FOR OFFICIAL USE

National Qualifications

Mark

X816/75/01 Computing Science

Duration — 1 hour 30 minutes

X8167501

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

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 ©

SECTION 1 — SOFTWARE DESIGN AND DEVELOPMENT AND COMPUTER SYSTEMS — 55 marks

Attempt ALL questions

1. A question in a program requires a true or false response.

State the most suitable data type for storing this response. **1**

_____

2. The code below should receive input and display a user's name.

```
...
Line 3    DECLARE name INITIALLY ""
Line 4    SEND "Please type in your name" TO DISPLAY
Line 5    SD "Your name is" & name TO DISPLAY
Line 6    RECEIVE name FROM KEYBOARD
...
```

Identify the syntax error and logic error in the program code above. **2**

Syntax error _____

_____

Logic error _____

_____

3. Convert the following 8-bit binary number into denary.

1110 0010 **1**

4. A user enters the value 2 when running the program below.

MARKS DO NOT WRITE IN THIS MARGIN

```
Line 1    DECLARE answer INITIALLY 0
Line 2    DECLARE numOne INITIALLY 3
Line 3    RECEIVE numTwo FROM KEYBOARD
Line 4    SET answer TO numOne ^ numTwo
Line 5    SEND answer TO DISPLAY
```

State the output. **1**

5. Explain why the development of software is called an iterative process. **1**

6. Explain why encryption is used when sending emails across wireless networks. **1**

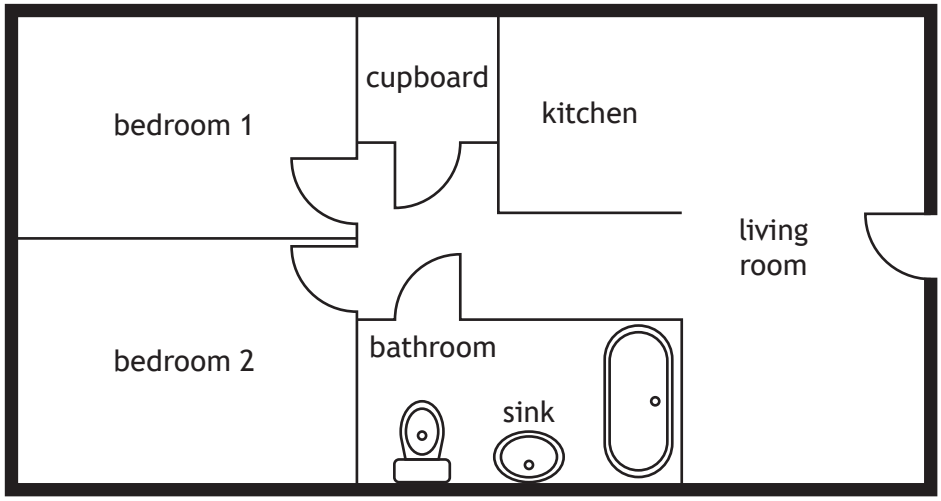
7. Input validation is required to ensure that a program will only accept the numbers 1 or 5.

(a) Using a design technique of your choice, design an efficient solution to ensure that the program will only accept valid numbers from the user. **4**

(b) State a numerical example of exceptional test data that could be used to test the design. **1**

8. Describe one way schools can help to reduce the environmental impact of the computers they use. **1**

9. A vector graphics package is used to create a floor plan for a house as shown below.



(a) State the object used to create the outline of the sink. **1**

(b) The line thickness and line colour are attributes of the lines used to draw the outside walls.

State one other attribute of these lines. **1**

10. A cinema is developing an app to survey customers. Cinema staff will ask customers questions as they leave the cinema. Staff will use a touchscreen on a tablet to input and submit the responses given by each customer.

Customers will be asked the following questions.

- Which of the two films the cinema is currently showing did you see?
- What score would you give the film, from 1 to 5?
- Did you purchase food in the cinema?

(a) As many customers as possible should be surveyed as they leave the cinema. It is important that answers to questions can be input as quickly as possible using a touchscreen.

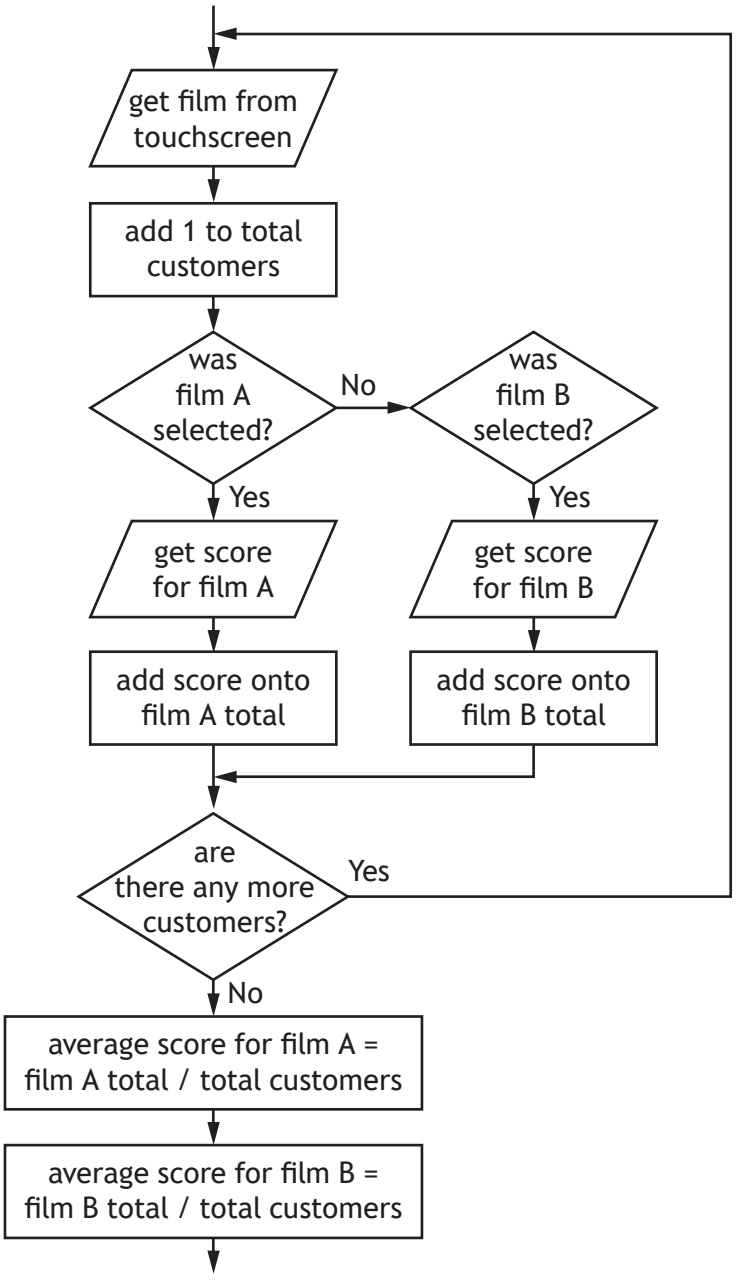
Using the information above, design a user interface for this part of the app. **4**

DO NOT WRITE IN THIS MARGIN

10. (continued)

At the end of each day the app will calculate the average score for each film.

The suggested design for this part of the app is shown below.



10. (continued)

(b) Read the design for the cinema app and identify

(i) a value that will be stored as an integer **1**

(ii) the condition used in the loop **1**

(iii) an inefficient part of the design that could be removed without affecting the solution. **1**

(c) The design does not calculate the average score for each film correctly.
Describe a solution that would fix this error. **2**

[Turn over

11. A spelling game stores 20 words. Each word has an accompanying sound file where an actor's voice speaks the word.

When the game is running the program repeats the following 20 times.

- Selects one of the 20 words
- Loads a sound file matching the selected word
- Plays the sound file through a speaker
- Asks the user to type in the word
- Compares the user's entry to the stored word
- Informs the user if they have spelled the word correctly

When the game is over the program displays the total number of words that have been spelled correctly by the user.

(a) Complete the table below by identifying three processes from the above description of the game. **3**

Input(s)	User enters the word
Process(es)	
Output(s)	Play matching sound file through speaker. Display whether or not the user spelled the word correctly. Display the total number of correctly spelled words.

11. (continued)

(b) The spelling game stores 20 words.

(i) State the data structure and data type that will be required to store the 20 words. **2**

Data structure _____

Data type _____

(ii) State where in the computer system the 20 words will be stored while the program is running. **1**

_____

(iii) State the part of the processor that will compare the selected stored word with the user's input. **1**

_____

[Turn over

11. (continued)

(c) Part of the program code is shown below.

```
...
Line 27  REPEAT 20 TIMES
Line 28    SET choice TO <a number between 0 to 19>
Line 29    <load selected sound file>
Line 30    SEND <sound file> TO <speaker>
Line 31    RECEIVE usersWord FROM KEYBOARD
Line 32    IF usersWord = NOT(storedWords[choice]) THEN
Line 33      SEND "Sorry, the correct spelling is " &
             storedWords[choice] TO DISPLAY
Line 34    ELSE
Line 35      SEND "Well Done" to DISPLAY
Line 36      SET correctGuesses TO correctGuesses + 1
Line 37    END IF
Line 38  END REPEAT
Line 39  SEND "You guessed " & correctGuesses & " words
         correctly" TO DISPLAY
```

(i) Identify the logical operator used in the above code. **1**

(ii) Using a programming language of your choice, re-write Line 28 to show how the value stored in the variable choice would be generated. Your answer should use a function. **2**

(iii) When the above code was tested several times, it was found that the user was not asked to spell all 20 of the stored words.

Explain why the program did not ask the user to spell every stored word. **1**

11. (continued)

(d) The first stored word is

Animal

State the number of bits required to store this word using extended ASCII. **1**

[Turn over

DO NOT WRITE IN THIS MARGIN

12. A company runs a sightseeing trip around Iron Craig Island each Saturday and Sunday. Their boat can hold 100 passengers.

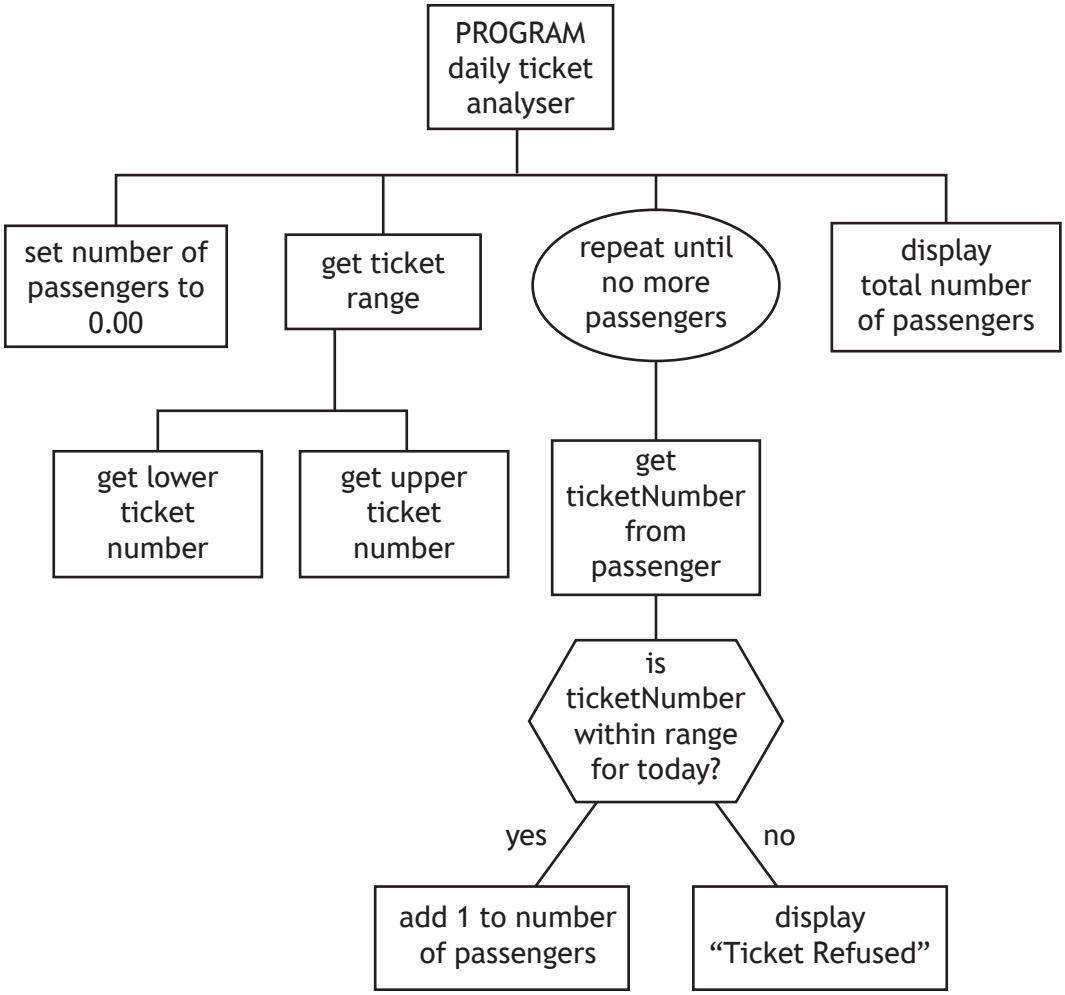
Every weekend the available tickets are numbered as follows.

Saturday's ticket numbers	1 to 100
Sunday's ticket numbers	101 to 200

A program is being developed to

- allow the company to check the validity of each passenger's ticket as they board the boat
- calculate and display the total number of the passengers on each trip.

The program design is shown below.



12. (continued)

(a) (i) State the type of loop required when implementing this design. **1**

_____

(ii) State the standard algorithm used in this design. **1**

_____

(iii) Several different programming constructs will be required when the program code is written.

Complete the table below to show this. **3**

Example from design	Matching construct
Set totalPassengers to 0.00	
	Conditional statement
	Arithmetic operation

(b) The total number of passengers is set to 0.00 in the design.

State a more appropriate data type to store the total number of passengers. Give a reason for your answer. **2**

Data type _____

Reason _____

_____

[Turn over

DO NOT WRITE IN THIS MARGIN

12. (continued)

(c) The program is edited to calculate the total value of the passengers' tickets. The price of a ticket is different for each deck.

	Deck 1	Deck 2
Saturday's ticket numbers	1 to 50	51 to 100
Sunday's ticket numbers	101 to 150	151 to 200
Ticket price	£5	£10

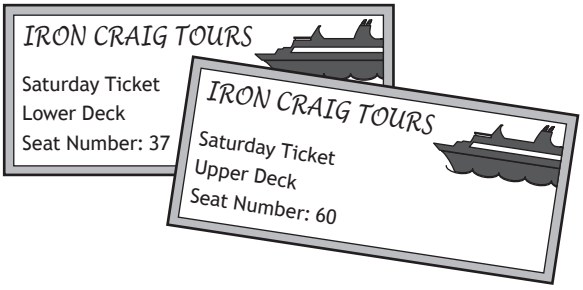
The edited code is shown below.

```
...
Line 5    RECEIVE lower FROM KEYBOARD
Line 6    RECEIVE upper FROM KEYBOARD
...
Line 14   IF ticketNumber < lower OR ticketNumber > upper THEN
Line 15     SEND "Ticket Refused" TO DISPLAY
Line 16   ELSE
Line 17     SET numberOfPassengers TO numberOfPassengers + 1
Line 18     IF ticketNumber <= (lower + 49) THEN
Line 19       SET totalValue TO totalValue + 5
Line 20     END IF
Line 21     IF ticketNumber >= (lower + 50) THEN
Line 22       SET totalValue TO totalValue + 10
Line 23     END IF
Line 24   END IF
...
```

12. (c) (continued)

Using a programming language of your choice, re-write lines 18 to 23 in a more efficient way. **3**

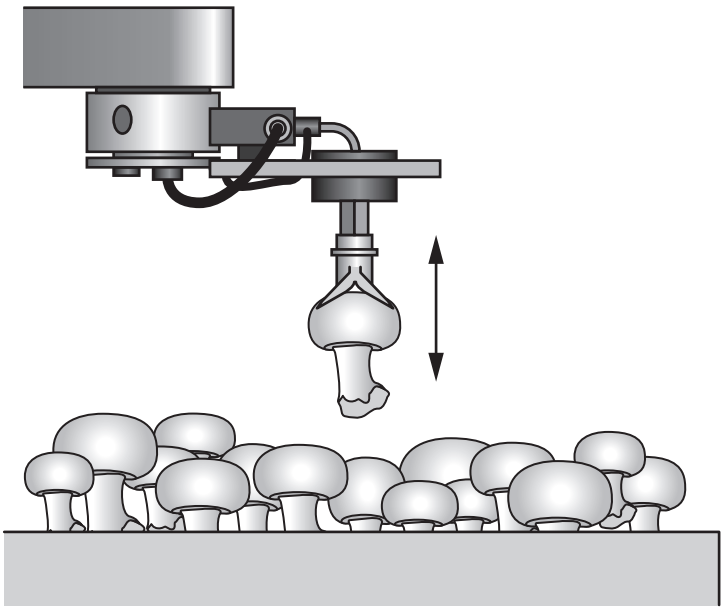
(d) Tickets include a bit-mapped graphic.



Describe how a bit-mapped graphic is represented in a computer system's memory. **2**

DO NOT WRITE IN THIS MARGIN

13. A farm uses a robot to scan mushrooms and measure their diameter. If they have grown to the correct size, the mushrooms are picked and packed into boxes.



The program that controls the robot is shown below.

```
Line 1    DECLARE maxSize AS REAL INITIALLY 4.0
Line 2    DECLARE fullBox AS INTEGER INITIALLY 20
Line 3    DECLARE count AS INTEGER INITIALLY 0
Line 4    DECLARE mushroomSize AS REAL INITIALLY 0.0

Line 5    WHILE <there are more mushrooms to scan> DO
Line 6       RECEIVE mushroomSize FROM <scanner>

Line 7       IF mushroomSize >= maxSize/2 AND mushroomSize <=
               maxSize THEN

Line 8          <pick and pack scanned mushroom>
Line 9          SET count TO count + 1
Line 10         IF count = fullBox THEN
Line 11              SEND "Box Full" TO TOUCHSCREEN
Line 12              SEND "Replace with Empty Box" TO
                          TOUCHSCREEN
Line 13              <pause until box replaced>
Line 14              SET count TO 0
Line 15         END IF

Line 16      END IF
Line 17   END WHILE
```

13. (continued)

(a) Explain fully how this program informs the farmer when a box of mushrooms is full. **3**

(b) The robot currently picks mushrooms that are no more than 4 cm in diameter and packs 20 mushrooms into a box.

(i) State the smallest size a picked mushroom could be. **1**

(ii) Explain why line 14 is necessary. **1**

[Turn over

13. (continued)

(c) The scanner on a second robot calculates how white each mushroom is and outputs this as a 'whiteness' reading between 0 and 10.

```
Line 1   DECLARE maxSize AS REAL INITIALLY 4.0
Line 2   DECLARE fullBox AS INTEGER INITIALLY 20
Line 3   DECLARE count AS INTEGER INITIALLY 0
Line 4   DECLARE whiteness AS REAL INITIALLY 0.0

Line 5   WHILE <there are more mushrooms to scan> DO
Line 6      RECEIVE mushroomSize FROM <scanner>

Line 7      IF mushroomSize >= maxSize/2 AND mushroomSize <=
               maxSize THEN

Line 8         <pick and pack scanned mushroom>
Line 9         SET count TO count + 1
Line 10        IF count = fullBox THEN
Line 11             SEND "Box Full" TO TOUCHSCREEN
Line 12             SEND "Replace with Empty Box" TO TOUCHSCREEN
Line 13             <pause until box replaced>
Line 14             SET count TO 0
Line 15        END IF

Line 16     END IF
Line 17  END WHILE
```

Line 4 of the original program has been edited.

Describe how else the original program could be edited so that mushrooms of any size, with a whiteness reading of at least 9 would be picked by the robot. **2**

SECTION 2 — DATABASE DESIGN AND DEVELOPMENT — 25 marks

Attempt ALL questions

14. A database is used to store data about restaurants. This includes the type of food they serve, the average price of a meal and a rating of 1, 2, 3, 4 or 5 stars.

(a) The SQL query below is executed.

```
SELECT name, address, phoneNumber
FROM restaurant
WHERE (foodType = "Italian" OR foodType = "French")
AND starRating > 1
AND starRating < 5
ORDER BY averagePrice ASC
```

Describe the output that would be listed under the headings name, address and phoneNumber when the above query is executed. **3**

(b) State which SQL operation would be required to change the phone number of a restaurant in the database. **1**

15. A data dictionary includes entity names and attribute names.

State one other item of information that would be included in a data dictionary. **1**

[Turn over

16. A primary school is organising a range of 30 activities for its 550 pupils for the last day of term. The organiser wishes to create and use a database.

The following are essential.

Each pupil selects one activity. They must return a form which contains their name, class and emergency contact details.

The organiser provides class teachers with a list of pupils' names and chosen activities.

Each activity has a leader and a unique activity name. Activity prices range from £2 to £30. The organiser provides a list for each activity leader, showing each pupil's name, class and emergency contact details.

The organiser records which pupils have returned a form so that they can search for pupils who have not signed up to an activity.

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

Functional requirement 1 _____

_____

_____

Functional requirement 2 _____

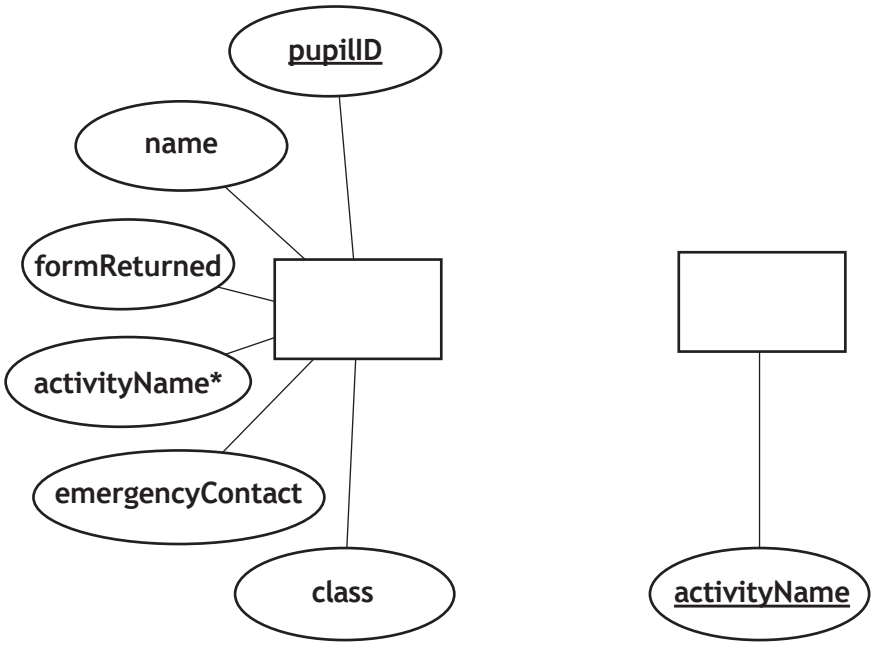
_____

_____

(b) Complete the entity-relationship diagram on the opposite page for the database by

- naming the entities
- drawing any missing attributes from either entity
- drawing the relationship between the entities
- naming the relationship between the entities. **4**

16. (continued)



(c) Identify the attribute that would be stored as a Boolean field when the database is implemented. **1**

(d) When the database is implemented validation is added to several fields.

(i) The primary school has 14 different class names. For example P1A, P4B, P6/7A.

Describe how validation of this field could be implemented when the database tables are created. **2**

(ii) State one field where range validation would be appropriate. **1**

[Turn over

17. A car retailer has four showrooms.

MARKS DO NOT WRITE IN THIS MARGIN

A relational database is used to store details of the four showrooms and the cars they have for sale.

Showroom		
showroomID	**city**	**manager**
Gla1	Glasgow	Ray Rain
Gla2	Glasgow	Kate Jones
Abd	Aberdeen	Sue Gearan
Dun	Dundee	Sadiq Yavuz

Car						
carID	**make**	**model**	**colour**	**seats**	**salePrice**	**showroomID**
1	McLaren	F1	blue	3	900000	Dun
2	Jaguar	XKR	silver	2	70000	Gla1
3	SMART	Sports	green	3	22300	Abd
4	Nissan	GT-R	red	4	80000	Dun
5	Alfa Romeo	Giulia	green	2	50000	Dun
6	Audi	TT Coupe	white	4	12050	Gla2
7	Mazda	MX-5	black	2	21987	Abd
8	Jaguar	F-Type	red	2	105200	Dun
9	SMART	Sports	yellow	3	17000	Gla1
...	...	...	...	...	...	...

(a) Design a query that would output the model, number of seats and the showroom manager for all the Jaguar cars located in Glasgow. **4**

Field(s)	
Table(s)	
Search criteria	

MARKS

DO NOT WRITE IN THIS MARGIN

(b) An SQL statement is implemented to find all two seater cars and produces the output below.

make	model	salePrice
Alfa Romeo	Giulia	50000
Alfa Romeo	GTV	35000
Alfa Romeo	Spider	66000
Fiat	Spider 124	26345
Jaguar	F-Type	105200
Jaguar	XJS	45595
Jaguar	XKR	70000
Lotus	Evora	72500
Mazda	MX-5	21987
Porsche	Cayman 718	40000

Write the SQL statement that will produce this output, in the order shown. **4**

(c) One functional requirement is to output the make, model and price of cars costing less than 60000 which are not in Glasgow.

```
SELECT make, model, colour, salePrice
FROM Car
WHERE showroomID = "Abd"
AND salePrice < 60000;
```

Give two reasons why the SQL statement would not produce the required output. **2**

Reason 1 _____

_____

Reason 2 _____

_____

SECTION 3 — WEB DESIGN AND DEVELOPMENT — 25 marks

Attempt ALL questions

18. A team of web designers create a low-fidelity prototype for a bakery that wishes to sell its cakes online.

(a) State one benefit to the bakery of a low-fidelity prototype being created. **1**

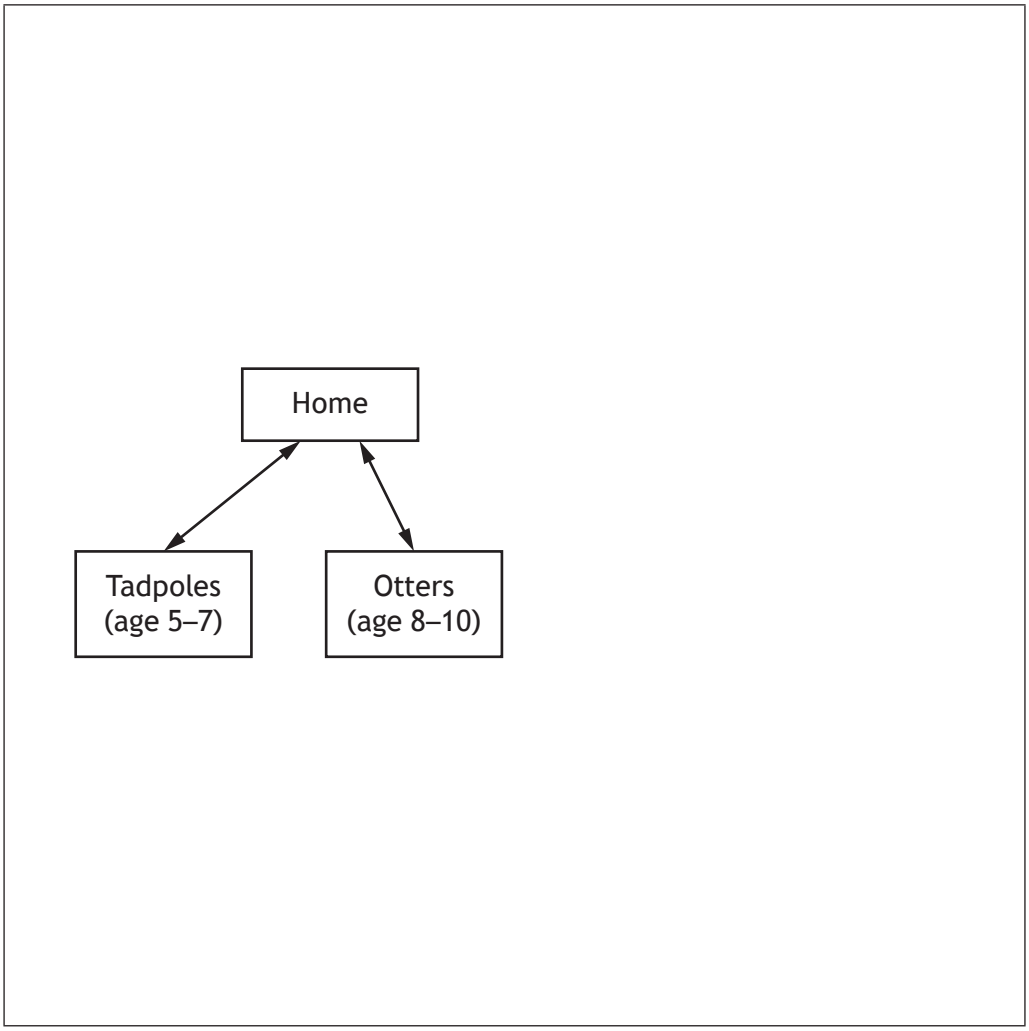
(b) The designers ensure there is consistency across the prototype.
Describe why consistency is a benefit for end-users. **1**

19. A swimming club currently runs sessions for swimmers aged 5–7 and 8–10.

The diagram below shows the current structure of the club's website.

The club wants to add a new page to their website showing information for swimmers in the Dolphins group (aged 11–14). They would also like to add an external link from their home page to local competition dates.

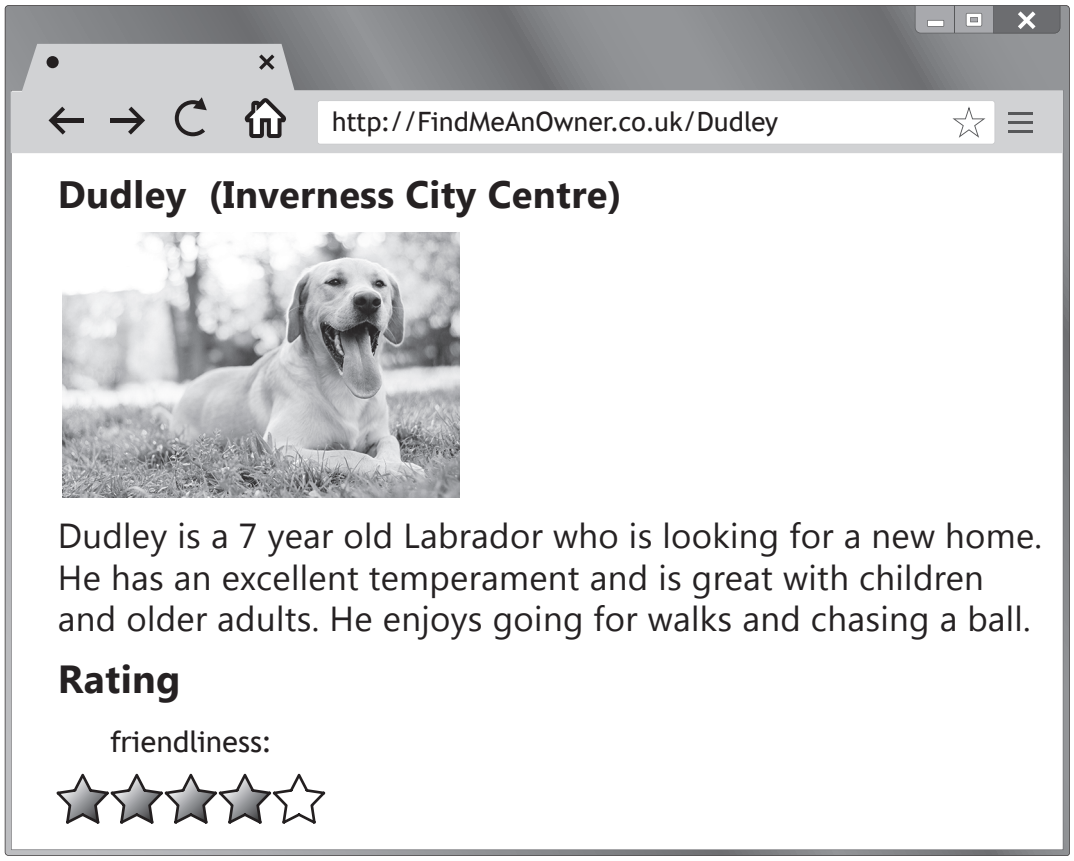
Complete the diagram below to show the structure of the updated site. **3**



[Turn over

20. Find Me An Owner dog rescue centre is creating a new website.

Each dog has its own web page. The home page contains links to all of these pages. One of the pages is shown below.



(a) (i) State a suitable file format for the image of the dog and explain your choice. **2**

File format _____

Explanation _____

_____

_____

20. (a) (continued)

(ii) The staff at the centre took the photo of the dog.

Explain why the centre staff do not have to worry about the Copyright Designs and Patents Act when using this picture on the web page. **1**

_____

_____

(b) The following HTML code is added to each dog's web page.

```
<p> Back to the home page <a href= "home.html"> click
here </a>
</p>
```

Show how this code would be displayed when viewed in a browser. **2**

20. (continued)

(c) When testing one of the links on the home page the following error screen appears.

(i) State one possible reason why the 'Page Not Found' error was displayed. **1**

(ii) All the links on the website have now been tested.

Describe two other tests that should be carried out on the website. **2**

Test 1 _____

Test 2 _____

[Turn over for next question

DO NOT WRITE ON THIS PAGE

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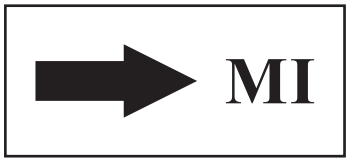
21. MoveIt estate agency is developing a new website.

The following code is used to create the home page for the estate agent's website. The home page includes a heading, a video, a welcome message and the company logo shown below.



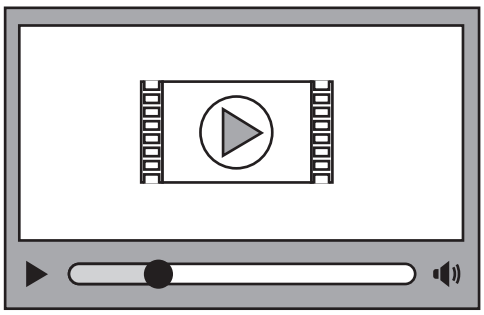

```
…
<style>
h1 {text-align:right;font-size:24pt}
.pageText {text-align:left;font-size:12pt}
</style>
…
<h1 class="pageText"> MoveIt Estate Agents </h1>

<video width="400" height="300" controls>
<source src="intro.mp4">
</video>

<p class="pageText"> Welcome to MoveIt Estate Agents
</p>
<img src="logo.jpg" width="200" height="100">
…
```

21. (continued)

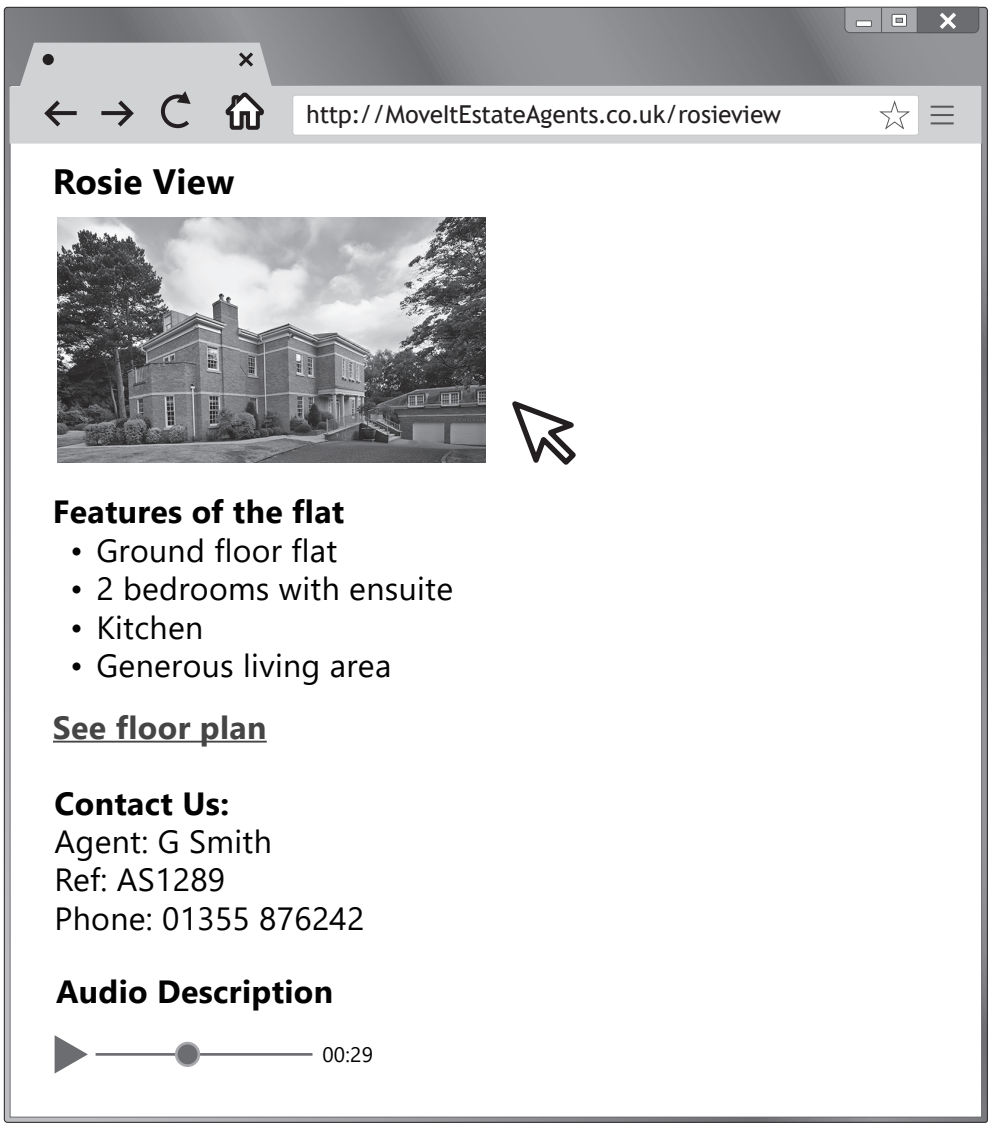
(a) Draw how the home page will look when viewed in a browser. Some of the content has already been added. **3**



[Turn over

21. (continued)

One of the implemented pages from MoveIt's website is shown below.



21. (continued)

(b) The following code is used to create the page.

```
…
<h3> Features of the flat </h3>

<ul>
<li> Ground floor flat </li>
<li> 2 bedrooms with ensuite </li>
<li> Kitchen </li>
<li> Generous living area </li>
</ul>

<a href="floorplan.html"> See floor plan </a>

<h3> Contact Us: </h3>

<p class="contactInfo"> Agent: G Smith </p>
<p class="contactInfo"> Ref: AS1289 </p>
<p class="contactInfo"> Phone: 01355 876242 </p>
…
```

(i) Write the single CSS rule that could be used to centre align the three paragraphs underneath 'Contact Us', ensuring the size of the font is 12. **3**

_____{_____

_____}

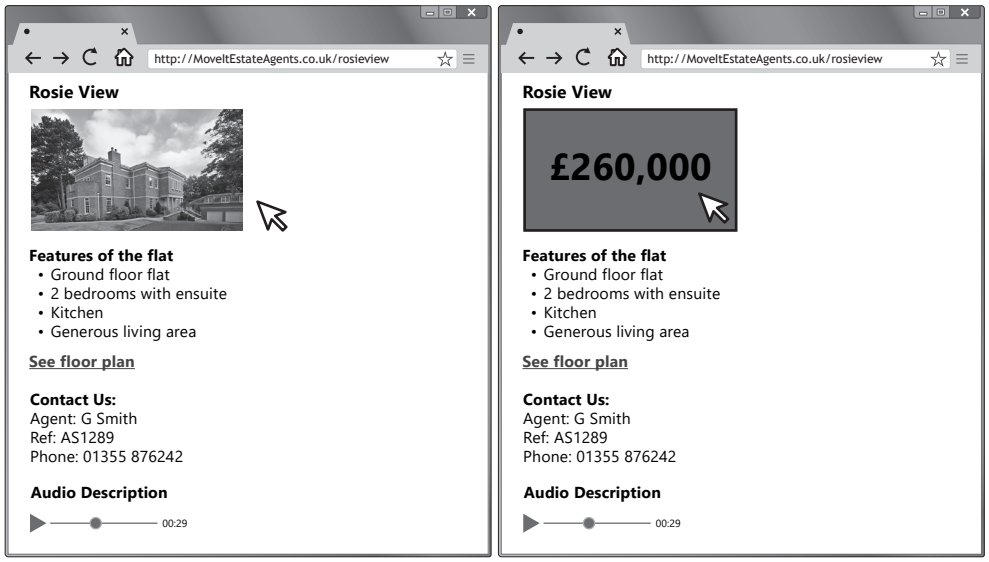
(ii) State the type of addressing in the hyperlink that is used to take the user to the floor plan page. **1**

_____

[Turn over

21. (continued)

(c) The page includes a feature that changes the image of the flat to the price of the flat when the user moves the cursor over the image.



(i) State the language used to implement this feature. **1**

(ii) State the type of event that would be used in this feature. **1**

(d) The website currently includes audio descriptions of each flat. These audio clips are stored using a compressed file format.

(i) State one benefit to the end-user of the site using a compressed format for these audio files. **1**

21. (d) (continued)

(ii) When recording the audio descriptions, a choice of sample rates can be used.

Sample rate A	Sample rate B
800 Hz	44 kHz

State one advantage and one disadvantage of using Sample rate B when recording and storing the sound file rather than Sample rate A. **2**

Advantage of Sample rate B _____

_____

Disadvantage of Sample rate B _____

_____

[END OF QUESTION PAPER}

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ADDITIONAL SPACE FOR ANSWERS

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ADDITIONAL SPACE FOR ANSWERS

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