FOR OFFICIAL USE

H

National
Qualifications
2023 MODIFIED

Mark

X816/76/01 Computing Science

THURSDAY, 25 MAY
12:30 PM – 2:30 PM

X816760 1

Fill in these boxes and read what is printed below.

Full name of centre

Town

Forename(s)

Surname

Number of seat

Date of birth
Day Month Year

Scottish candidate number

Total marks — 80

SECTION 1 — Software design and development, and Computer 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.
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 the marks for this paper.

SQA ©

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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 1111 0000 into denary. **1**

2. A software development project can be progressed using an agile methodology or an iterative development process.

Describe two advantages of the agile methodology when compared to iterative. **2**

Advantage 1 _____

_____

_____

_____

Advantage 2 _____

_____

_____

_____

MARKS | DO NOT WRITE IN THIS MARGIN

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

−0.0000 0101 0000 1111

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

Space for working

sign	mantissa	exponent

(b) State the effect of increasing the number of bits allocated to the mantissa. **1**

4. State the purpose of the public key in the secure transmission of data. **1**

[Turn over

MARKS | DO NOT WRITE IN THIS MARGIN

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

1.	
2.	The processor activates the read line on the control bus.
3.	
4.	The instruction in the instruction register is then interpreted by the decoder and carried out.

(b) State one factor that can improve the performance of the fetch-execute cycle and explain why it improves performance. **2**

Factor _____

Explanation _____

_____

_____

6. An employee has acquired their manager's login details without permission. The employee uses the details to increase their monthly sales bonus.

State two ways in which the Computer Misuse Act has been breached. **2**

_____

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MARKS | DO NOT WRITE IN THIS MARGIN

7. A word is a palindrome if it reads the same backwards as forwards, for example:

mum, noon, madam, kayak, racecar

A program identifies if a word is a palindrome by checking if the first and last characters are the same. If they are, it then checks the second and second last characters and so on.

The incomplete program is shown below.

```
Line 1  FUNCTION checkPalindrome(STRING word) RETURNS BOOLEAN
Line 2    DECLARE left INITIALLY 0
Line 3    DECLARE right INITIALLY length(word)- 1
Line 4    DECLARE validPalin INITIALLY TRUE
Line 5    WHILE left < right AND ____________________________ DO
Line 6      IF word[left] = word[right] THEN
Line 7        SET left TO left + 1
Line 8        SET right TO right - 1
Line 9      ELSE
Line 10       SET validPalin TO FALSE
Line 11     END IF
Line 12   END WHILE
Line 13   RETURN validPalin
Line 14 END FUNCTION
...
Line 25 RECEIVE userWord FROM KEYBOARD
Line 26 ____________________________________________________________
Line 27 IF palindrome = TRUE THEN
Line 28   SEND userWord & " is a palindrome" TO DISPLAY
Line 29 ELSE
Line 30   SEND userWord & " is not a palindrome" TO DISPLAY
Line 31 END IF
```

(a) Using a programming language of your choice, complete Line 5 below. **1**

```
WHILE left < right AND ____________________________________
```

(b) Using a programming language of your choice, write the missing code at Line 26 to call the function. **2**

[Turn over

DO NOT WRITE IN THIS MARGIN

8. A number matching game stores four winning numbers and compares them to a player's input of four numbers. 250 points are awarded for each number matched. For example, two matched numbers would be awarded 500 points.

The code below contains an error, as the player is always awarded 1000 points.

```
…
Line 10   DECLARE winningNos INITIALLY [10, 14, 21, 33]
Line 11   DECLARE numMatches INITIALLY 0
Line 12   DECLARE points INITIALLY 0
Line 13   RECEIVE no1 FROM KEYBOARD
Line 14   RECEIVE no2 FROM KEYBOARD
Line 15   RECEIVE no3 FROM KEYBOARD
Line 16   RECEIVE no4 FROM KEYBOARD
Line 17   FOR index FROM 0 TO 3 DO
Line 18     IF no1 = winningNos[index] THEN
Line 19       SET numMatches TO numMatches + 1
Line 20     ELSE IF no2 = winningNos[index] THEN
Line 21       SET numMatches TO numMatches + 1
Line 22     ELSE IF no3 = winningNos[index] THEN
Line 23       SET numMatches TO numMatches + 1
Line 24     ELSE
Line 25       SET numMatches TO numMatches + 1
Line 26     END IF
Line 27   END FOR
Line 28   SET points TO 250 * numMatches
Line 29   SEND "You matched "& numMatches & " numbers and have
          won " & points TO DISPLAY
…
```

MARKS | DO NOT WRITE IN THIS MARGIN

8. (continued)

(a) A breakpoint is set at Line 26 and the program is tested using the following four player numbers as input:

no1	no2	no3	no4
5	10	15	22

Complete the trace table to show the values stored when the breakpoint is activated on the first two iterations of the loop. **2**

Breakpoint	Variable	Value
1st iteration	`index`	0
	`winningNos[index]`	
	`numMatches`	
2nd iteration	`index`	1
	`winningNos[index]`	
	`numMatches`	

(b) Explain, with reference to the code, why the number of matches always results in 4. **1**

_____

_____

_____

_____

[Turn over

DO NOT WRITE IN THIS MARGIN

9. A software developer is creating a program for a dog grooming company that has branches in Dundee, Edinburgh, Glasgow and Stirling. The following data is stored about each dog:

- dog ID
- name of the dog
- branch the dog attends
- number of visits to the branch.

One feature of the program is to offer a discount to customers that have visited the Dundee or the Stirling branch more than four times.

The data shown below is stored in four parallel 1D arrays to test this feature.

dogID	dogName	branch	noOfVisits
G123	Rover	Glasgow	7
A872	Roman	Stirling	2
D321	Keeva	Dundee	6
G876	Bailey	Edinburgh	6
A423	Jack	Stirling	5
D872	Ozzy	Dundee	2

The code below was created to display the dogID for those customers that are to be offered a discount.

```
Line 1    PROCEDURE customerSearch (ARRAY OF STRING petNo,
          ARRAY OF STRING city, ARRAY OF INTEGER visits)
Line 2    FOR i FROM 0 TO length(petNo)-1 DO
Line 3      IF city[i]= "Stirling" OR
            (city[i]= "Dundee" AND visits[i] > 4) THEN
Line 4          SEND petNo[i] TO DISPLAY
Line 5        END IF
Line 6      END FOR
Line 7    END PROCEDURE
…
Line 20   DECLARE dogID INITIALLY ["G123", "A872","D321",
            "G876","A423","D872"]
Line 21   DECLARE dogName INITIALLY ["Rover","Roman","Keeva",
            "Bailey","Jack","Ozzy"]
Line 22   DECLARE branch INITIALLY ["Glasgow","Stirling",
            "Dundee","Edinburgh","Stirling","Dundee"]
Line 23   DECLARE noOfVisits INITIALLY [7,2,6,6,5,2]
Line 24   customerSearch(dogID, branch, noOfVisits)
```

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MARKS | DO NOT WRITE IN THIS MARGIN

9. (continued)

(a) During testing it is found that, due to an issue with Line 3, this code is not fit for purpose.

(i) Using the test data shown, state the output. **2**

(ii) Re-write Line 3 of the code to make this code fit for purpose. **1**

(b) Formal and actual parameters are used in this code.

Identify one formal parameter and its associated actual parameter. **2**

Formal parameter _____

Actual parameter _____

(c) Describe the operation of Line 24 during the execution of this program.

```
customerSearch(dogID, branch, noOfVisits)
```

2

_____

_____

_____

(d) The program makes use of local variables.

(i) Identify a local variable in the code. **1**

_____

(ii) Describe the scope of this local variable. **1**

_____

_____

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MARKS | DO NOT WRITE IN THIS MARGIN

9. (d) (continued)

(iii) Explain why using local variables increases the maintainability of program code. **1**

(e) The area manager wants to know how many dogs have made more than five visits to a particular branch.

Using a programming language of your choice, the arrays `branch` and `noOfVisits`, write the code to ask the user for the branch name and to display how many dogs have made more than five visits to this branch. **4**

MARKS | DO NOT WRITE IN THIS MARGIN

10. A check digit is the number at the end of a series of characters that can confirm that something is correct.

A program is to be written to add a check digit to a user's password. The password is input and then the program totals the ASCII values of all the characters, divides the total by 11 and calculates the remainder. This remainder is then attached to the original password as a check digit. For example, for the password 'Fox':

Character	**ASCII Value**
F	70
o	111
x	120
Total	301
	301/11 = 27 remainder 4

The updated password is 'Fox4'.

(a) State one boundary for this program. **1**

(b) Using a recognised design technique, design an algorithm that would create the updated password and store it in a file. **5**

MARKS | DO NOT WRITE IN THIS MARGIN

10. (continued)

(c) When implemented, the program will be modular.

Describe two benefits of implementing modular code. **2**

_____

_____

_____

_____

MARKS | DO NOT WRITE IN THIS MARGIN

11. A shop sells a range of 80 different washing machines. Sample data about the washing machines is shown below:

Brand	RefNo	Maximum wash load (kg)	Spin speed (rpm)	Price (£)	Number in stock
Doolton	D120	11	1400	389.99	34
Hisky	H873	10	1400	289.99	42
Aarch	A423	10	1500	279.00	3
Doolton	D232	12	1500	279.29	22
Aarch	A189	12	1600	349.99	12
Doolton	D387	10	1500	299.00	36
...	...	...	...	...	...

A program is designed to help customers decide which washing machine to buy.

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

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

(ii) Using a programming language of your choice, declare the variable called `machines` which can store the details of the 80 washing machines. Your answer should use the record data structure created in part (i). **2**

MARKS | DO NOT WRITE IN THIS MARGIN

11. (continued)

(b) Customers often ask questions about the washing machines.

For example:

'How much is the cheapest washing machine that can do a wash load of 11 kg or more and a spin speed of 1500 rpm or more?'

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

1. Read data from text file into data structure.
2. Ask user to enter the smallest wash load and the slowest spin speed required.
3. Find the price of the cheapest washing machine(s) if there is one that meets the entered criteria.
4. Display the price of the cheapest washing machine(s) that meets the entered criteria or a message stating 'No washing machine meets the criteria'.

Complete the table below to show the missing data flow for steps 3 and 4. **2**

Step	IN/OUT	Data flow
1	IN	
	OUT	machines()
2	IN	
	OUT	smallestWash, slowestSpin
3	IN	
	OUT	cheapestPrice, found
4	IN	
	OUT	

MARKS | DO NOT WRITE IN THIS MARGIN

11. (continued)

(c) Step 3 finds the price of the cheapest washing machine(s) that meets the entered criteria. If there is not a washing machine that meets the criteria then `found` is set to `false`.

Using a programming language of your choice, write the code for step 3. Your answer should use the data structure created in part (a). **7**

[END OF SECTION 1]

[Turn over

MARKS | DO NOT WRITE IN THIS MARGIN

SECTION 2 — DATABASE DESIGN AND DEVELOPMENT — 25 marks

Attempt ALL questions

12. A dog walking company uses a relational database to store details about the dogs that they take on walks.

Customer	Dog	Walk	Staff
<u>custID</u>	<u>dogID</u>	<u>walkID</u>	<u>walkerID</u>
forename	name	route	forename
surname	breed	dogID*	surname
address	age	walkerID*	mobileNo
mobileNo	custID*	date	

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**

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MARKS | DO NOT WRITE IN THIS MARGIN

13. A database table is shown below.

Car					
carID	**model**	**year**	**type**	**price**	**doors**
FF102	Fierra	2016	Hatchback	12600	5
FF105	Fierra	2018	Hatchback	16100	3
FF165	Fierra	2019	Hatchback	15100	3
CL202	CLC200	2019	Estate	13400	5
CL209	CLC300	2017	Estate	19500	5
GU303	Gulf	2015	Saloon	16500	5
DU405	Duke	2017	Saloon	23000	3
PH283	Phoenix	2017	Hybrid	15300	3
FR302	FirCross	2019	Hybrid	18200	3

Complete the table below showing the expected output from the following SQL statement. **2**

```
SELECT type, MIN(price) as 'Cheapest Price'
FROM Car
WHERE year >= 2018
GROUP BY type;
```

type	Cheapest Price

[Turn over

DO NOT WRITE IN THIS MARGIN

14. A takeaway restaurant is implementing an online ordering system and is using a relational database to store details about the dishes, customers and orders.

The restaurant can view order details. Customers are able to place and edit orders. The four tables used in the database are shown below.

Customer					
custID	**forename**	**surname**	**address**	**telephone**	**postcode**
41	Henry	Taylor	95 Whitehouse St	01224 931167	AB25 1SL
42	Anna	Smith	84 Fraser Ave	01224 474845	AB16 5LL
43	Jane	Robin	80 Maxwell St	01224 325715	AB12 5XN
...	...	...	...	...	...

CustOrder		
orderID	**custID**	**orderDate**
ORD1	41	15/05/2023
ORD2	42	15/05/2023
ORD3	41	16/05/2023
...	...	...

OrderItem		
orderID	**dishID**	**quantity**
ORD1	DISH01	2
ORD1	DISH05	3
ORD1	DISH04	3
ORD1	DISH06	1
ORD2	DISH02	2
ORD2	DISH04	2
ORD3	DISH03	7
ORD3	DISH04	6
...	...	...

Dish			
dishID	**description**	**course**	**price**
DISH01	Pepper and egg sushi	Starter	6.99
DISH02	Poppy and rosemary salad	Main	4.99
DISH03	Ice cream	Dessert	3.99
DISH04	Cappuccino	Drink	3.99
DISH05	Chicken fajita	Main	8.99
DISH06	One pan chicken	Main	9.99
DISH07	Chilli chicken wings	Starter	4.99
...	...	...	...

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MARKS | DO NOT WRITE IN THIS MARGIN

14. (continued)

(a) Design a query to display the number of orders that the customer with custID 41 made in May 2023. **2**

Field(s) and Calculation(s)	
Tables(s)	
Search Criteria	
Grouping	
Sort Order	

(b) The takeaway restaurant would like to offer a discount for all customers who order a main dish.

Complete the design of a query to display the full name and telephone number of every customer who has ordered a main dish. **2**

Field(s) and Calculation(s)	
Tables(s)	
Search Criteria	course = 'Main'
Grouping	
Sort Order	

[Turn over

MARKS | DO NOT WRITE IN THIS MARGIN

14. (continued)

(c) The manager wants to increase the price of main dishes that contain chicken by £2.00.

Write the SQL statement that would implement this. **3**

(d) The restaurant wants a query to calculate the total cost of each order. The expected output is shown below.

orderID	orderDate	Total Value
ORD1	15/05/2023	62.91
ORD2	15/05/2023	17.96
ORD3	16/05/2023	51.87

The following SQL statement is executed but the actual output does not match the expected output.

```
SELECT CustOrder.orderID, orderDate, (price * quantity) AS
'Total Value'
FROM CustOrder, OrderItem, Dish
WHERE CustOrder.orderID = OrderItem.orderID
ORDER BY orderID ASC;
```

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

Error 1 _____

_____

Error 2 _____

_____

Error 3 _____

_____

DO NOT WRITE IN THIS MARGIN

15. The Caledonian Drone Racing League stores the results of their first season's competitions in a relational database. Pilots' times for each race are recorded in seconds.

The relational database uses the following three tables.

Pilot	Race	Entry
pilotID forename surname	raceID title city	raceID* pilotID* position raceTime

Sample data from the three tables is shown below.

Pilot		
pilotID	**forename**	**surname**
P001	Matthew	Thomas
P002	Ann	Wilson
P003	Joseph	Dow
P004	Sam	Friar
...	...	...

Race		
raceID	**title**	**city**
1	Granite Range	Aberdeen
2	Clyde Maze	Glasgow
3	Factory Frenzy	Ayr

Entry			
raceID	**pilotID**	**position**	**raceTime**
1	P001	2	92.4
1	P002	3	96.5
1	P003	1	86.8
1	P004	4	98.5
1	P005	5	98.9
...	...	...	...
2	P001	4	120.5
2	P003	2	109.7
2	P002	1	101.5
2	P004	3	115.5
2	P006	5	121.0
...	...	...	...
3	P001	3	109.8
3	P002	2	109.6
3	P003	1	106.9
3	P004	4	145.2
...	...	...	...

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MARKS | DO NOT WRITE IN THIS MARGIN

15. (continued)

Pilots win £150 for first place. The league would like to produce a list of the names and total amount of winnings for those pilots that have come in first place.

The expected output is shown below.

pilotID	forename	surname	Winnings
P002	Ann	Wilson	150
P003	Joseph	Dow	300

(a) Design a query to display the output above. **3**

Field(s) and Calculation(s)	
Tables(s)	
Search Criteria	
Grouping	
Sort Order	

(b) Write an SQL statement to display the title of each race and the average time for that race.

The expected output is shown below. **3**

title	Average Time
Clyde Maze	114.27
Factory Frenzy	116.67
Granite Range	103.22

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MARKS | DO NOT WRITE IN THIS MARGIN

15. (continued)

(c) A query was created to display the fastest time in any race. This query was saved as 'Fastest' and the output of it is shown below.

FastestTime
86.8

Using the 'Fastest' query, complete the SQL statement below to display the name of the pilot(s) who achieved this time. **3**

```
SELECT forename,surname
```

(d) The first season was such a success they are running a second season using the same races.

The pilot who won the first race of the second season in Aberdeen won the same race in the first season. When the organisers try to add this new record they found the database was not fit for purpose.

Explain why this record could not be added to the `Entry` table. **1**

_____

_____

_____

_____

[END OF SECTION 2]

[Turn over

MARKS | DO NOT WRITE IN THIS MARGIN

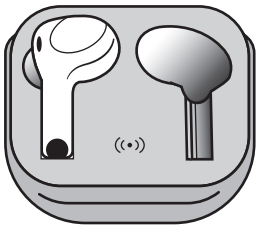
SECTION 3 — WEB DESIGN AND DEVELOPMENT — 25 marks

Attempt ALL questions

16. A feature is to be added to an online shopping website that allows the user to click on the image of a product to see a different, larger, image of the same product.

An example of the intended effect is shown below.

before click



earBuds1.jpg

after click

earBuds2.jpg

The code used to implement this feature is shown below.

JavaScript Code

```
function changePic() {
  document.getElementById("budPic").style.height="200px";
  document.getElementById("budPic").style.width="200px";
}
```

CSS Code

```
#budPic {height: 100px; width; 100px;}
```

HTML Code

```
<p> Click on the image below to see it in more detail. </p>
<img src="earBuds1.jpg" id="budPic">
```

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

_____

_____

_____

_____

_____

_____

X816760124

MARKS | DO NOT WRITE IN THIS MARGIN

17. A new video sharing website is being developed. This site should allow users to upload new videos to the site, watch uploaded videos and comment on them. Users should sign into the site using a username and password.

Once signed in, users should be able to navigate to one of three pages — a profile page, a videos page and a settings page.

From the profile page, users should be able to navigate to a page where they can upload videos and read comments left by other users, a page where they can edit their profile and a page where they can edit the details of previously uploaded videos.

From the videos page, users should be able to view a page with the top ten trending videos and view a page showing the videos that they have watched most recently.

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

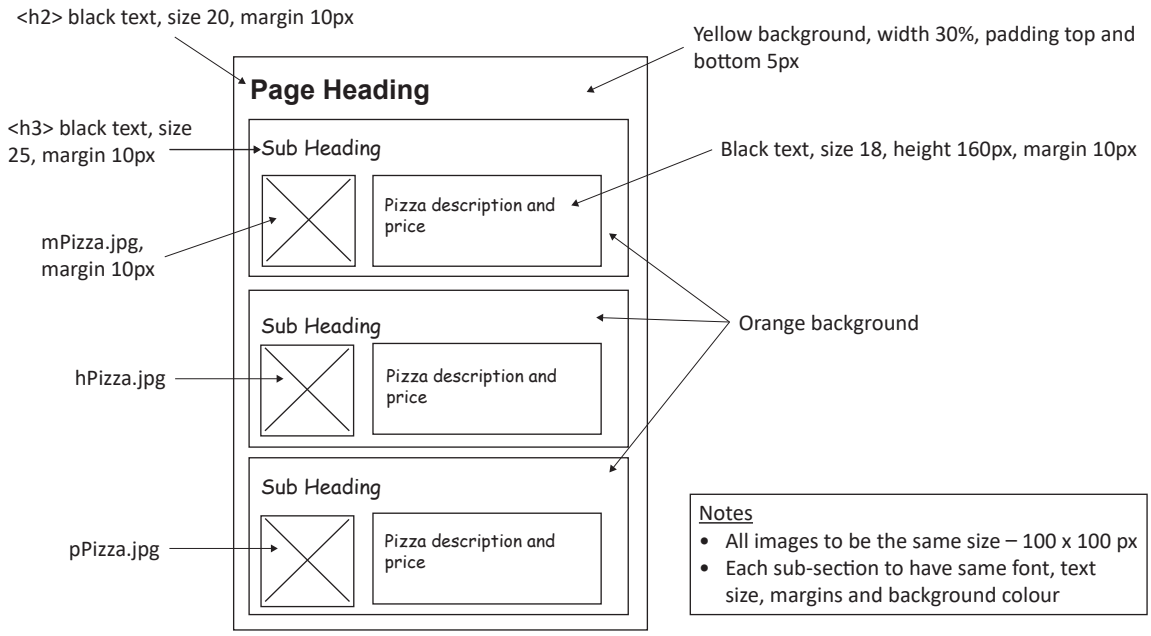
(b) Draw the navigational structure of this website. **2**

[Turn over

MARKS | DO NOT WRITE IN THIS MARGIN

18. A pizza restaurant is redesigning their website and want to display information about the three most popular pizzas — Margherita, Hawaiian and Pepperoni.

Part of the wireframe design is shown below.



(a) Write a single CSS rule to apply the correct margins to all the h2, h3 and image elements on the web page. **2**

(b) Complete the CSS rule below to correctly position the images to allow the pizza information and price to appear in the correct position. **1**

```
img{height: 100px; width: 100px; ______________________}
```

18. (continued)

MARKS | DO NOT WRITE IN THIS MARGIN

(c) To add interactivity to this page the restaurant would like the information about each pizza to only appear to the user when they place their cursor over the image of the pizza.

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

```
…
<section id="menu">
 <h2> Pizza Choices </h2>
 <div id="margherita">
  <h3> Margherita </h3>
  <_____________________________________>
  <div id="margInfo">
   <p> Classic cheese and tomato </p>
   <p> £7.99 </p>
  </div>
 </div>
 …
</section>
…
```

(i) Write the CSS rule needed to initially hide the description and price of the Margherita pizza. **2**

(ii) Complete the missing JavaScript code to allow the information to be displayed on the screen. **1**

```
function displayMText(){
  document.getElementById("margInfo").style.display =

  "_____________________________________";}
```

(iii) Write the missing line of the HTML code shown above to apply the JavaScript function from part (ii) to the image 'mPizza.jpg' when the user places their cursor over the image. **2**

[Turn over

MARKS | DO NOT WRITE IN THIS MARGIN

18. (continued)

(d) A page on the website allows users to leave a review of the restaurant using an online form. A design for part of this form is shown below.

Please leave your comment below. If you would like the comment to remain anonymous then please leave the name blank.

Name: John Smith

Comment*: I really enjoyed my pizza – it tasted great! I would definitely recommend this place to my friends.

(i) Write the line of HTML code needed for the form element that would allow the user to type their name. **1**

(ii) Write the line of HTML code needed for the form element that would allow the user to type their comment. **2**

MARKS | DO NOT WRITE IN THIS MARGIN

19. A new website is being designed to help teenagers and young adults apply for online learning courses.

One of the pages of the website should allow users to enter all of the following details:

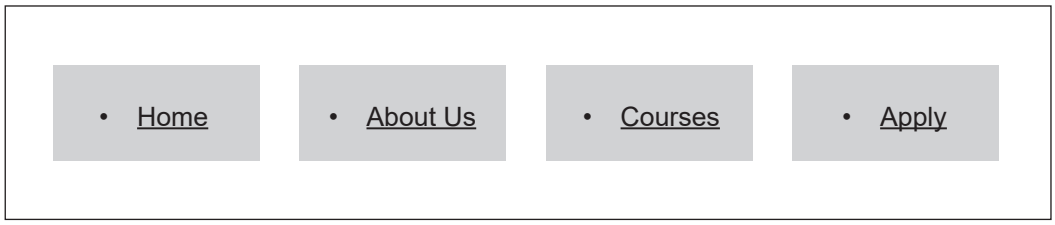
- full name
- email address
- date of birth
- recent work experience
- most recent type of education — school or college or university.

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

[Turn over

19. (continued)

(b) A low-fidelity prototype for the website's navigation bar is shown below.



Some of the CSS code used to implement the navigation bar is shown below.

```
…
li {
  list-style-type: none;
  background-color: grey;
  float: left;
  color: black;
}

li a {
  display: block;
  color: grey;
  text-align: center;
  padding: 14px 16px;
}

li a:hover {
  color: white;
}
…
```

During testing, it was found that the code for the navigation bar did not produce the expected output.

(i) State two reasons why the navigation bar did not display as intended. **2**

_____

_____

_____

_____

_____

_____

19. (b) (continued) MARKS | DO NOT WRITE IN THIS MARGIN

(ii) Both of the CSS rules below are used to style the web page.

CSS Rule 1	CSS Rule 2

`li a:hover {`
`  color: white;`
`}`
	`a:hover {`
	`  color: yellow;`
	`}`

Explain the difference between these two CSS rules. **2**

(c) Compatibility testing is then carried out on the completed website. During compatibility testing a number of comments were made.

Example comment 1	Example comment 2
The layout of the pages was not as I had expected. I had to scroll a long way to reach the bottom of the page.	*Some of the expected styling did not appear on the pages when I viewed them.*

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

[END OF SECTION 3]

[END OF QUESTION PAPER]

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