FOR OFFICIAL USE

National Qualifications

Mark

X816/76/01 Computing Science

Duration — 2 hours

X8167601

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. Two's complement can be used to represent positive and negative integers.

Comp Sys

(a) Convert the denary number −9 into 8-bit two's complement. **1**

(b) State the range of denary values that can be represented using 8-bit two's complement. **2**

2. Increasing clock speed is one method of improving processor performance.

Comp Sys

(a) State one other method of improving processor performance. **1**

(b) Explain how your answer to part (a) improves performance. **1**

3. Describe an intelligent system used on a car journey that is beneficial for the environment.

Comp Sys

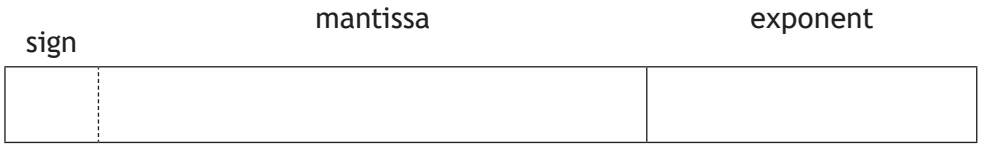
Justify your answer. **2**

4. Write the binary number −0.0011 using floating-point representation.

Comp Sys

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

Space for working



5. An online bank uses digital signatures when sending financial documents.

Comp Sys

Describe the purpose of a digital signature when sending documents. **2**

6. A function is used to ensure that a user's input for their date of birth contains exactly six numbers.

For example, someone with a date of birth of 31st May 2003 would be entered as 310503.

The first version of the code for this function is shown below.

```
...
Line 235   FUNCTION validateDob (STRING dob) RETURN BOOLEAN
Line 236     DECLARE valid INITIALLY false
Line 237     DECLARE lengthCheck INITIALLY false
Line 238     DECLARE countValid INITIALLY 0
Line 239     DECLARE thisValue INITIALLY 0

Line 240     IF length(dob) = 6 THEN
Line 241       SET lengthCheck TO true
Line 242     END IF

Line 243     FOR EACH character FROM dob
Line 244       SET thisValue TO <ASCII value of character>
Line 245       IF thisValue >= 48 AND thisValue <=57 THEN
Line 246           SET countValid TO countValid + 1
Line 247       END IF
Line 248     END FOR EACH

Line 249     IF _____________ AND _____________ THEN
Line 250       SET valid TO true
Line 251     END IF
Line 252     RETURN valid
Line 253   END FUNCTION
```

(a) Complete line 249 in the space below. **2**

(b) Explain why this version of the function is inefficient. **1**

7. An athletics competition takes place between different clubs. The competition includes four throwing events which are shot put, discus, hammer and javelin.

The result for each competitor is stored in a csv file. The file stores the competitor's name, club, event name and distance thrown in metres.

A program is required to read the data from the csv file and then process it.

A sample of the data is shown below.

F Dean,Rothesay Rovers,Discus,58.04
J Smith,Hawick Harriers,Shot Put,17.23
K Singh,Rothesay Rovers,Javelin,71.75
…

(a) The data from the file is imported into an array of records.

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

(ii) The csv file contains 800 results.

Using a programming language of your choice, declare a variable that can store the data for the 800 results. Your answer should include the data structure from part (i). **2**

[Turn over

7. (continued)

(b) In order to qualify for the javelin final, a competitor must throw a distance of 70 metres or more.

The event organisers would like the program to create a file with the name and club of all the competitors who have qualified for the javelin final.

Using a recognised design technique, design an algorithm that would create this file. **5**

7. (continued)

(c) The event organisers would like to be able to display the distance thrown by a competitor in a particular event.

Using a programming language of your choice, write code that

- asks for the name of a competitor and the event
- displays the competitor name, distance and event, for example 'J Smith threw 17.23 in the Shot Put' or displays the message 'Competitor not found'.

Your answer should make use of the data structure defined in part (a). **6**

8. An app uses three selected letters from a user's password to help identify a user when logging in. An example is shown below.

Please enter the letters requested from your password.
For example, if your password was "London" and you are asked for letters 1, 3 and 5 then you should enter L, n, o

Letter 1	Letter 3	Letter 5
*	*	*

The top-level design for this part of the program is shown below.

1. Ask user for username and find password
2. Generate three random positions within length of password
3. Ask user for letters at generated random positions and check for a match

(a) Complete the table below to show the missing data flow in steps 2 and 3. **2**

Step	IN/OUT	Data Flow
1	IN	
	OUT	password
2	IN	
	OUT	randPos1, randPos2, randPos3
3	IN	
	OUT	valid

(b) By considering the data flow in part (a), explain why it would be appropriate to make use of a function rather than a procedure for step 3. **1**

8. (continued)

(c) Explain why the programmer refers to the data flow in the top-level design when implementing the code for the program. **1**

_____

_____

_____

[Turn over

8. (continued)

(d) The code for step 2 is shown below.

```
...
Line 45  PROCEDURE getLetters (STRING word, INTEGER first,
         INTEGER second, INTEGER third)
Line 46    DECLARE wordLength AS INTEGER INITIALLY
           length(word)
Line 47    SET first TO <random number from 1 to wordLength>
Line 48    SET second TO <random number from 1 to wordLength>
Line 49    SET third TO <random number from 1 to wordLength>
Line 50  END PROCEDURE
...
Line 60  getLetters(password,randPos1,randPos2,randPos3)
...
```

(i) Formal and actual parameters are used in the code above.

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

Formal parameter _____

Actual parameter _____

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

_____

_____

(iii) During testing it was found that users were asked for duplicate letters, for example asking for letters 1, 1 and 7 of their password.

Describe how the procedure could be altered to ensure three different letters are requested from the user. **2**

_____

_____

_____

_____

_____

8. (continued)

(e) Explain why the use of procedures improves the efficiency of code. **2**

[Turn over

9. JustDine is developing a smartphone app to allow a user to identify restaurants based on the type of food. Restaurants register with JustDine. The app will store the name, city, type of food and rating for each restaurant.

Features of the app:

- Users can enter the type of food and city
- Displays the number of matching restaurants
- Displays the name and rating of the highest rated matching restaurant.

The user interface for the app is shown below.

(a) During analysis the inputs, processes and outputs were identified.

Describe two processes. **2**

9. (continued)

(b) Details for registered restaurants are stored in four parallel 1-D arrays.

- `restaurantName`
- `foodType`
- `city`
- `rating`

Using a recognised design technique, design an algorithm that would count the number of restaurants that match the user's food type and city. **4**

MARKS

DO NOT WRITE IN THIS MARGIN

(c) The following function is to be used to find the highest rating for a restaurant.

During testing it is found that this code contains an error.

```
...
Line 26  FUNCTION findMax (ARRAY OF REAL list) RETURNS
         REAL
Line 27    DECLARE upper INITIALLY length(list) -1
Line 28    DECLARE highest INITIALLY list[0]
Line 29        FOR index FROM 1 TO upper DO
Line 30           IF highest > list[index] THEN
Line 31              SET highest TO list[index]
Line 32           END IF
Line 33        END FOR
Line 34    RETURN highest
Line 35  END FUNCTION
...
```

A trace table is used when the function is tested with the following values [4.51, 4.12, 4.99].

Line Number	index	list [index]	highest	highest > list [index]
...				
28			4.51	
29	1			
30		4.12	4.51	true
31			**A**	
29	2			
30		**B**	4.12	**C**
34			4.12	

(i) Identify the missing values A, B and C. **3**

A _____

B _____

C _____

(ii) Describe how a breakpoint could be used to check the values in the trace table. **2**

_____

_____

_____

_____

9. (c) (continued)

(iii) Describe how the error in this code can be corrected. **1**

_____

_____

_____

(d) The function `findMax` in part (c) is used to assign the highest rating from the array `rating` to the variable `myHighest`.

Using a programming language of your choice, write the line of code that assigns the highest rating to `myHighest`. **2**

[END OF SECTION 1]

[Turn over

SECTION 2 — DATABASE DESIGN AND DEVELOPMENT — 25 marks

Attempt ALL questions

10. A relational database is used to store data about the products that a shop sells. The database has the following tables.

Product	**Category**	**Courier**	**Manufacturer**
productID	categoryName	courierID	manufacturerName
name	categoryDescrip	courierName	manufacturerAddress
description	currentDiscount	courierAddress	manufacturerTelNo
price		courierTelNo	courierID*
categoryName*			
manufacturerName*			

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**

11. A database table is shown below.

Film				
filmID	**title**	**releaseDate**	**runTime**	**rating**
SC1	Spider craze	01/12/2018	117	12A
WM1	Waterman	21/12/2018	143	PG
IL1	Isn't it love	13/02/2019	89	12A
BW1	Battle of the world	14/02/2019	122	12A
HT1	How to train your puppy	22/02/2019	104	PG
IC2	Ice cold	22/02/2019	119	15
MB1	Miss Becca	03/03/2019	104	15
TA1	The afterlife	05/03/2019	109	15
CD1	Captain Delsie	08/03/2019	124	12A
GB1	Green band	12/03/2019	130	12A

Complete the table below showing the expected output from the following SQL statement. **3**

```
SELECT rating, MAX(runTime) AS [Longest movie]
FROM Film
GROUP BY rating
ORDER BY MAX(runTime) DESC;
```

rating	**Longest movie**

[Turn over

DO NOT WRITE IN THIS MARGIN

12. A shop uses a relational database to keep track of stock. One of the database tables is shown below.

Snack					
productID	**productName**	**type**	**weight**	**price**	**stock**
001	Baked Cheese Snacks	Single	37.5	0.65	565
002	Sweet Chilli Flakes	Single	28	0.65	300
003	Chicken Crisps	Single	32.5	0.55	240
004	Ready Salted Crisps	Single	30	0.58	654
005	Cheese Straws	Single	12	0.70	120
006	Tomato Puffs	Single	20	0.70	400
007	Prawn Cocktail Crisps	Multi-bag	78.6	1.00	335
008	Wheat Crunch Crisps	Multi-bag	138	1.00	356
009	Assorted Flat Crisps	Multi-bag	153	1.50	545
010	Variety Pack	Multi-bag	150	0.56	678
011	Salted Pack	Multi-bag	150	1.30	614
012	Salted Pretzels	Family bag	80	0.45	450
013	Tortilla Chips	Family bag	200	0.46	456
014	Aberdeen Angus Crisps	Family bag	225	1.89	684
015	Salt and Pepper Shakes	Family bag	150	0.99	600

12. (continued)

(a) Design a query to display the most expensive multi-bag and family bag as shown below. **4**

type	Most Expensive Item
Multi-bag	1.50
Family bag	1.89

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

(b) The manager wants to half the price of all products with stock levels of more than 500.

Write the SQL statement that would make these changes. **3**

[Turn over

12. (continued)

(c) A query is written to display the total amount of stock for each type of snack.

The expected ordered output is shown below.

type	Total Stock
Multi-bag	2528
Single	2279
Family bag	2190

When the SQL statement below is tested the actual output does not match the expected output.

```
SELECT type, COUNT(stock)
FROM Snack
GROUP BY type;
```

Re-write the SQL statement to produce the expected output. **3**

(d) Write the SQL statement to remove all records of snacks that include 'Salt' in any part of their product name. **2**

13. A holiday rental shop rents a range of items to customers. It uses a relational database consisting of three linked tables storing data on items, customers and rentals.

When initially designing the `Rental` table for this database, the primary key was designed using a compound key of `customerID` and `itemID`.

Rental
customerID*
itemID*
startDate
noOfDays

An example of the data to be stored in the `Rental` table is shown below.

Rental			
customerID	**itemID**	**startDate**	**noOfDays**
AM974	CB001	26/06/2021	14
AM974	KB001	30/06/2021	3
DR734	MS003	05/07/2021	7
AM974	RB002	30/06/2021	3
JS003	KB002	04/07/2021	2
JS003	KB002	10/07/2021	1
JS003	RB001	04/07/2021	2
KW001	WH001	10/07/2021	14
RB435	MS003	15/07/2021	14
SP234	CB001	02/08/2021	7
DR734	KB001	06/07/2021	6
DR734	IR001	07/07/2021	2
...	...	...	...

(a) Explain why a compound key of `customerID` and `itemID` would mean that the table is not fit for purpose. **1**

DO NOT WRITE IN THIS MARGIN

13. (continued)

(b) The `Rental` table was re-designed with a primary key called `rentalID`. Extracts from the three tables are shown below.

Rental				
rentalID	**customerID**	**itemID**	**startDate**	**noOfDays**
REN14	AM232	EK001	01/08/2021	14
REN1	AM974	CB001	26/06/2021	14
REN2	AM974	KB001	30/06/2021	3
...	...	...	...	...

Customer				
customerID	**firstName**	**surname**	**hotel**	**resort**
AM232	Amy	Moore	Esmerelda	Caleta
AM974	Amy	Moore	Labranda	Jandia
DR734	Darcia	Rycroft	Arenas	Corralejo
...	....	...	...	...

Item			
itemID	**itemType**	**itemModel**	**dailyRentalPrice**
CB001	Children's buggy	Basic	£6.00
CB002	Children's buggy	Mid	£7.00
CB003	Children's buggy	Deluxe	£9.00
EK001	Kettle	Mid	£4.00
IR001	Iron	Mid	£3.00
KB001	Kid's bike	Basic	£14.00
...	...	...	...

MARKS

DO NOT WRITE IN THIS MARGIN

A list is required to show details of all rentals with a start date in July 2021. The list should display the calculated rental cost for each rental, as shown below.

customerID	itemType	startDate	Rental Cost
JS001	Manual wheelchair	02/07/2021	£32.00
JS003	Road bike	04/07/2021	£40.00
JS003	Kid's bike	04/07/2021	£30.00
DR734	Mobility scooter	05/07/2021	£126.00
DR734	Kid's bike	06/07/2021	£84.00
DR734	Iron	07/07/2021	£6.00
AM974	Road bike	08/07/2021	£42.00
KW001	Manual wheelchair	10/07/2021	£112.00
JS003	Kid's bike	10/07/2021	£15.00
KW001	Kettle	12/07/2021	£48.00
RB435	Mobility scooter	15/07/2021	£252.00

Design a query to produce this sorted output. **4**

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

13. (continued)

(c) A query was created to display the highest daily rental price. This query was saved as 'MaxRental'.

Max daily rental
23.00

Using the 'MaxRental' query, complete the SQL statement below to display the item type and item model of any item matching this highest price. **2**

```
SELECT itemType, itemModel
```

[Turn over for SECTION 3

DO NOT WRITE ON THIS PAGE

SECTION 3 — WEB DESIGN AND DEVELOPMENT — 25 marks

Attempt ALL questions

14. The HTML code and JavaScript function below changes the colour of text when the mouse moves over it.

```
<script>
      function displayRed(my_text)
      {my_text.style.color='red';}
</script>

<p onmouseover="displayRed(this)">Sale now on</p>
```

(a) Write an additional JavaScript function to change the colour of `Sale now on` to black. **1**

(b) Re-write the paragraph element to include a call to your function from part (a), so that the text can also be changed to black when the mouse moves away. **2**

15. Some CSS properties for a website are implemented/coded as follows.

```
header {margin-right:10px; margin-left:10px;}
nav {margin-right:10px; margin-left:10px;}
#event {width:700px; margin-left:10px;}
#gaminglogo {width:75px; height: 75px; float:right;
margin-right: 20px;}
#eventlogo {float:right; width:75px; height:75px;
margin-right:20px;}
#floorplan {margin-left:10px; width:700px;}
footer {margin-left:10px; margin-right:10px;}
```

Using grouping selectors to remove any repetition, re-write the code to make it more efficient. **3**

[Turn over

16. Music Tutor is a company that offers music lessons. They are creating a website to advertise the business.

A 'Contact Us' page will contain a form where customers supply their details and make an enquiry.

The HTML code for the form is shown below.

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

      Email Address:<br>
      <input type="text" name="email"><br><br>

      Mobile Number:<br>
      <input type="text" name="mobile"><br><br>

      Instrument:<br>
      <select name="instrument" size="3">
           <option value="clarinet">Clarinet</option>
           <option value="flute">Flute</option>
           <option value="trumpet">Trumpet</option>
           <option value="tuba">Tuba</option>
           <option value="violin">Violin</option>
      </select>
      <br><br>

      Contact Method:<br>
      <input type="radio" name="contact"
      value="Phone">Phone Call<br>
      <input type="radio" name="contact"
      value="Email">Email<br>
      <input type="radio" name="contact" value="Text">Text
      Message<br>
      <br>

      Additional Comments:<br>
      <input type="textarea" name="comments" rows="10"
      cols="30">
      <br><br>


</form>
```

16. (continued)

(a) (i) State which essential HTML form element is missing from the form. **1**

(ii) Write the additional line of HTML code to add the missing form element. **1**

(b) (i) During usability testing of the form, feedback indicated that the preferred default contact method should be email.

State the attribute that should be added to the email option to achieve this. **1**

(ii) A customer wants to select both violin and flute but the form does not allow this.

Re-write the line of HTML code to allow this. **1**

(c) A range of personas are used when conducting usability testing of the website.

State one suitable persona and explain why adopting this persona is helpful when conducting usability testing. **2**

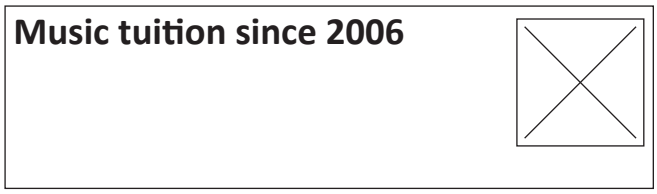
Persona _____

Explanation _____

[Turn over

16. (continued)

When designing the website the image and heading are to be on the same line as shown below.

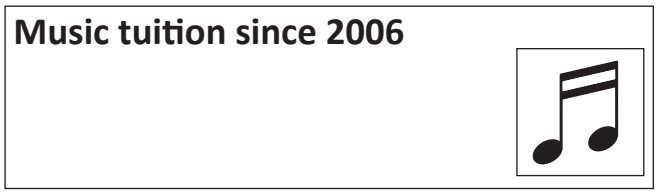


The following HTML and CSS code is used.

```
<head>
     <style>
          img {float: right;}
     </style>
</head>

<body>
     <h1>Music tuition since 2006 </h1>
     <img src="musicnote.jpg" width = 200>
...
```

However, the image appears on the line beneath the heading, as shown below.



The following CSS rule is added.

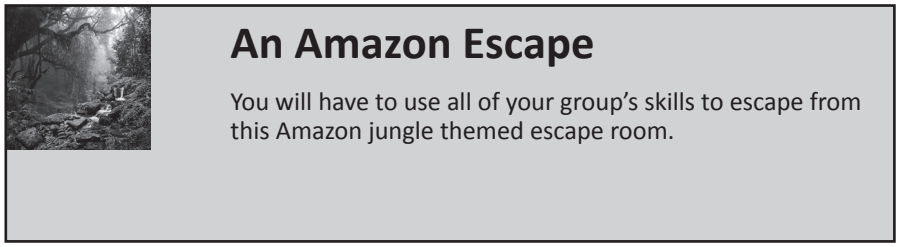
```
h1 {display: inline;}
```

(d) Explain why the display property of the `h1` element had to be changed to achieve this layout. **2**

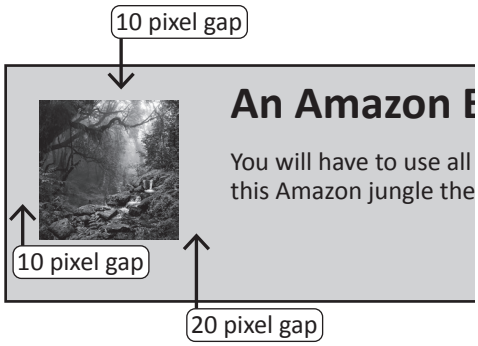
17. Pranav runs an escape room company that uses a website to promote the different themed escape rooms.

(a) Part of the information page of the company's website is shown below.

The image is too close to the top left of the section element.



The layout should be as below. The gaps above and to the left of the image are 10 pixels. The gap to the right is 20 pixels.



Complete the appropriate CSS rule for this image. **2**

```
.eventimage {

}
```

[Turn over

17. (continued)

Pranav wants to add a new web page with a form where customers can contact his company to enquire about bookings.

Customers are required to enter a contact name, email address, date of booking and the party size (max of 6).

Customers will have to choose a theme from Amazon Escape, Mayan Mayhem or Aztec Anarchy. They can also provide any additional information.

(b) Draw a suitable wireframe for this form which indicates validation. **4**

17. (continued)

(c) The wireframe is then used to create a low-fidelity prototype.

Describe one benefit for the developer and one benefit for the client of using this low-fidelity prototype. **2**

Developer benefit _____

_____

Client benefit _____

_____

(d) The navigation bar for the website is as shown below.

(i) This version of the navigation bar used the code below.

```
nav {height:35px; background-color: darkgrey}
nav ul li {float:left;width:150px;text-
align:center;}
nav ul li a {display:block; padding:8px;}
```

Complete the CSS rule to remove the bullet points from the navigation bar. **1**

```
nav ul {                                    }
```

(ii) Explain why the unordered list in the navigation bar will display differently from any other unordered list in the website. **2**

_____

_____

_____

_____

[END OF SECTION 2]

[END OF QUESTION PAPER]

MARKS | DO NOT WRITE IN THIS MARGIN

ADDITIONAL SPACE FOR ANSWERS

MARKS | DO NOT WRITE IN THIS MARGIN

ADDITIONAL SPACE FOR ANSWERS

[BLANK PAGE]

DO NOT WRITE ON THIS PAGE

Acknowledgement of copyright
Question 17 Teo Tarras/shutterstock.com