IF courserecord > score THEN
209        SEND "Course record by player with score of " & score
210        SET coursecounter = counter
211     END IF
212     SET counter TO counter + 1
213  END FOR
214  DISPLAY player[coursecounter] & " has course record."
```

An evaluation has been carried out and this code is not efficient. Describe two reasons why this code does not make efficient use of coding constructs. **2**

Reason 1 _____

Reason 2 _____

15. (continued)

(e) The players attending the tournament are driven to the golf course in cars which have management systems to reduce their impact on the environment.

Describe two features of car management systems and explain why each feature reduces the car's impact on the environment. **4**

[Turn over

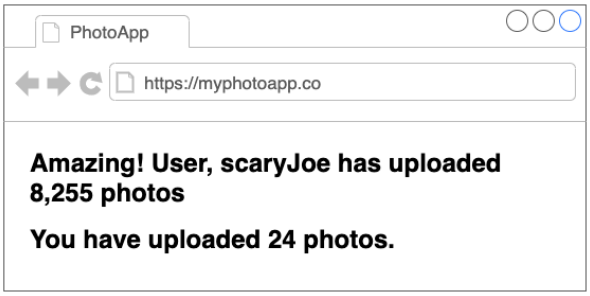
MARKS | DO NOT WRITE IN THIS MARGIN

16. Sally is creating a web site which will allow users to upload their photos from their mobile phones and share them with their friends. The users will need either their mobile phone number or a username to access the site. They will be challenged with a password to check it is them.

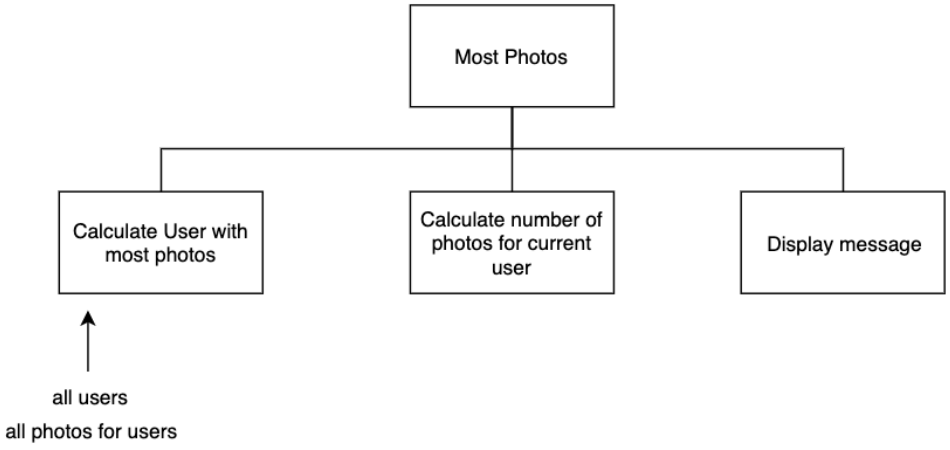
The site will allow users to upload photos and tag their friends in the photos using their friends' usernames. When a user is tagged in a photo, a message is sent to his or her phone with the link to the tagged image. Clicking on the link will display the image.

(a) From the information provided and the detail of inputs and outputs above, state the processes required to create the software for the web site. **2**

(b) A new feature is designed for the website which identifies the user with the most photos uploaded and then compares the uploads with the current logged in user. The results of this feature are shown below.



A structure diagram has been created for this new feature. Add the data flow for the sub-programs below. **4**



[Turn over

16. (continued)

(c) A database will be used to hold the data for web site. A partially complete data dictionary for this is shown below.

Entity: User				
Attribute	Key	Type	Size	Validation
Login	PK	Text	30	Unique Username
MobileNumber		Text	10	
Password		Text	30	

Entity: Photo				
Attribute	Key	Type	Size	Validation
PhotoID	PK	Number		Unique number
UploadedBy		Text	30	
UploadDate		Date		Valid Date

Entity: Tagged				
Attribute	Key	Type	Size	Validation
PhotoID	PK	Number		
Login	PK	Text	30	

(i) State the validation required for "UploadedBy". **1**

(ii) State the type of key used for the entity "Tagged". **1**

(d) The web server for the site is upgraded. The size of the data bus has been doubled.

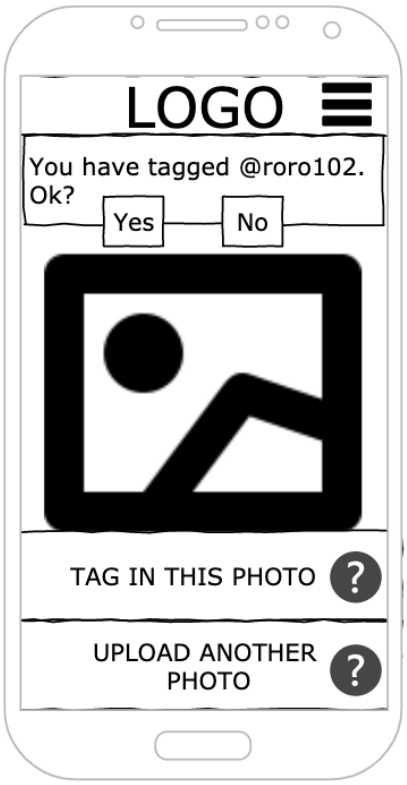
(i) Explain why increasing the width of the data bus will improve system performance. **2**

(ii) State one other factor that could account for the server performing better than previously. **1**

[Turn over

16. (continued)

(e) A design for the site on mobile devices is shown below.



Evaluate this design in terms of usability. **2**

MARKS | DO NOT WRITE IN THIS MARGIN

ADDITIONAL SPACE FOR ANSWERS

ADDITIONAL SPACE FOR ANSWERS

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ADDITIONAL SPACE FOR ANSWERS