H

National Qualifications 2019

Mark

X816/76/01

Computing Science

WEDNESDAY, 22 MAY
9:00 AM – 11:30 AM

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 — 110

SECTION 1 — 25 marks

Attempt ALL questions.

SECTION 2 — 85 marks

Attempt ALL questions.

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

A/PB

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

   1001 1010   **1**

2. A string variable called `month` has been assigned the value 'April' and another string variable called `year` has been assigned the value '2019' as shown below.

   Line 1   `DECLARE month INITIALLY "April"`
   Line 2   `DECLARE year INITIALLY "2019"`
   Line 3   _____

   The variable `shortDate` is to be assigned the value 'Apr19' using substring operations.

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

3. An instruction to be executed is in memory address 3412.

   Complete the missing steps of the fetch-execute cycle shown below.   **2**

   Step 1   The processor sets up the address bus with the address 3412.

   Step 2   _____

               _____

               _____

   Step 3   _____

               _____

               _____

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

4. The decimal number 6.125 converted to binary is 110.001.

Convert 110.001 to floating-point representation. 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. Describe the role of the client when developing software using agile methodologies. **2**

_____

_____

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_____

[Turn over

6. A database table is shown below.

Dishes			
dishName	**course**	**price**	**portions**
Chicken wings	Starter	8.99	2
Baked haddock	Main	15.99	1
Soup of the day	Starter	2.50	1
Paté	Starter	2.99	2
Brownies to share	Dessert	8.99	2
Panacotta	Dessert	6.00	1
Mushroom risotto	Main	9.99	1
Chicken curry	Main	12.99	1
Mixed platter	Starter	14.99	4

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

```
SELECT course, MIN(price) AS 'least expensive item'
FROM Dishes
WHERE portions >=2
GROUP BY course;
```

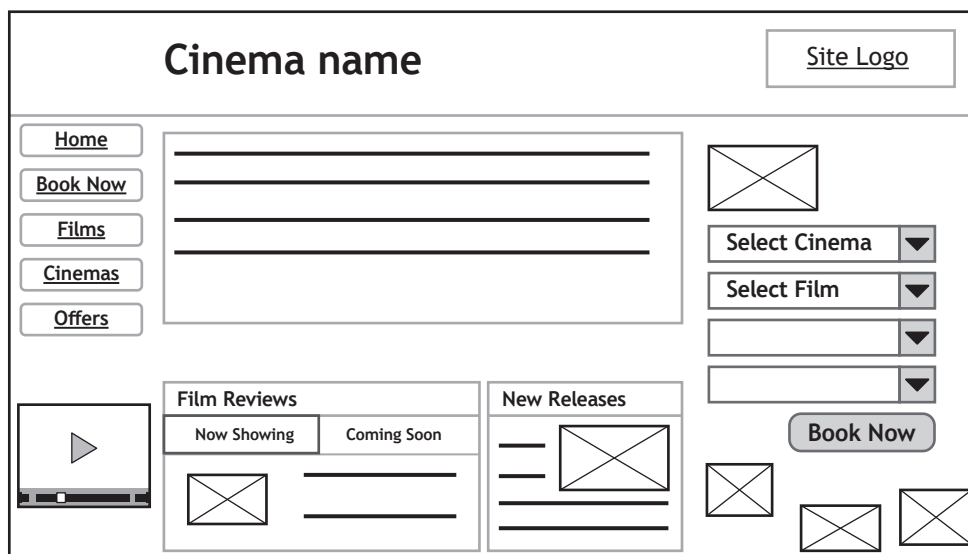| course	least expensive item

7. A compound key is an example of a primary key.

Describe what is meant by a compound key in a relational database.

_____

_____

_____

8. A cinema is adding an online booking system to their website.

The wireframe design below has been created for the new home page.

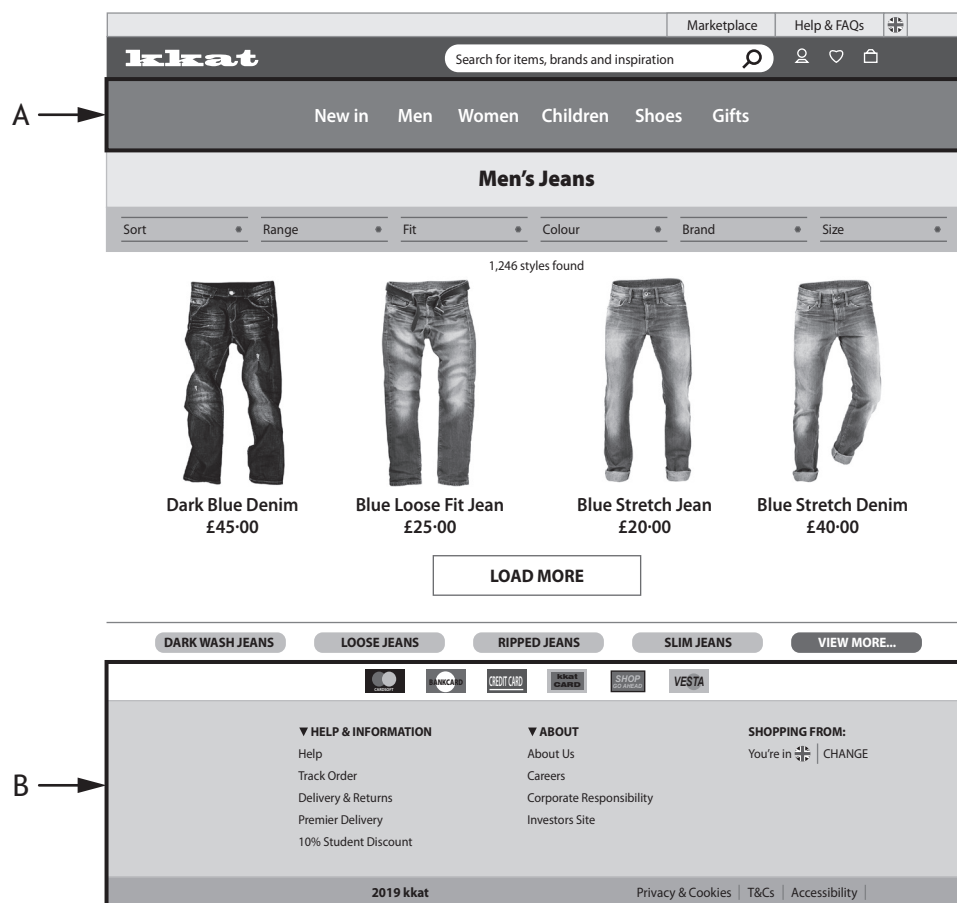(a) State two reasons why this is not an effective user-interface design. **2**

_____

_____

_____

_____

(b) A low-fidelity prototype has been created for the home page.

Describe how this is used when performing usability testing. **2**

_____

_____

_____

_____

_____

9. HTML 5 elements have been used to define different parts of a web page shown below.

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

A _____

B _____

10. A shop has a unique product code for each item it sells, for example X756.

The linear search algorithm shown below is used to find the position of a product code in an array.

```
Line 1    FUNCTION linearSearch (ARRAY OF STRING list)
          RETURNS INTEGER
Line 2      DECLARE position INITIALLY 0
Line 3      DECLARE target INITIALLY ""
Line 4      SEND "Enter target value" TO DISPLAY
Line 5      RECEIVE target FROM KEYBOARD
Line 6      FOR index FROM 0 TO length(list)-1 DO
Line 7        IF target=list[index] THEN
Line 8          SET position TO index
Line 9        END IF
Line 10     END FOR
Line 11     RETURN position
Line 12   END FUNCTION
```

The array of unique product codes is shown below.

C232	T546	X756	W482	B629	....

(a) State the value that will be returned by the function if `target` is X756.　**1**

(b) This linear search algorithm is inefficient.

Describe how the algorithm could be made more efficient.　**2**

(c) The product code 'F333' is entered. It is not in the array.

  (i) State the value returned by the function.　**1**

  (ii) State the type of error. Explain your answer.　**2**

Error _____

Explanation _____

11. A car manufacturer includes an event data recorder in their cars. This device begins recording when the car's sensors detect a sudden change in speed. The data captured can be analysed when required. A sample of data is shown below.

Event data	Sample
speed (mph)	58.2
accelerator (%)	42
brake (%)	0
seatbelt on	True

When triggered by a sensor this data is sampled 10 times per second for 20 seconds.

Software is to be developed that can analyse the data captured from a car's event data recorder.

(a) During the analysis stage boundaries are identified.

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

(b) (i) Using a programming language of your choice, define a suitable record data structure for the data above. **2**
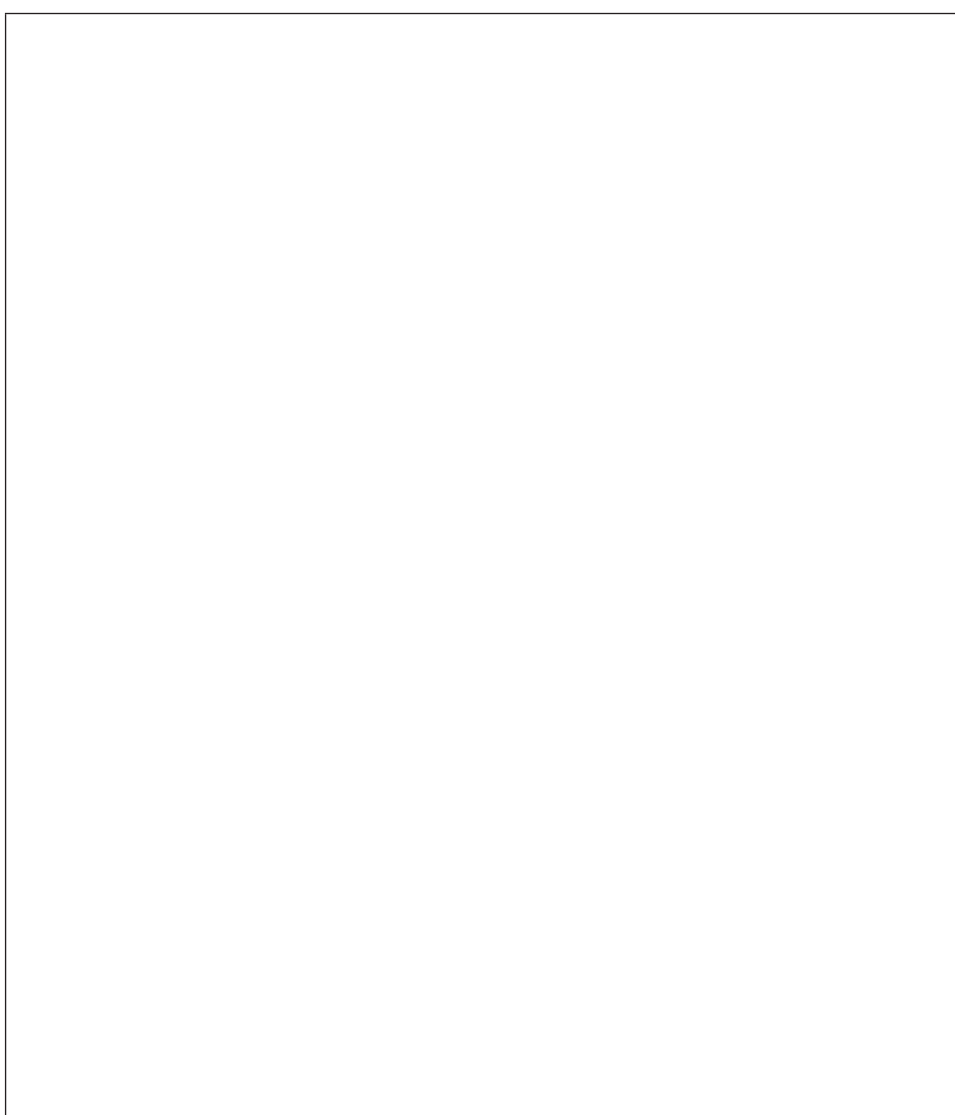
11. (b) (continued)

(ii) Using a programming language of your choice, define the variable which can store the details of the 200 readings. Your answer should use the record data structure created in part (i).

2

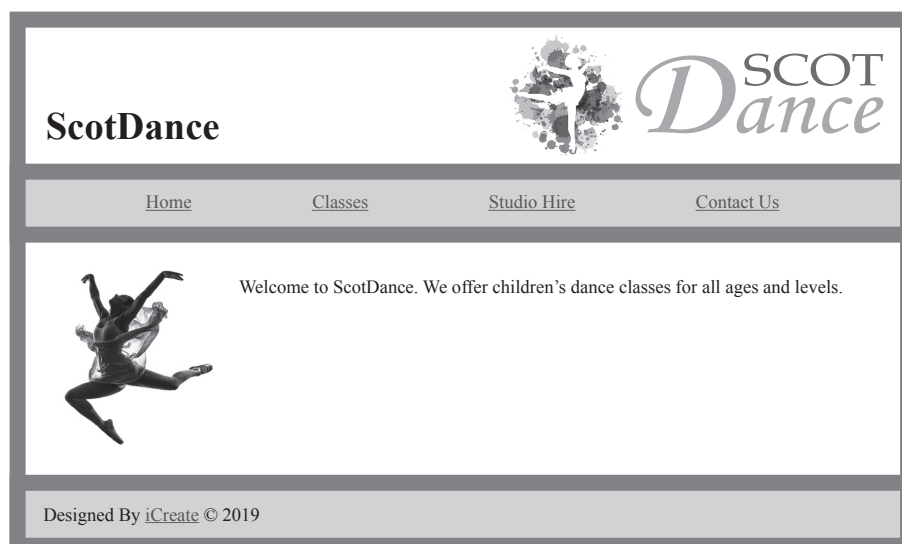(c) Using a recognised design technique, design an algorithm to find the maximum speed.

4

[Turn over

12. ScotDance is a dance school which provides classes for children. A website is being created to display information about the dance school and to allow people to contact them, book classes or hire the studio.

The home page is shown below.

(a) The main element of the home page is to have the same CSS styles applied to it as the header element with the exception of the CSS rule to set the height. The height rule should only be applied to the header element.

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

```
header {
   background-color:white;
   margin-top:20px;
   margin-bottom:20px;
   height:90px;
   }
```

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

2

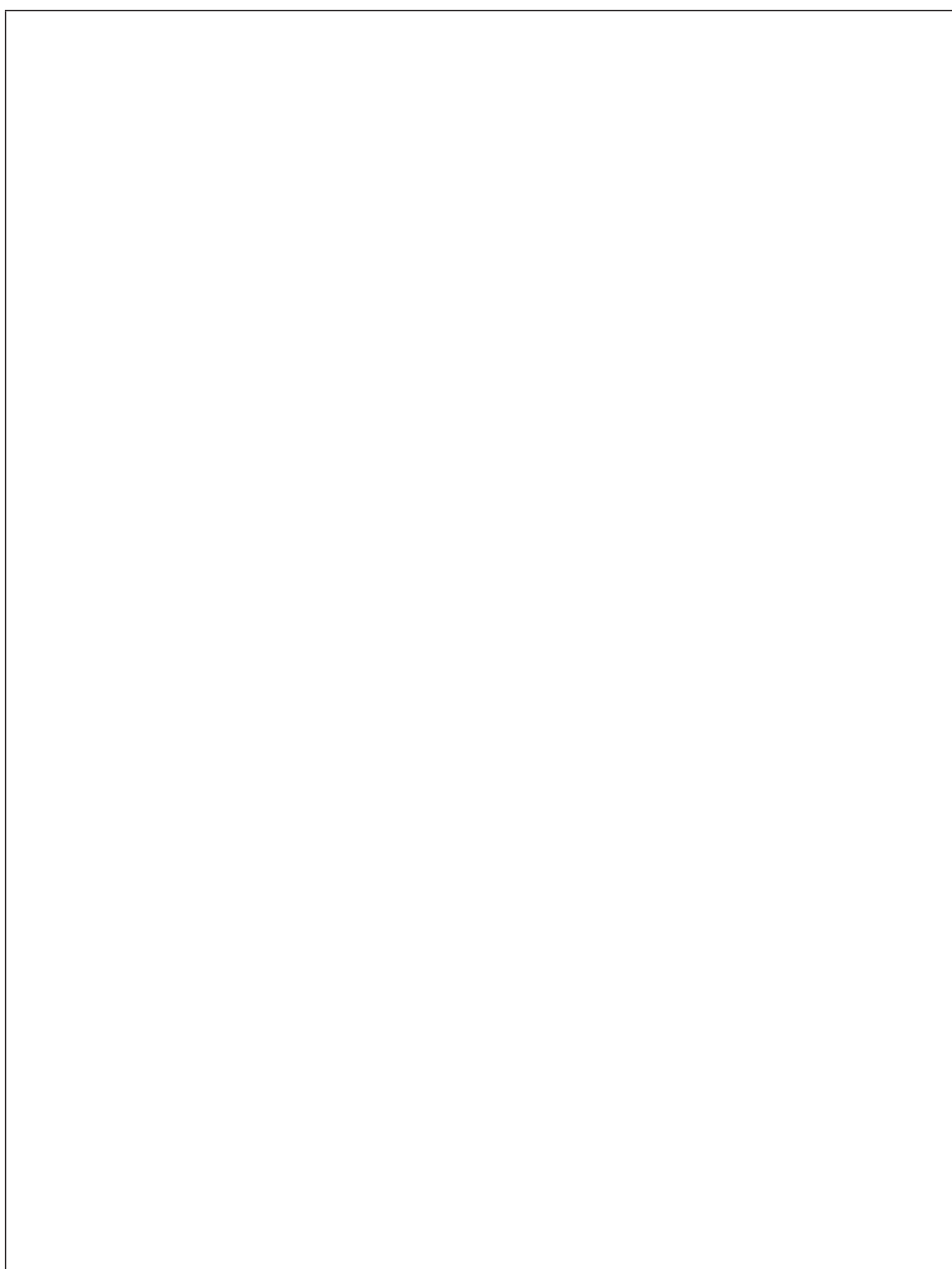**12. (continued)**

(b) The Studio Hire web page should include a form for online booking. When using the form, customers will need to submit the following information.

- Name

- Mobile number

- Date required

- Session (morning, afternoon or evening)

- Additional information (max 400 characters)

Using this information, draw a wireframe design for the form on the Studio Hire web page.

4

12. (continued)

A form on the Contact Us web page is created using the HTML code shown below.

```
<form>
Name:
<input type="text" name="name" size="40" required><br><br>

Email Address:
<input type="text" name="email" size="45" maxlength="5"
required><br><br>

Age of Child:
<input type="radio" name="age" value="<=5" > 5 and under
<input type="radio" name="age" value="6-10"> 6 - 10
<input type="radio" name="age" value="11-14"> 11 - 14
<input type="radio" name="age" value="15+" > 15+
<br><br>

Class Interested In:
<select name="choiceOfClass">
<option value="ballet">Ballet</option>
<option value="modern">Modern</option>
<option value="tap">Tap</option>
</select><br><br>

Further comments:<br>
<textarea name="comment" rows="5" cols="62"
maxlength="500">
</textarea><br><br>

How many days per week do you want your child to train?
<input type="number" name="days"><br><br>

<input type="submit" onclick="alert('Form Entered')"
value="Submit"><br><br>
</form>
```

(c) State the type of validation used when inputting the 'Name'.   **1**

12. (continued)

(d) It is important that the website is fully tested and evaluated. Testing should include checking that all input validation works correctly. When testing the form, two errors are found.

(i) When entering the number of days per week for training, a user can enter any number.

Re-write the code so that the number of days entered is restricted to between 1 and 7 inclusive. **1**

(ii) There is also an error on the email field.

State the change required to the HTML code to ensure that most email addresses can be entered on the form. **1**

_____

_____

(e) A dropdown list is used to enter the choice of class.

Describe two reasons for using a dropdown list rather than radio buttons on a form. **2**

_____

_____

_____

_____

(f) Compatibility testing should also be carried out on the website.

State one problem that may be identified when testing compatibility. **1**

_____

_____

13. A charity called Animal Help has a website that allows people to raise funds through sponsorship.

Details entered are stored in a relational database.

Fundraisers can see their total donations from all of their sponsors and Animal Help can view the funds being raised on their behalf.

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

_____

_____

_____

_____

(b) The database has the following tables.

Fundraiser	Donation	Sponsor
fundraiserID	donationID	sponsorID
name	fundraiserID*	name
email	sponsorID*	email
	date	
	amount	

Draw an entity-relationship diagram to show the relationships that exist in this database. **2**

Your answer should show the entity names and cardinality. Attributes are not required on the diagram.

[Turn over for next question

DO NOT WRITE ON THIS PAGE

13. **(continued)**

A sample of the data in each of the three tables is shown below.

Fundraiser		
fundraiserID	**name**	**email**
1	Frazier Allston	fallston@fastmail.co.uk
2	Axel Ginie	aginie@freemail.com
3	Lucilia Hurworth	lhurworth@cmu.edu
...	...	

Donation				
donationID	**fundraiserID**	**sponsorID**	**date**	**amount**
DON0001	1	4	01/05/2019	25.00
DON0002	2	2	05/05/2019	10.00
DON0003	3	3	12/05/2019	10.00
DON0004	2	2	14/05/2019	25.00
DON0005	1	1	19/05/2019	5.00
DON0006	1	3	19/05/2019	10.00
DON0007	1	2	19/05/2019	15.00
DON0008	3	1	20/05/2019	15.00
...	...			

Sponsor		
sponsorID	**name**	**email**
1	Mata Dwyer	mdwyer@printfriendly.com
2	Evy Reymers	ereymers@yolasite.com
3	Bob Towey	btowey@behance.net
4	John Walker	jwalker@clickbank.net
...	...	

(c) Animal Help produces a report of the average donation made to each fundraiser.

Write the SQL statement to produce the output shown below.

3

fundraiserID	Average donation (£)
1	13.75
2	17.50
3	12.50

13. (continued)

(d) Animal Help provides a report of the largest single donation made to each fundraiser.

name	Largest donation (£)
Axel Ginie	25.00
Frazier Allston	25.00
Lucilia Hurworth	15.00

The following SQL statement is executed.

```
SELECT name,COUNT(amount)
FROM Fundraiser,Donation
WHERE Fundraiser.fundraiserID = Donation.fundraiserID
```

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 _____

_____

(e) When people make donations their payment details must be kept secure.

Describe how encryption is used to ensure the secure transmission of data.   **2**

_____

_____

_____

_____

_____

[Turn over

14. A travel company performs a search on a particular location and exports the following data about hotels to a text file.

- Hotel name

- Star rating from 1 to 5

- The price per night for a room

- Review score from previous guests from 0 to 10

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

Club Praia de Oure,4,47.00,7.0

Adriano Beach Club,4,121.25,8.3

...

A program is required to make recommendations to customers. One end-user requirement is to find the cheapest five star hotel. The algorithm used is shown below.

1. Import hotel data

2. Find the position of cheapest five star hotel

3. Display cheapest five star hotel

(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	hotelname[], stars[],price[], reviews[]
2	IN	
	OUT	
3	IN	position, hotelname[], stars[],price[], reviews[]
	OUT	

14. (continued)

(b) Step 2 finds the position of the cheapest hotel with five stars.

Using a recognised design technique, design this step.

5

[Turn over

15. Two hundred competitors entered a regional orienteering competition in either the Junior or Senior category. Each competitor received a score based on their performance. The names, categories and scores are stored in a csv file called 'competitors.csv'. Part of the file is shown below.
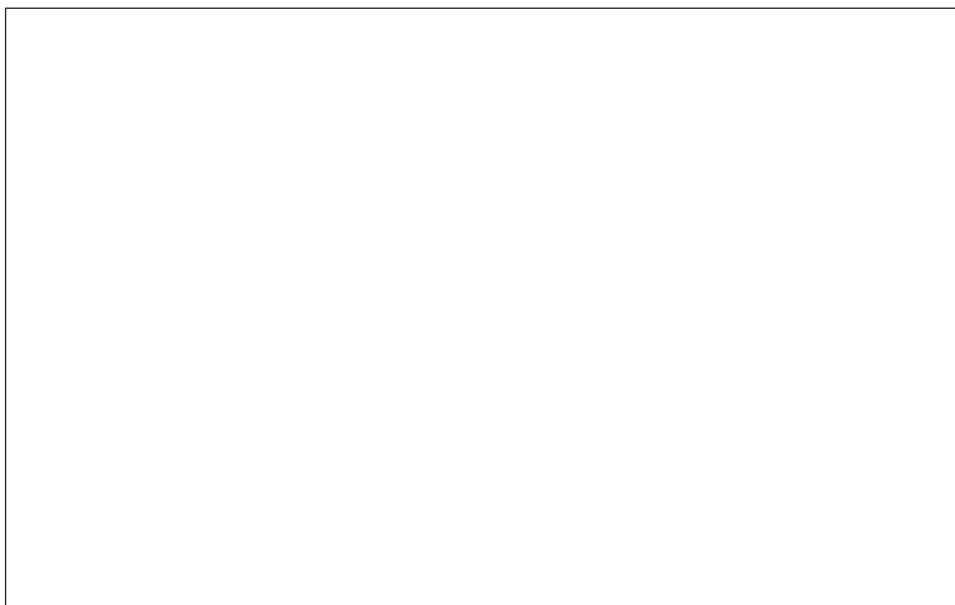
Senga Jones,Senior,67

Agnes Adam,Junior,88

...

A program is required to read the data from the csv file and then offer a menu of different options.

(a) The data will be stored in parallel 1D arrays.

Using a programming language of your choice, declare parallel 1D arrays that can store the data for the 200 competitors.

2

15. (continued)

(b) Different options are selected by clicking on a button as shown below.

Orienteering qualifiers

Please select from the buttons below:

| Count the number of Junior qualifiers | | Count the number of Senior qualifiers |

When the 'Count the number of Junior qualifiers' option is selected, the user is asked to enter the qualifying score. The program will then count how many Juniors achieved at least that score. An example output is shown below.

```
'12 Juniors achieved the qualifying score of 42'
```

Using a programming language of your choice, write the code to ask for a qualifying score and then output the appropriate message.

5

16. Bailey's Dog Kennels is developing a website. The website will have a multi-level structure, consisting of a home page with a horizontal navigational bar that links to four main web pages: Kennels, Grooming, Gallery and Contact Us.

The grooming web page will have links to three sub-pages showing costs, treatments and photos.

(a) Design a multi-level structure for this website. **2**

16. (continued)

(b) A browser displays the header element of the home page as shown below.

Complete the CSS below to style the header.   **3**

```
header{

    _____:lightgrey;
    padding:0px;
    }

.imageBanner{

    _____:20px;
    float:left;
    padding:0px;
    height:90px;
    width:130px;
    }

h1{

    _____;
    margin-right:30px;
    margin-top:30px;
    color:white;
    display:inline;
    }
```

[Turn over

16. (continued)

(c) The navigational bar shown below makes use of the following CSS.

Home	Kennels	Grooming	Gallery	Contact Us

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

nav ul li{
     float:left;
     }

nav ul li a{
     display:block;
     color:green;
     width:100px;
     text-align:center;
     padding:14px;
     }

nav li a:hover{
     background-color:black;
     color:white:
     }
```

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

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

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

Identify the line of code that allows this to happen.   **1**
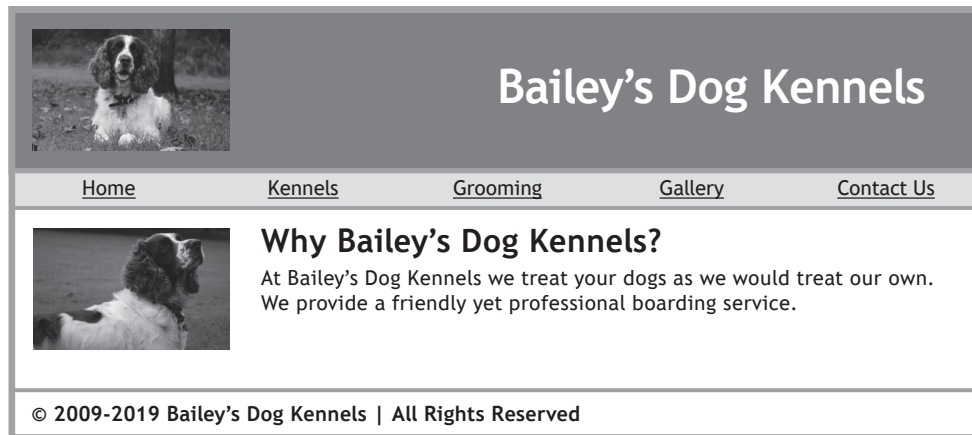
[Turn over for next question

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16. **(continued)**

(d) The home page for Bailey's Dog Kennels is shown below.

Home	Kennels	Grooming	Gallery	Contact Us

Why Bailey's Dog Kennels?
At Bailey's Dog Kennels we treat your dogs as we would treat our own. We provide a friendly yet professional boarding service.

© 2009-2019 Bailey's Dog Kennels | All Rights Reserved

When the mouse is placed over the image in the main section, the image changes.

Why Bailey's Dog Kennels?
At Bailey's Dog Kennels we treat your dogs as we would treat our own. We provide a friendly yet professional boarding service.

© 2009-2019 Bailey's Dog Kennels | All Rights Reserved

When the mouse is moved away from the image, the image should return to the original one, however, at present this is not happening.

HTML code for the home page is shown below.

```
<!DOCTYPE html>
<html>
<head>
  <title>Home Page</title>
  <link rel="stylesheet" type="text/css" href="../CSS/styles.css">
  <script>
    function rollover(my_image){my_image.src = '../images/Bailey2.png';}
  </script>
</head>
<body>
  <header>
    <h1>Bailey's Dog Kennels</h1>
    <img class="imageBanner" src="../images/BaileyLogo.png">
  </header>
  <nav>
    <ul>
      <li><a href="home.html">Home</a></li>
      <li><a href="kennels.html">Kennels</a></li>
      <li><a href="grooming.html">Grooming</a></li>
      <li><a href="gallery.html">Gallery</a></li>
      <li><a href="contactUs.html">Contact Us</a></li>
    </ul>
  </nav>
  <main>
    <h2> <img id="dog1Image" src="../images/Bailey1.png"
    onmouseover="rollover(this)">
    Why Bailey's Dog Kennels?</h2>
    <p>At Bailey's Dog Kennels we treat your dogs as we would treat our own.
    We provide a friendly yet professional boarding service.</p>
  </main>
  <footer>
    <h3>© 2009-2019 Bailey's Dog Kennels | All Rights Reserved</h3>
  </footer>
</body>
</html>
```

(i) Write the new function to display the original image when the mouse is moved away from the image.

2

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

2

16. (continued)

(e) Bailey's Dog Kennels installed an intelligent heating system.

Describe one environmental benefit to using a heating system which is intelligent.

1

_____

_____

_____

_____

[Turn over for next question

DO NOT WRITE ON THIS PAGE

17. A company offers driving lessons. They have a number of instructors and currently organise their customer bookings as shown in the three database tables below.

Instructor

instructorID	forename	surname
1	James	Smith
2	Anna	Bloggs
3	George	Grant
4	Rachel	Smith
...	...	

Booking

bookingID	instructorID	customerID	lessonDuration	date	time
BK0001	4	1	1	01/05/2019	14:00
BK0002	1	2	1	22/05/2019	16:00
BK0003	4	1	2	08/05/2019	14:30
BK0004	2	3	2	12/06/2019	10:00
BK0005	3	2	1	29/05/2019	14:00
...	...				

Customer

customerID	forename	surname	address	telephone	postcode
1	Matthew	Thomas	113 Cherry Terrace	07850843527	AB43 4SH
2	Simon	Wenger	91 Almo Alley	07892843825	AB33 8UP
3	Nicola	Mckay	9 Prairie Crescent	07945043032	AB43 9NZ
...	...				

17. (continued)

(a) Design a query to display the customer's forename, surname and the total amount of hours of lessons booked by each customer during May 2019.

The design has been partially completed for you.　　**3**

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

(b) The company charges £35 per hour for each lesson booked.

Using the sample data provided, write the SQL statement that would produce the following output.　　**3**

Total payments (£)
245

17. (continued)

(c) The customer Simon Wenger has moved home. His new address and postcode is 27 Drummer Street, AB33 7QR.

Write the SQL statement to make these changes. **3**

(d) Design a query to display the forename, surname and the number of lessons booked for each instructor.

The instructor who has the most lessons booked should be displayed first. **4**

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

[Turn over for next question

DO NOT WRITE ON THIS PAGE

18. CoasterRocks theme park is running an online competition to win a free family ticket. People visit the web page and enter their email.

WELCOME TO COASTERROCKS

where screams do come true

One lucky person will win a free family ticket worth £200. Just enter your email address in the box provided and click Submit.

Email: ☐

Confirm email: ☐

Submit

Only one entry per person is permitted.
Any further entries from the same email address will be removed.

After the closing date a program will sort the emails into order so that multiple entries from the same email can be identified. It will then create a list of unique emails from which to choose the winner.

The algorithm for this program is shown below.

1. Imports the emails from the text file into the array called `emails`

2. Sorts the `emails` array into ascending order

3. Stores a list of unique emails in an array called `uniques`

4. Chooses a random winner from the `uniques` array

The table below shows the contents of the `emails` and `uniques` arrays after steps 2 and 3.

`emails` array after step 2	`uniques` array after step 3
allan@giggle.com bert@yeeha.com bert@yeeha.com bert@yeeha.com colin@iclood.com colin@iclood.com ……………………….	allan@giggle.com bert@yeeha.com colin@iclood.com ……………………….. ……………………….. ……………………….. ………………………….

18. **(continued)**

Part of the program code is shown below.

```
Line 1    DECLARE emails AS ARRAY OF STRING INITIALLY []
Line 2    DECLARE uniques AS ARRAY OF STRING INITIALLY []
...
Line 11   importEmails(emails)
Line 12   sortEmails(emails)
Line 13   removeDuplicates(emails, uniques)
Line 14   chooseWinner(uniques)
...
Line 70   PROCEDURE removeDuplicates(ARRAY OF STRING list,
          ARRAY of STRING newList)
Line 71     DECLARE position INITIALLY 0
Line 72     SET newList[position] TO list[0]
Line 73     FOR index FROM 1 to length(list)-1 DO
Line 74        IF list[index] ≠ newList[position] THEN
Line 75           SET position TO position + 1
Line 76           SET newList[position] TO list[index]
Line 77        END IF
Line 78     END FOR
Line 79   END PROCEDURE
```

(a) Identify from the code shown above

    (i) a formal parameter _____ **1**

    (ii) an actual parameter. _____ **1**

(b)   (i) Explain what is meant by the scope of a variable. **1**

_____

_____

_____

_____

    (ii) State the scope of the variable `emails`. **1**

_____

_____

[Turn over

(c) The data below is used to test the program.

emails array
allan@giggle.com
bert@yeeha.com
bert@yeeha.com
bert@yeeha.com
colin@iclood.com
colin@iclood.com
...

(i) A breakpoint has been set at Line 77. The variables in the table below are inspected.

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

Variable	Value
position	
newList[position]	
list[index]	

(ii) Explain the operation of lines 74 to 76 during the first iteration of the loop. **2**

_____

_____

_____

_____

_____

_____

(d) The theme park is aware that their website might be subjected to a DOS attack.

State the effect on customers of a DOS attack. **1**

_____

_____

[END OF QUESTION PAPER]

ADDITIONAL SPACE FOR ANSWERS

page 37

ADDITIONAL SPACE FOR ANSWERS

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