FOR OFFICIAL USE

National Qualifications 2025

Mark

X816/76/01 Computing Science

FRIDAY, 25 APRIL

9:00 AM – 11:00 AM

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. (a) The lowest number that can be represented in two's complement using a fixed number of bits is −512.

State the largest number that can be represented with this number of bits. **1**

(b) State the number of bits being used to provide this range of numbers. **1**

2. Senga is buying a new house and has been e-mailed an offer of a loan by her bank. The bank included a digital signature when e-mailing the document.

State two benefits of using a digital signature. **2**

Benefit 1 _____

_____

_____

Benefit 2 _____

_____

_____

MARKS | DO NOT WRITE IN THIS MARGIN

3. An algorithm is required to count the number of upper and lower case characters in a string variable called `sentence`. Upper case characters have an ASCII code between 65 and 90 and lower case characters are between 97 and 122.

The expected output for the sentence 'To be or not to be?' would be:

Upper case: 1

Lower case: 12

Using a design technique of your choice, design this algorithm. **4**

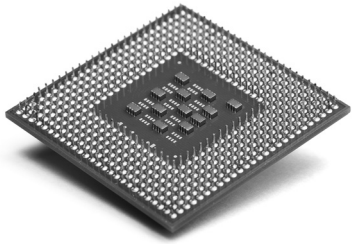
4. A software development company is working with a client that is known to modify their requirements during the development process.

Explain why the agile development methodology would be more suitable than the iterative methodology for this client. **1**

* X 8 1 6 7 6 0 1 0 3 *

MARKS | DO NOT WRITE IN THIS MARGIN

5. The processor carries out the fetch-execute cycle when running a program.



(a) State how the processor makes use of the control bus during the fetch-execute cycle. **1**

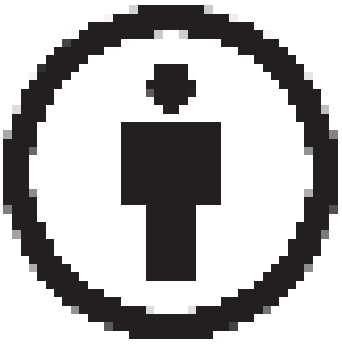
(b) (i) State how a manufacturer could improve the performance when designing a new version of the processor. **1**

(ii) Explain why this improves performance. **1**

MARKS | DO NOT WRITE IN THIS MARGIN

6. The graphic shown below is stored as a vector and as a bit-mapped graphic.

Both graphics have been scaled.

Graphic A	Graphic B
	

(a) Identify which graphic is the vector. Justify your answer. **1**

(b) State one advantage of using bit-mapped graphics compared to vector graphics. **1**

[Turn over

MARKS | DO NOT WRITE IN THIS MARGIN

7. Storms that affect Scotland are named. The name, region affected, month and year of each storm from each of the five years 2020–2024 is stored in a csv file.

Sample data from this file is shown below.

…
Robyn, North East, November, 2020
Brendan, North West, January, 2021
Ciara, South, February, 2021
Dennis, South East, September, 2021
…

A program is used to:

1. read data from file into parallel 1D arrays
2. ask for a year then count and display the number of autumn storms in that year
3. count the number of storms for each year
4. display the year with the most storms.

Autumn months are September, October and November.

(a) Complete the table below to show the missing data flow for Steps 2, 3 and 4 of this program. **3**

Step	IN	OUT
1		name(), region(), month(), year()
2		
3		numStormsYear()
4		

MARKS | DO NOT WRITE IN THIS MARGIN

7. (continued)

(b) Using a design technique of your choice, design an algorithm for Step 2. **4**

[Turn over

MARKS | DO NOT WRITE IN THIS MARGIN

7. (continued)

(c) The program is to be extended to allow a user to enter a possible name for a future storm. Storm names should be unique.

The program should check if the name entered is already present in the array `name`. A suitable message should be displayed to tell the user if the name is present or not.

Using a programming language of your choice, write the code for this new feature. **3**

MARKS | DO NOT WRITE IN THIS MARGIN

8. An online game measures a player's reaction time to seeing a green dot appear on the screen.

Each time someone plays the game their name, e-mail address, attemptID and reaction time to the nearest thousandth of a second is stored.

Sample data is shown below.

Lucy Scott	lscott@hmail.com	lscott8	0.215
Deaglán Mag Uidhir	deaghlan@nsm.com	deaghlan9	0.125
...	...	...	...

The game allows a maximum of 10 000 attempts each day. Players can play more than once, and each time their attemptID will be different.

(a) (i) Using a programming language of your choice, define a suitable record structure to store a player's data. **2**

(ii) Using a programming language of your choice, declare a variable that could be used to store details for 10 000 attempts. Your answer should make use of the record data structure defined in part (i). **2**

MARKS | DO NOT WRITE IN THIS MARGIN

8. (continued)

(b) The game stores the number of times it has been played that day in a variable `numPlays`. At the end of each day, the game finds the fastest time.

(i) Using a programming language of your choice, write the code to find the fastest time. Your answer should use the record data structure and variable declared in part (a). **5**

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8. (b) (continued) **MARKS** DO NOT WRITE IN THIS MARGIN

(ii) Explain why the variable `numPlays` is needed instead of traversing the entire array of 10 000. **1**

(c) The reaction time of 0.125 is stored as a binary number as:

0.001

Convert the binary number above into 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

[Turn over

MARKS | DO NOT WRITE IN THIS MARGIN

8. (continued)

(d) A player can play the game multiple times each day. Each time that they play, the program allocates them an `attemptID` using all the characters before the '@' in their e-mail and the value of `numPlays`.

A function that returns the position of any character in a string is used to implement this feature.

The code for this function is shown below.

```
...
Line 47   FUNCTION findCharIndex(STRING value, STRING
          character) RETURNS INTEGER
Line 48     DECLARE positionChar INITIALLY -1
Line 49     FOR index FROM 0 TO length(value)-1 DO
Line 50         IF value[index]= character THEN
Line 51              SET positionChar TO index
Line 52         END IF
Line 53     END FOR
Line 54     RETURN positionChar
Line 55   END FUNCTION
...
Line 70   SET position TO <return value of findCharIndex>
Line 71   SET attemptID TO <characters before the '@'
          character concatenated with the value of numPlays>
```

(i) Using a programming language of your choice, write the code for line 70 to assign the location of the '@' character in the `email` variable to `position` by calling the function `findCharIndex`. **2**

MARKS | DO NOT WRITE IN THIS MARGIN

8. (d) (continued)

(ii) Using a programming language of your choice, write the code for line 71 to assign all of the characters before the '@' character concatenated with the value of the variable `numPlays` to `attemptID`. **2**

[Turn over

MARKS | DO NOT WRITE IN THIS MARGIN

9. A function is written to remove a specified number from an array and return a new array without that number. If the number is not present then the original array should be returned.

For example, if the value 12 is to be removed from the array [42, 12, 67] then the array [42, 67] is returned.

```
...
Line 4   FUNCTION removal(ARRAY OF INTEGER values, INTEGER target)
         RETURNS ARRAY OF INTEGER
Line 5      DECLARE newList INITIALLY [0] * length(values)-1
Line 6      DECLARE position INITIALLY 0
Line 7      FOR index FROM 0 TO length(values)-1 DO
Line 8         IF values[index] ≠ target THEN
Line 9            SET newList[position] TO values[index]
Line 10           SET position TO position+1
Line 11        END IF
Line 12     END FOR
Line 13     RETURN newList
Line 14  END FUNCTION
...
...
Line 20  DECLARE numbers INITIALLY [42,12,67]
Line 21  DECLARE deleteValue AS INTEGER INITIALLY FROM KEYBOARD
Line 22  newNums = removal(numbers,deleteValue)
Line 23  SEND newNums TO DISPLAY
```

(a) The code above limits the scope of several variables.

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

(ii) Describe one benefit of limiting the scope of a variable in modular programming. **1**

(b) Describe the operation of line 22 during the execution of this program. **2**

MARKS | DO NOT WRITE IN THIS MARGIN

9. (continued)

(c) One test case is to enter the number 99 when prompted at line 21. The expected output would be [42,12,67].

Complete the trace table below by identifying the missing values in the highlighted boxes. **3**

Line number	newList	position	index
5	[0,0]		
6		0	
7			0
9	[42,0]		
10			
7			1
9			
10			
7			

(d) Describe how a debugging technique could be used to check the values in the trace table. **2**

_____

_____

_____

_____

[Turn over

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MARKS | DO NOT WRITE IN THIS MARGIN

9. (continued)

(e) (i) Explain why the code does not produce the correct output. **2**

(ii) Describe the additional code that should be added to the function to make it fit for purpose. **2**

(f) Evaluate the robustness of the function. Explain your answer. **1**

[END OF SECTION 1]

MARKS | DO NOT WRITE IN THIS MARGIN

SECTION 2 — DATABASE DESIGN AND DEVELOPMENT — 25 marks

Attempt ALL questions

10. A TV network uses a relational database to store data about its TV programmes. One of the tables is shown below.

Programme			
title	**year**	**genre**	**duration**
Dr Whitlet	2019	Sci-Fi	45
Game of Action	2020	Drama	30
My Life	2023	Romance	50
Island Life	2024	Drama	50
Red Mirror	2024	Drama	45
Real Love	2023	Romance	40
Kim	2021	Romance	60
The Dark Sky	2023	Sci-Fi	90

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

```
SELECT year, genre, MIN(duration) AS 'Shortest time'
FROM Programme
WHERE year > 2021
GROUP BY year, genre;
```

2

year	**genre**	**Shortest time**

MARKS | DO NOT WRITE IN THIS MARGIN

11. A laundry company uses a relational database to manage customer orders.

The database has the following tables.

Customer	Order	Item	OrderItem
customerID	orderID	itemID	orderItemID
forename	customerID*	itemName	orderID*
surname	orderDate	description	itemID*
address	deliveryDate	price	quantity
phone	status		
accountBalance	totalAmount		

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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12. A photography company uses a database to store and manage data about customers, appointments, photographers and invoices.

Sample data from the database is shown below.

Customer				
custID	**firstname**	**surname**	**phoneNo**	**postcode**
C001	Liam	Miller	05878834723	G68 3JN
C002	Max	Wilson	05318748333	EH1 1DJ
C003	Arran	Jones	05773834934	DD1 8JR
C004	Anabiah	Awan	05934429391	FK8 4RW
C005	Olivia	Waugh	05417723837	G64 3WP
...	...	...	...	...

Appointment						
appID	**custID**	**staffID**	**appDate**	**time**	**location**	**notes**
APP1	C001	P1	14/12/2024	14:00	Victoria Park	Photos of child
APP2	C002	P4	02/02/2025	19:30	Castle	Engagement
APP3	C003	P5	15/02/2025	09:00	Science Museum	Work pictures
APP4	C001	P1	10/03/2025	12:00	Central Park	Family portrait
APP5	C004	P4	15/03/2025	14:00	Cathedral	Wedding photos
...	...	...	...	...	...	...

Photographer				
staffID	**fName**	**sName**	**email**	**speciality**
P1	Heidi	Colvin	colvin@sqmail.com	Family
P2	Sheikh	Momin	momin@sqmail.com	Fashion
P3	Jayden	Nelson	jnels@sqmail.com	Portrait
P4	Alisha	Hussain	alishah@sqmail.com	Wedding
P5	Fernami	Hardie	hardie@sqmail.com	Event
...	...	...	...	...

X 8 1 6 7 6 0 1 1 9

MARKS | DO NOT WRITE IN THIS MARGIN

12. (continued)

Invoice				
invoiceID	**appID**	**invoiceDate**	**cost**	**status**
INV001	APP1	18/12/2024	156.45	Paid
INV002	APP2	10/02/2025	250.00	Paid
INV003	APP3	20/02/2025	100.00	Unpaid
INV004	APP4	16/03/2025	95.00	Paid
INV005	APP5	20/04/2025	650.90	Unpaid
...	...	...	...	...

(a) Design a query to display the full name of each photographer and the number of appointments that they have in July 2025. **3**

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

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12. (continued)

MARKS | DO NOT WRITE IN THIS MARGIN

(b) The photography company is increasing the cost by £20 for appointments where their invoice date was before 31 March 2025 and remains unpaid.

Write the SQL statement that would change the total cost for these appointments. **3**

(c) The company would like to display a list showing the highest cost that has been invoiced for each photographer. The expected output is shown below.

fName	sName	Highest cost
Fernami	Hardie	100.00
Alisha	Hussain	650.90

The following SQL statement is not fit for purpose.

```
SELECT fName, sName, MAX(cost) AS [Highest cost]
FROM Invoice, Photographer
WHERE Invoice.appID = Appointment.appID
ORDER BY MAX(cost) ASC;
```

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

Error 1 _____

_____

Error 2 _____

_____

Error 3 _____

_____

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DO NOT WRITE IN THIS MARGIN

13. A garage offers vehicle services, maintenance, and MOTs. The management uses a relational database to store details of customers, vehicles, appointments and parts.

Sample data from the database tables is shown below.

Customer		
custID	**name**	**telNo**
0013	K Amin	05767490813
0017	J Atigah	05534384344
0024	F Hunter	05848534323
0027	H Moore	05583223411
0039	L Fletcher	05748339222
...	...	...

Part			
partID	**partName**	**quantity**	**price**
P001	Air filter	34	11.99
P002	Brake disc	21	61.99
P003	Brake pad	8	68.99
P004	Oil filter	43	20.99
P005	Shock absorbers	13	95.99
...	...	...	...

Vehicle				
regNo	**custID**	**make**	**model**	**year**
HK69 TYR	0013	Ford	Transit	2019
LR16 JRD	0017	Vauxhall	Mokka	2016
SO70 KRF	0013	Kia	Creed	2020
GL65 ORJ	0024	Vauxhall	Adam	2015
SC15 YHA	0017	Renault	Clio	2015
HR19 JWW	0024	Ford	Focus	2019
KK20 DRT	0039	Vauxhall	Mokka	2020
...	...	...	...	...

Appointment					
appID	**regNo**	**description**	**partID**	**date**	**cost**
AP011	HK69 TYR	Service	P001	24/03/2025	169.50
AP015	LR16 JRD	Maintenance	P002	29/03/2025	246.83
AP021	SO70 KRF	Service	P004	30/03/2025	78.50
AP020	HR19 JWW	Service	P001	30/03/2025	185.23
AP023	GL65 ORJ	MOT		01/04/2025	54.95
AP025	SC15 YHA	MOT	P005	02/04/2025	233.74
AP026	KK20 DRT	Maintenance	P005	02/04/2025	210.00
...	...	...	...	...	...

MARKS | DO NOT WRITE IN THIS MARGIN

13. (continued)

(a) The garage wants to use a query to invoice a customer for the work done on their vehicle.

Design a query to display the full name, vehicle registration number and the name of the part for customer 'L Fletcher'. **2**

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

(b) Write the SQL statement to display the total value of all parts in stock as shown below. **2**

Total value
4411.81

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13. (continued)

MARKS | DO NOT WRITE IN THIS MARGIN

(c) The garage would like to display details of all appointments that cost more than the average appointment cost.

(i) Write the SQL statement to display the average appointment cost, as shown below. **2**

Average cost
168.39

(ii) The query from part (i) is saved as 'avgCost'. Using this query, complete the SQL statement below to display details of all appointments that cost more than the average cost. The details should be displayed in the order shown below. **4**

name	appID	date	description	cost
J Atigah	AP015	29/03/2025	Maintenance	246.83
J Atigah	AP025	02/04/2025	MOT	233.74
L Fletcher	AP026	02/04/2025	Maintenance	210.00
F Hunter	AP020	30/03/2025	Service	185.23
K Amin	AP011	24/03/2025	Service	169.50

```
SELECT name, appID, date, description, cost
```

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MARKS | DO NOT WRITE IN THIS MARGIN

13. (continued)

(d) At present only one part can be used in a single repair so the database design would require an additional entity called `PartsListing` to be added.

Complete the diagram below showing the cardinality between the `PartsListing` entity and the two existing entities. **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

14. The following HTML code is for a form intended to allow users to post review comments for a movie.

```
<form>
  <p>Your Name:</p>
  <input type="text" name="yourName"><br>
  <input type="text" name="comments"><br>
  <input type="submit" value="Submit">
</form>
```

(a) Usability testing is carried out using personas, test cases and scenarios.

Describe what is meant by 'personas'. **1**

(b) State two issues that should be identified during usability testing of this form. **2**

MARKS | DO NOT WRITE IN THIS MARGIN

15. A tourist office wants the navigation bar shown below on their website. The background colour should change to black and the font colour to white when the cursor moves over a link.

The following CSS code is used to implement this.

```
nav {height:30px; margin-bottom: 30px;}
nav ul {list-style-type:none;}
nav ul li {float:left; width:120px;}
nav ul li a {display:inline; padding:10px;}
nav:hover {background-color:black; color:white;}
```

During testing the navigation bar is found not to be fit for purpose.

Describe the change needed to the CSS code so that the navigation bar functions as intended. **1**

_____

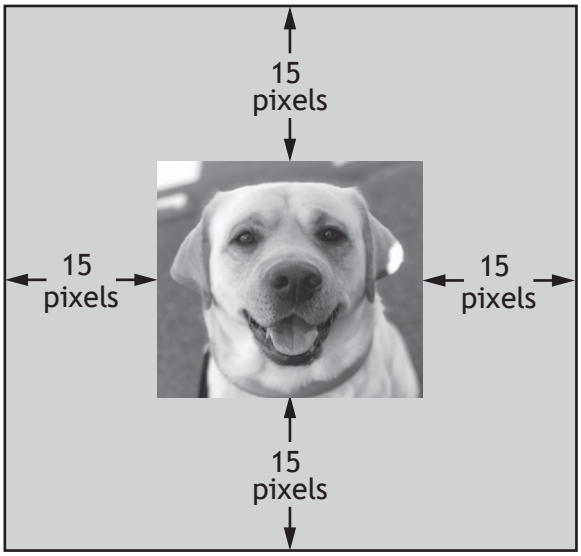
_____

_____

_____

[Turn over

16. An image is to be displayed on a web page as shown below.



The HTML code below is used to display the image.

```
…
    <div>
         <img src="dog.jpg">
    </div>
…
```

Complete the first line of code in the CSS rule below to implement the correct spacing. **1**

```
div { ____________________________________________;

    width: 250px; width: 250px;
    background-color: lightgrey;
    border:2px solid;
     }
```

MARKS | DO NOT WRITE IN THIS MARGIN

17. A holiday booking website is being developed.

(a) One of the pages of the website should allow users to request further information about holidays. Users will enter all of the following details:

- e-mail
- departure date
- number of nights (between 1 and 14)
- holiday type (either self-catering, bed and breakfast, or all inclusive)
- number of people in the party (minimum of 1).

Using the information above, draw a wireframe design for this web page. **4**

[Turn over

DO NOT WRITE IN THIS MARGIN

17. (continued)

(b) When a user searches for hotels, information is shown as below.

```
<style>
…
section p {background-color: DarkGrey;}
…
</style>
…
<p>These hotels match your search criteria </p>
<section id="hotel1">
 <h2>Dundee Arms</h2>
 <img src="hotel.png">
 <p>This is a lovely little local hotel</p>
 <h3>Price</h3>
 <p>Double rooms from £80 per night.</p>
 <h3>Rating 4/5</h3>
 <h3>+ More details</h3>
 <div id="info1">
  <p>Additional hotel info.....</p>
 </div>
</section>
```

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MARKS | DO NOT WRITE IN THIS MARGIN

17. (b) (continued)

The text 'This is a lovely . . .' and 'Double rooms . . .' have a dark grey background.

(i) State the type of selector in the CSS rule below.

```
section p {background-color: DarkGrey;}
```

1

_____

(ii) Describe the effect of the CSS rule in part (i). **1**

_____

_____

_____

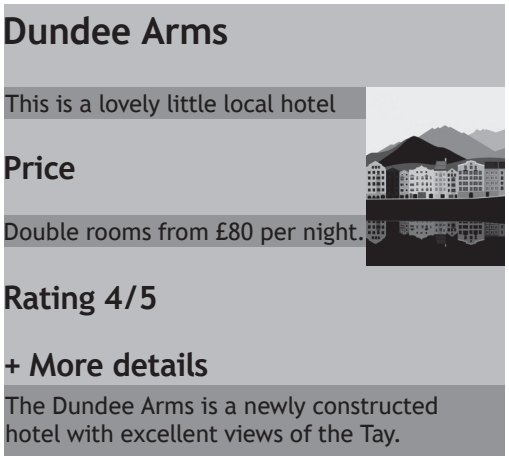
[Turn over

17. (continued)

(c) The 'More details' section is hidden when the page is viewed in a browser.

A user should be able to view more details about the hotel by clicking on the text 'More Details'. If it is clicked on again then the text in the 'More details' section is hidden. The page is updated as shown below.

When 'More details' is clicked once



When 'More details' is clicked again

(i) When implemented the code below is used to show or hide the more details text.

Complete the missing JavaScript code to ensure that the specified element is displayed. **1**

```
function toggleDisplay(DivToShow) {
  var x = document.getElementById(DivToShow);
  if (x.style.display === "none") {
    x.style.display = ________________________________;
  } else {
    x.style.display = "none";
  }
}
```

MARKS | DO NOT WRITE IN THIS MARGIN

17. (c) (continued)

(ii) The function to display the additional information for Dundee Arms from part (i) has been implemented.

```
<section id="hotel1">
     <h2>Dundee Arms</h2>
     …
     <h3>Rating 4/5</h3>

     <h3 _____ A _____>+ More details</h3>
     <div id="info1">
          <p>Additional hotel info...</p>
     </div>
</section>
```

Write the code required at position '**A**' to call the function when the heading 'More details' is clicked. **2**

[Turn over

MARKS | DO NOT WRITE IN THIS MARGIN

18. A website allows people to buy and sell cars online.

(a) When the site is loaded, there are pages that allow users to create an account, list their car or to search for cars. There is also a page to provide details on car leasing.

From the search page there are pages for new cars, used cars and electric cars.

Draw the navigational structure for this website. **2**

MARKS | DO NOT WRITE IN THIS MARGIN

18. (continued)

(b) When creating a listing to sell a car, the user must enter the age and price of the car. Cars can be listed with a price between £200 and £75,000.

The HTML code below allows the user to enter the car's age and price.

```
<form>
…
  <p>Enter the age of the car:</p>
  <input type="number" name="age">

  <br>
  <p>Enter listing price:</p>
  <input type="number" name="price">
…
</form>
```

Re-write the line of HTML code to ensure that the price of the car is entered and is a valid price. **2**

[Turn over

DO NOT WRITE IN THIS MARGIN

18. (continued)

(c) When listing a car, the user has to choose between Silver or Gold packages. The following HTML and CSS code is implemented.

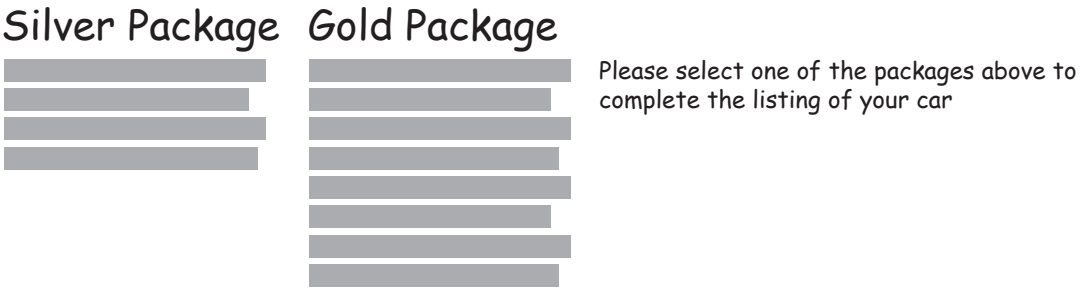
HTML	CSS

`<h1>Listing Choice</h1>`
 	
`<section id="silver">`
`<h1>Silver Package</h1>`
`<ul>`
`<li>Item 1</li>`
`...`
`</ul>`
`</section>`
 	
`<section id="gold">`
`<h1>Gold Package</h1>`
`<ul>`
`<li>Item 1</li>`
`...`
`</ul>`
`</section>`
 	
`<div>`
`<p>Please select`
`....</p>`
`</div>`
	`section {width: 150px;}`
	
	`#silver {background-color: red; float:left;}`
	
	`#gold {background-color: blue; float:left;}`

(i) The intended layout is shown below.

18. (c) (i) (continued)

When tested the text is displayed to the right instead of below.



Complete the CSS rule below to make this change. **1**

```
div{_____________________________________________}
```

(ii) The text in both the 'Silver Package' and 'Gold Package' sections should be Arial.

Complete the CSS rule below to apply this property. **1**

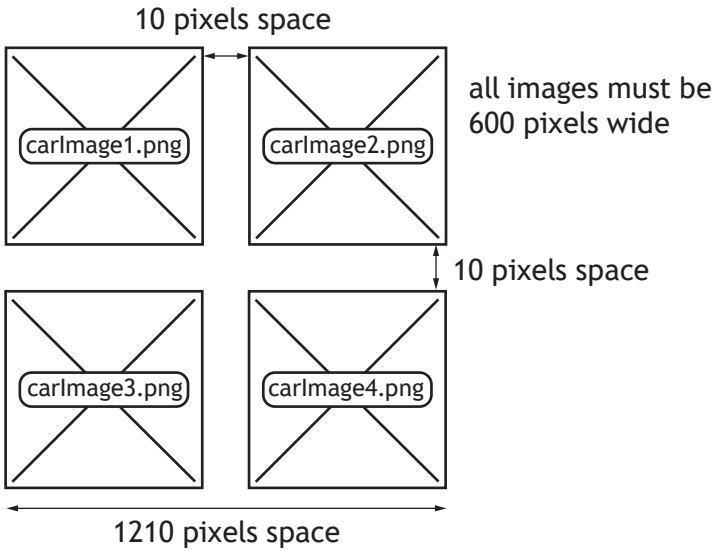
```
_____________________________{font-family: Arial;}
```

[Turn over

18. (continued)

MARKS | DO NOT WRITE IN THIS MARGIN

(d) When viewing the details of a car there should be four images shown in a grid.



The HTML and CSS code below is written to implement this.

```
…
<style>
      img {width: 600px; display: block; float:left;
      margin: 10px;}
      div {width: 1210px;}
</style>
</head>

<body>
…
      <div>
            <img src="carImage1.png">
            <img src="carImage2.png">
      </div>

      <div>
            <img src="carImage3.png">
            <img src="carImage4.png">
      </div>
…
```

(i) Explain why the code above is not fit for purpose even when the page is viewed in a full screen browser. **2**

_____

_____

_____

_____

18. (d) (continued) **MARKS** DO NOT WRITE IN THIS MARGIN

(ii) The code from part (i) is corrected. However, during compatibility testing, users report that when viewing the site on their smartphone it still does not display as intended.

Explain why the issue may still exist when viewing the site using a browser on a smartphone. **1**

(e) An extract from one of the pages is shown below.

> Thank you for visiting our site!
>
> See you again.
>
> If you want to know more about us please visit our social media page **here.**

The following HTML is used.

```
<p>Thank you for visiting our site!</p>

<p>See you again.</p>

<p>If you want to know more about us please visit our
social media page
<a href = http://instapage.com/AberCars>here.</a> </p>
```

Explain why the paragraph elements appear on different lines, but the anchor element is displayed on the same line as the paragraph element. **2**

[END OF SECTION 3]

[END OF QUESTION PAPER]

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ADDITIONAL SPACE FOR ANSWERS

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ADDITIONAL SPACE FOR ANSWERS

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