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National
Qualifications

Mark

--

CS(H)22A

Computing Science

Duration – 2 hours

Fill in these boxes and read what is printed below.

Full name of centre

Town

--

--

Forenames(s)

Surname

Number of seat

--

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Date of birth

Day

Month

Year

D	D
---	---

M	M
---	---

Y	Y
---	---

Scottish candidate number

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Total marks - 80

SECTION 1 - 55 marks

Attempt ALL questions.

Attempt questions in **EITHER**:

Section 2 (25 marks) - Database Design and Development - Page 14

OR

Section 3 (25 marks) - Web Design and Development - Page 20

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 marks for this paper.

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SECTION 1 - 55 MARKS

MARKS

DO NOT
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Attempt ALL questions

1. 8-bit two's complement is used to represent numbers.

(a) Convert the following 8-bit two's complement number into denary.

1

1000 1010

--

(b) State the range of numbers that can be represented by 8-bit two's complement.

2

2. Explain, referring to a programming language of your choice, how floating point data in a program is converted to an integer.

2

3. Describe one problem that can occur when using global variables in a program.

1

4. Tracking cookies are a feature of modern web browsing.

Describe two potential security risks related to using tracking cookies.

2

Risk 1 _____

Risk 2 _____

5. Software for a security entry system stores the codes used to access a building, in an array.

AB23X	HYS67	N8X9S	EJSWS	MNJAG	88HSB
-------	-------	-------	-------	-------	-------

A function is used to validate codes entered and returns a message with the security permission linked to the code.

```
Line 57  FUNCTION  securityCheck (ARRAY OF STRING codes, STRING
          userCode)RETURNS STRING
Line 58    FOR EACH code FROM codes DO
Line 59      IF userCode = code THEN
Line 60        SET message TO "Allow access"
Line 61      ELSE
Line 62        SET message TO "No access"
Line 63      END IF
Line 64    END FOR
Line 65    RETURN message
Line 66  END FUNCTION
```

The program does not work correctly.

- (a) Identify the error in the program.

2

- (b) Rewrite part of the code above so the function works as expected.

2

6. A computer program deals cards to players. The program makes use of a record structure to hold the details of the cards.

Each card has a suit, a name, a value and a colour. All face cards (Jack, Queen and King) have a value of 10, the Ace has a value of 1 and all other cards, 2 to 10 have their face value e.g. 10 has a value of 10. Hearts and diamonds are red cards, spades and clubs are black cards.



For example, the Jack of Hearts has these values:

Suit: Hearts

Name: Jack

Value: 10

Colour: Red

- (a) (i) Using a programming language of your choice, create an efficient record structure to store this information.

3

A large, empty rectangular box intended for the student to write their programming solution for part (a)(i).

- (ii) There are 52 cards in a deck.

Using a programming language of your choice, define a variable to store all the cards in a deck.



2

A large, empty rectangular box intended for the student to write their programming solution for part (a)(ii).

6. (continued)

- (b) The program sets up the deck when the program starts.

Complete the missing steps in this code to setup the deck using your record structure and array from (a)(i) and (a)(ii)

5

```

Line 57 SET suits TO ["Spades", "Hearts", "Clubs", "Diamonds"]
Line 58 SET names TO ["Ace", "Two", "Three", "Four", "Five", "Six", "Seven", "Eight", "Nine", "Ten",
Line 59   "Jack", "Queen", "King"]
Line 59 FOR suit = 1 TO 4 DO
Line 60   FOR name = 1 To 13
Line 61     SET index TO (suit - 1 ) * 13 + name

Line 62     _____

Line 63     _____
Line 64     IF (suits[suit] = "Spades" OR suits[suit] = "Clubs" THEN

Line 65     _____
Line 66     ELSE

Line 67     _____
Line 68     END IF
Line 69     IF name > 9 THEN

Line 70     SET _____
Line 71     ELSE

Line 72     SET _____
Line 73     END IF
Line 74     END FOR
Line 75     END FOR

```

- (c) During testing of the program, the programmer makes use of breakpoints and watchpoints.

Explain the difference between a watchpoint and a breakpoint.

3

[Turn over

6. (continued)

- (d) The card program currently runs on this computer.



Eight Core Processor

32-bit Data Bus

128 Mb Cache Memory

2800 Mhz Clock Speed

- (i) Explain how changing the width of the data bus from 32-bit to 64-bit would improve the performance of the computer.

2

- (ii) State what is meant by cache memory.

2

- (iii) Explain why increasing the size of cache memory may not improve the performance of a program.

2

7. Code breaker is a simple puzzle game and an app developer wants to develop a program to play the game with a user. The game creates a random code with four letters: A, B, C and D. The code is four characters long and can contain any combination of the four letters.

A user is allowed 10 guesses to match the code. If the user enters a letter that appears in the code but in another position, their feedback is question mark, if the user enters a letter in the position correct, they get a tick in their feedback. If the letter isn't in the code, they get a cross. Some examples of this feedback are shown below.

Code	Guess	Feedback
DDCA	ABCD	? X ✓ ?
DDCA	AACD	? ? ✓ ?
DDCA	DDCA	✓✓✓✓

- (a) During the analysis stage boundaries are identified.

State two boundaries for this task.

2

- (b) The characters in the program can be represented as either ASCII or Unicode.

Describe an advantage of using Unicode over ASCII, referring to the number of bits used to represent a character in each format.

2

7. (continued)

- (c) The app developer updates the app so that the scores of users are uploaded to a server.

Describe how the system could ensure secure encrypted transfer of data to the server.

2

- (d) An algorithm is used to find the user with the highest score for the app. Unfortunately, when this code runs, it never exits the loop.

```

Line 72  SET counter TO 0
Line 73  SET maximum TO scores[counter]
Line 74  SET counter TO counter + 1
Line 75  WHILE counter <= LENGTH(scores)-1
Line 76    IF scores[counter] > maximum THEN
Line 77      SET maximum TO scores[counter]
Line 78      SET counter TO counter + 1
Line 79    END IF
Line 80  END WHILE

```

- (i) Complete this trace table for the first four values in the array scores. The first one, has been done for you.

scores [2716, 3737, 8009, 2028, 3340]

2

Line	counter	scores[counter]	maximum
73	0	2716	2716
79			
79			
79			

- (ii) Explain the error in this algorithm and how it can be resolved.

2

[Turn over]

8. Forest Green make six different flavours of ice cream and a flavour may be ordered multiple times per day. They use the following program to count the orders for the day. The orders are stored in an array called orders.

orders	Chocolate	Mint	IronBrew	...	Vanilla	Mint
--------	-----------	------	----------	-----	---------	------

A section of this code is shown below.

```

Line 37 ...
Line 38 SET MintOrders TO CountOrders(orders,"Mint")
Line 39 SET ChocOrders TO CountOrders(orders,"Chocolate")
Line 40 SET IronBrewOrders TO CountOrders(orders,"IronBrew")
Line 41 ...

Line 88 FUNCTION CountOrders(ARRAY OF STRING orders, STRING icecream)
      RETURNS INTEGER
Line 89   SET count TO 0
Line 90   FOR EACH order FROM orders DO
Line 91     IF order = icecream THEN
Line 92       count = count + 1
Line 93     END IF
Line 94   END FOR
Line 95   RETURN count
Line 96 END FUNCTION

```

- (a) Describe how the parameters are used within the function when it is called on line 38. Your answer should identify the formal and actual parameters.

3

- (b) Explain why the code for this program is inefficient.

2

[Turn over]

8. (continued)

- (c) A programmer has plans to use two parallel 1D-Arrays to store the six ice cream flavours being counted and the count for each one. When completed, the arrays would look something like:

orderKey	Chocolate	Mint	IronBrew	...
orderCount	7	3	10	...

The programmer designs this algorithm for the initial design of this part of the program.

- 3.1 add each **unique** icecream flavour in orders array to the orderKey array
- 3.2 initialise orderCount for every element in orderKey
- 3.3 count each order, updating the correct element in orderCount
- 3.4 display the results

- (i) Using a design technique of your choice, complete a design for step 3.1 above. Part of the design has been completed for you.

5

3.1 add each **unique** icecream flavour in orders array to the orderKey array:

```
DECLARE orderKey[6] AS ARRAY OF STRING
DECLARE unique AS BOOLEAN
FOR i FROM 0 TO 5 DO
    orderKey[i]="null"
END FOR
FOR EACH order FROM orders DO
    SET unique TO True
```

8. (c) (continued)

- (ii) Using a design technique of your choice, complete a design for step 3.3.

4

3.3 count each order, updating the correct element in orderCount:



[Turn over

[BLANK PAGE]

You must complete **EITHER** Section 2 or Section 3

Section 2 - Database Design and Development - Page 14

OR

Section 3 - Web Design and Development - Page 20

[Turn over for Section 2

SECTION 2 - Database Design and Development

Attempt ALL questions

MARKS

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9. A database consists of the following three tables.

Session

SessionID	SessionTime	SessionDay
...	...	...
2981	10:00 - 10:50	Thursday
2999	11:00 - 11:50	Thursday
3002	12:30 - 13:20	Thursday
3003	16:00 - 17:00	Friday
3005	09:00 - 11:00	Friday
...	...	...

Space

SpaceID	SpaceName	Equipment
...	...	...
002	Weights Room	Kettlebells
009	Weights Room	Sandbells
012	Spin Studio 1	Cycles
078	Spin Studio 2	Cycles
102	Gym 1	Treadmill
107	Gym 2	Elliptical
109	HIIT Space	Barbells
...	...	...

Booking

Client	SessionID	SpaceID
...	...	...
Miss E Smith	2981	009
Mr R Evans	2981	012
Mr M Paul	2981	107
Miss E Smith	3005	002
Mr R Evans	3005	107
...	...	...

- (a) State the compound key from the database above.

2

9. (continued)

- (b) Draw an entity relationship diagram for this database. Your answer should show the entity names and cardinality. You do not need to show attributes in your diagram.

2

10. A database table is shown below.

Commodity

product	area	buy	sell	profit
Mineral Extractors	Sherones	429	798	369
Domestic Appliances	Sherones	437	701	264
Liquor	Guguroro	587	841	254
Water Purifiers	Guguroro	182	401	219
Clothing	Guguroro	229	445	216
Basic Medicines	Setesuyara	195	316	121
Food Cartridges	Setesuyara	45	142	97
Power Generators	Setesuyara	437	529	92
Hydrogen Fuel	Setesuyara	94	107	13
Biowaste	Setesuyara	14	15	1

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

```
SELECT area, MAX(profit) AS "Trade Income"
FROM Commodity
WHERE buy < 430
GROUP BY area;
```

3

[Turn over

11. An orchestra uses a database to hold records of musicians, instruments, and performances at concerts.

Each concert should have a venue, date and type of music.

Each musician should have a name, a date of birth and what seat position in the orchestra that they play.

Each performance occurs at a specific concert by an individual musician on a certain instrument.

The musicians can be selected by the instrument or by their seat in the orchestra. A manager can count the number of musicians that are available to play instruments.

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

2

- (b) Tables from the database are shown below.

Performance				
perform_no	musician_no	concert_no	instrument	perf_type
1	3	4	banjo	jazz
2	4	1	violin	classical
3	4	4	bass	jazz
4	5	4	guitar	jazz
5	5	4	violin	jazz
6	6	1	violin	classical
7	6	1	drums	classical
8	7	5	trumpet	jazz
9	6	2	viola	classical
10	4	1	guitar	classical
...	...	...	...	...

Concert		
concert_no	concert_venue	con_date
1	Bridgewater Hall	06/01/2021
2	Bridgewater Hall	08/05/2021
3	Usher Hall	03/06/2021
4	Assembly Rooms	20/09/2021
5	Festspiel Haus	21/02/2021
...	...	...

Musician			
musician_no	name	born	seat
3	Helen Smyth	07/08/1978	1st
4	Harriet Smithson	08/03/1975	1st
5	James First	11/11/1981	2nd
6	Theo Mengel	13/03/1988	2nd
...	...	...	...

11. (b) (continued)

- (i) Design a query to display all the musician details and the number of concerts that each musician, has or will play, in a field called "Total Concerts". Musicians sometimes play more than one instrument at a concert.

4

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

- (ii) Each musician is paid a fee of £100 per instrument, for each concert. Design a query to calculate the fees due for each concert for jazz performances by 1st seat musicians.

4

Field(s) and calculation(s)	
Table(s)	Musician, Performance, Concert
Search criteria	
Grouping	
Sort order	

- (c) Read the problem at the beginning of the question again and evaluate the design of the database in terms of fitness for purpose. Describe a solution to improve the database design.

2

[Turn over

12. A classic vehicle company supply vehicles to customers across the world.
Sample data relating to customer orders is shown below.

customer

CID	Company	CLastname	CFirstname	Address	City	Country
103	Atelier graphique	Schmitt	Carine	54, rue Royale	Nantes	France
112	Signal Gift Stores	King	Jean	8489 Strong St.	Las Vegas	USA
114	Australian Collectors, Co.	Ferguson	Peter	636 St Kilda Road	Melbourne	Australia
119	La Rochelle Gifts	Labruno	Janine	67, rue des Cinquante Otages	Nantes	France
121	Baane Mini Imports	Bergulfsen	Jonas	Erling Skakkes gate 78	Stavern	Norway
124	Mini Gifts Distributors Ltd.	Nelson	Susan	5677 Strong St.	San Rafael	USA
125	Havel & Zbyszek Co	Piestrzeniewicz	Zbyszek	ul. Filtrowa 68	Warszawa	Poland
128	Blauer See Auto, Co.	Keitel	Roland	Lyonerstr. 34	Frankfurt	Germany
...	...	...	...	...	...	...

prod_order

orderNo	orderDate	productCode	shippedDate	status	CID
10103	29/01/2020	3891		On Order	121
10104	29/01/2020	1589		On Order	121
10278	06/08/2020	3891		On Order	112
10309	15/10/2021	1589		In Process	121
10315	29/10/2021	3990		In Process	119
10325	05/11/2021	1749	08/11/2021	Shipped	121
10342	24/11/2021	4473	29/11/2021	Shipped	114
10345	25/11/2021	1889	26/11/2021	Shipped	103
10346	29/11/2021	1662	30/11/2021	Shipped	112
10425	31/05/2022	3891		In Process	119
...	...	...	...	...	...

product

productCode	item	inStock	cost
3891	1969 Ford Falcon	3	83050
3990	1970 Plymouth Hemi Cuda	12	31920
4473	1957 Chevy Pickup	13	55700
4675	1969 Dodge Charger	15	58730
1097	1940 Ford Pickup Truck	6	58330
1129	1993 Mazda RX-7	8	83510
1342	1937 Lincoln Berline	18	60620
1367	1936 Mercedes-Benz 500K Special Roadster	18	24260
1589	1965 Aston Martin DB5	19	65960
1662	1980s Black Hawk Helicopter	11	77270
1749	1917 Grand Touring Sedan	6	86700
1889	1948 Porsche 356-A Roadster	18	53900
...	...	...	...

SECTION 3 - Web Design and Development

MARKS

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Attempt ALL questions

13. HTML 5 elements have been used to define parts of the web page shown below.

Home News Contact About

Machine intelligence for today

Your application to join our team

Thank you for applying to join our team. Your application details are shown below.

About You

Firstname: Charlotte Lastname: Green

Position Applied For: Lead Programmer

Your Contact Details

Mobile: 07700 900796 Email: charlotte@devhelp.com

Address: 55 York Road EAST LONDON E21 0LD

Qualifications

Bachelor of Science, Honours, First Class - Computing Science

University of Edinburgh

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

2

A _____

B _____

[Turn over

14. HTML for a menu is shown below.

```
<ul>
  <li><a href="home.html">Index</a></li>
  <li><a href="css.html">Learn CSS</a></li>
  <li><a href="javascript.html">Learn JavaScript</a></li>
</ul>
```

Two options are available for the styling of the menu.

Option 1	Option 2
Index Learn CSS Learn JavaScript	Index Learn CSS Learn JavaScript

Complete the CSS rule for Option 1 and for Option 2

2

Option 1:
li { ; }
Option 2:
li { ; }

15. A web development company makes use of the following document.

Alexi Johnson



Title: **Marketing and Performance Manager**
 Decision Maker: **Yes**
 Industry: **Software and Technology**
 Age: **30**
 Skills: **Team Management,
Project Planning, Recruitment**

Goals: **Build a great team, improve quality of development projects**
 Challenges: **Need to increase number of clients and recommendations**
 How we help: **Give Alexi tools to monitor projects and share success
with prospective clients**

(a) State the name given to this document.

1

(b) Describe how this document is used in the development process.

1

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[Turn over for Question 16]

16. A concert ticket company wish to develop a new web site. They are selling tickets for a VIP area at a concert. The concert seats are available as shown.

BLOCK A

	Seat 1	Seat 2	Seat 3	Seat 4	Seat 5	Seat 6
Row A	☐	☐	☐	☐	☐	☐
Row B	☐	☐	☐	☐	☐	☐
Row C	☐	☐	☐	☐	☐	☐
Row D	☐	☐	☐	☐	☐	☐

BLOCK B

	Seat 1	Seat 2	Seat 3	Seat 4	Seat 5	Seat 6
Row A	☐	☐	☐	☐	☐	☐
Row B	☐	☐	☐	☐	☐	☐
Row C	☐	☐	☐	☐	☐	☐
Row D	☐	☐	☐	☐	☐	☐

BLOCK C

	Seat 1	Seat 2	Seat 3	Seat 4	Seat 5	Seat 6
Row A	☐	☐	☐	☐	☐	☐
Row B	☐	☐	☐	☐	☐	☐
Row C	☐	☐	☐	☐	☐	☐
Row D	☐	☐	☐	☐	☐	☐

BLOCK D

	Seat 1	Seat 2	Seat 3	Seat 4	Seat 5	Seat 6
Row A	☐	☐	☐	☐	☐	☐
Row B	☐	☐	☐	☐	☐	☐
Row C	☐	☐	☐	☐	☐	☐
Row D	☐	☐	☐	☐	☐	☐

Seats are only sold in pairs e.g. A1 with A2, D3 with D4 or B5 with B6. Sales that would create single seat gaps are not allowed e.g. B2 with B3 would not be allowed as it would make B1 a single seat.

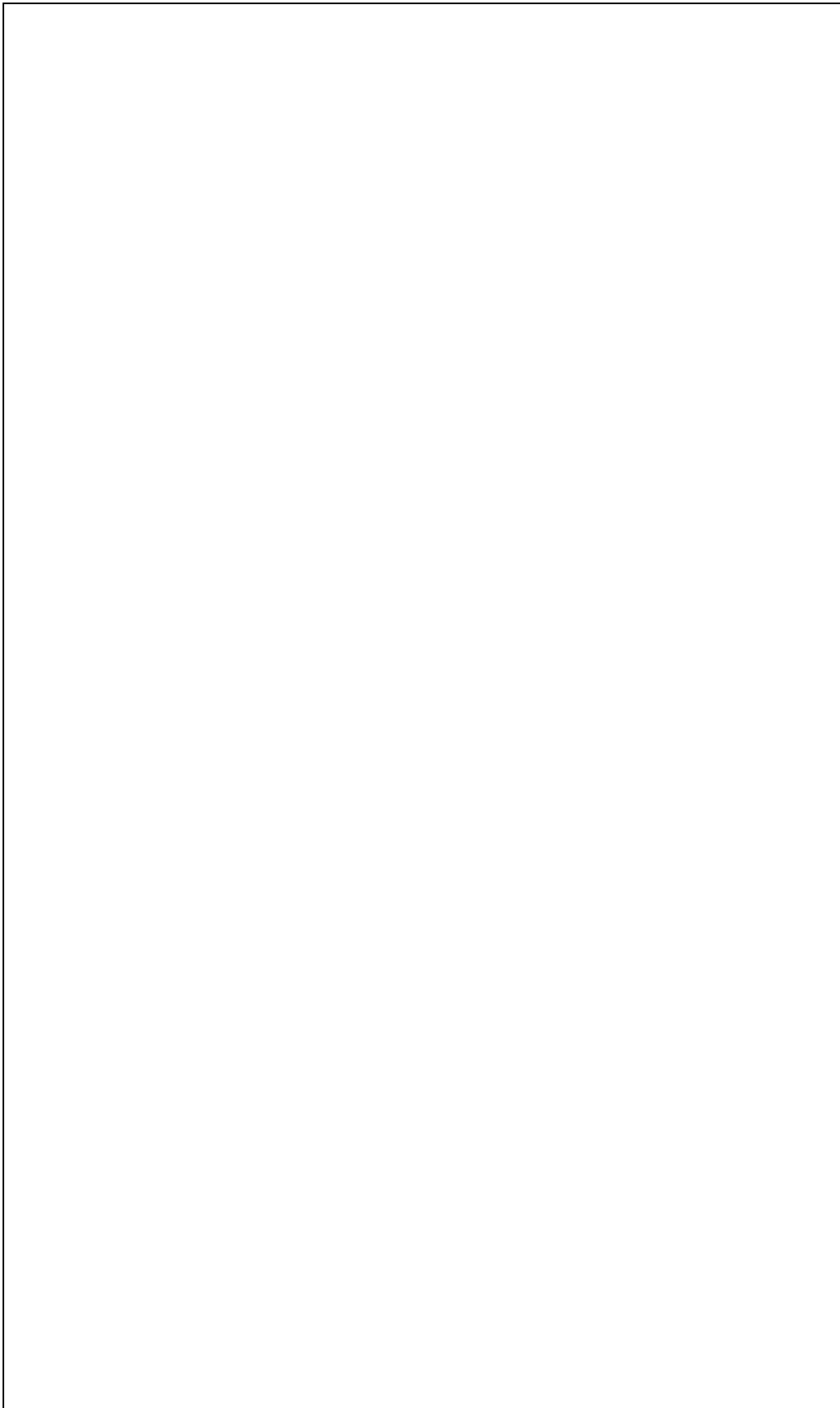
When selecting tickets, customers also have to enter the following details:

- Name
- Email Address
- Mobile Number

16. (continued)

- (a) Using this information, draw a wireframe design for the form on the concert ticket web page.

4



[Turn over

16. (continued)

- (b) Once a customer has selected their seats, the next stage of the process is to add payment details. An annotated wireframe design for this page and form is shown below.

Size 20px
Centered

[Stage 1 - Select Seats](#) | Stage 2 - Payment Details | [Stage 3 - Checkout](#)

Enter Your Payment Details

Card Number:

Date:

20px

The HTML for the body of this page is shown below.

```
<body>
<header>
  <span><a href="stage1.php">Stage 1 - Select Seats</a> | </span>
  <span>Stage 2 - Payment Details | </span>
  <span><a href="stage3.php">Stage 3 - Checkout</a></span>
</header>
<form action="stage3.php" method="post">
  
  <h1>Enter Your Payment Details</h1>
  Card Number:
  <input type="text" name="card" id="cardnumber"><br/>
  Date:
  <input type="text" name="expiry" id="expiry"><br />
  <input type="submit" name="submit" value="Submit">
</form>
</body>
```

Write CSS rules so the output will match the wireframe above.

3

```
body {
  font-family: Gotham;
}
```

```
header {
  font-size: 20px;
  text-align: center;
}
```

```
#cardimage {
```

```
}
```

```
form input {
```

```
}
```

16. (continued)

- (c) Explain why the descendant selector form input is used to format the page in (b).

[Turn over

MARKS

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MARGIN

2

17. An esports web site has a page where team managers can upload their team details to take part in competitions. The page makes use of the following CSS.

```
#sidenav {  
    float: left;  
    background: darkblue;  
    color: whitesmoke;  
    width: 25%;  
    padding: 5%;  
}  
  
#sidenav a hover {  
    color: white;  
    font-weight: bolder;  
}  
  
#sidenav a {  
    color: white;  
}  
  
#detail {  
    float: left;  
    height: 200px;  
    background: lightgray;  
    color: black;  
    width: 55%;  
    padding: 5%;  
}
```

- (a) This CSS code is not efficient. Rewrite this code making use of grouping and descendant selectors.

4

17. (a) (continued)

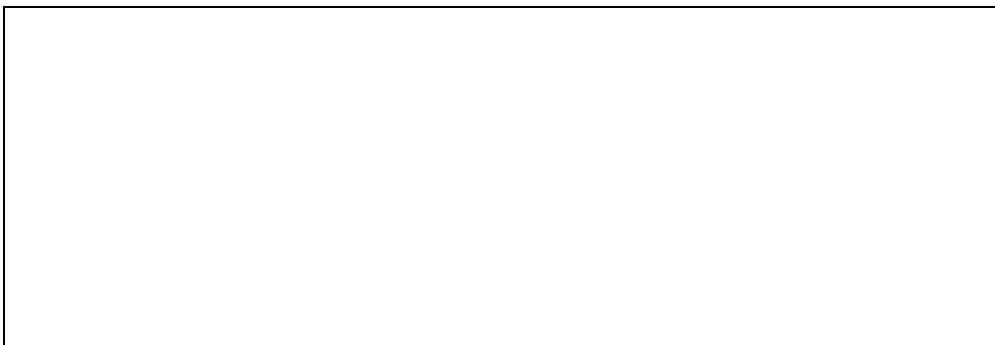
Additional space for answer (a).



- (b) An input field is required for the number of team members. The field is required and can be a minimum of 4 and a maximum of 8.

Write the HTML to ensure that only valid values will be accepted in the form.

2



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

State one problem that may be identified when testing compatibility.

1

17. (continued)

- (d) Once all the teams have been submitted, team managers have access to a matches page as shown below.



Evaluate this solution in terms of usability.

2

- (e) When a team icon is clicked, a dialogue appears on the page showing more information about a team.

1

Complete the following code to display this dialogue

```
<div id="racoon" _____ ="displayInfo('Racoon');">
  Racoon
</div>
```

[END OF SECTION 2 - PART B]

ADDITIONAL SPACE FOR ANSWERS

MARKS

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ADDITIONAL SPACE FOR ANSWERS

ADDITIONAL SPACE FOR ANSWERS