FOR OFFICIAL USE

National Qualifications

Mark

CS(H)20B

Computing Science

Duration — 2 hours 30 minutes

Fill in these boxes and read what is printed below.

Full name of centre

Town

Forenames(s)

Surname

Number of seat

Date of birth

Day D D

Month M M

Year Y Y

Scottish candidate number

Total marks – 110

SECTION 1 – 25 marks

Attempt ALL questions.

SECTION 2 – 85 marks

Attempt ALL questions.

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 marks for this paper.

MARKS | DO NOT WRITE IN THIS MARGIN

SECTION 1 – 25 marks

Attempt ALL questions

1. Convert the denary number -110 to binary using 8 bits. **1**

2. A Cascading Style Sheet contains the following rule.

```
.mydiv {
        margin: 20px;
        padding: 15px;
        width: 250px;
        height: 130px;
}
```

Label this diagram to show how the rule above would be applied. The width property is already shown. **3**

3. When analysing a project, boundaries are defined. Describe what is meant by boundaries in software development. **2**

MARKS | DO NOT WRITE IN THIS MARGIN

4. A website experiences a DOS attack.

(a) State two symptoms users experience when this happens. **2**

(b) State two costs that the website owners will have as a result of the DOS attack. **2**

5. Describe the purpose of registers within a processor. **2**

6. Describe one problem that can occur when using global variables in a program. **1**

7. Explain how the range and precision of floating-point numbers can be decreased. **2**

[Turn over

8. A database table is shown below.

Table: Munroes			
Name	Height	Rank	Location
a'Chochuill	991	157	*The Grampians, in from Blair Atholl*
a'Ghlo	1121	32	*The Grampians, in from Blair Atholl*
Achaladair	1038	94	*Loch Tay to Rannoch Moor*
Bheoil	1019	112	*Loch Linnhie to Loch Ericht*
Creag Mhor	981	168	*Loch Tay to Rannoch Moor*
Coire a'Chairn	981	169	*Loch Linnhie to Loch Ericht*
Braigh Coire	1072	66	*The Grampians, in from Blair Atholl*
Coire Sgreamhach	1072	65	Strath Orchy to Glen Coe

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

```
SELECT Name, MIN(Height) as [Lowest]
FROM Munroes
GROUP BY Lowest
```

Name	

9. An intelligent thermostat for a heating system is shown below.

Describe one environmental benefit of using a heating system which is intelligent. **1**

10. A section of code has been written which examines an array of one hundred values.

```
Line
1      SET requiredValue TO measurement[0]
2      SET requiredIndex TO 0
3      FOR index FROM 1 TO 99
4         IF measurement [index] < requiredValue THEN
5            requiredValue = measurement[index]
7            requiredIndex = index
8         END IF
9      END FOR
```

(a) State the name of the standard algorithm which is shown above. **1**

(b) Explain what will be held in `requiredIndex` when the FOR loop terminates. **2**

11. The content of a web page is correctly structured using HTML tags. A part of the site is shown below.

NASA's Planet-Hunting Probe Joins the Search for Intelligent Aliens

Scientists with the TESS mission will work with the Breakthrough Listen project.
Read More...

We May Finally Know How the Universe's Heavy Elements Formed

Scientists detected strontium in the aftermath of a dead-star collision.
Read More...

State the HTML tag that would be used to contain each of the items of content above. **1**

[Turn over

12. A ticket agency sells tickets for events. Customers can purchase up to six tickets for each event but repeat purchases, for the same event, are not allowed.

Customer

CustomerID	CustomerName	Address	Post Code
1896	Smith, J	3 West St, St Johns	WR2 4BF
2100	Mackay, C	546 Union Row, Leeds	LS1 1DN
3898	Watson, C	1FL, Welling Road, Conventry	CV1 1EJ

TicketSale

CustomerID	EventID	Number of Tickets	SalePrice
1896	0982	2	£50.55
1896	1766	5	£45.50
2100	1766	4	£17.99
2100	0982	2	£17.99
1896	1054	2	£50.55
3898	0982	3	£30.00
2100	2876	1	£17.99
3898	1054	2	£25.00

Event

EventID	EventName	Date	Time
0982	Alice Cooper	12/02/2020	19:00
1054	Little Mix	03/11/2020	18:00
1766	The Script	09/10/2020	19:30
2876	Rob Thomas	15/10/2020	14:00

State the primary key of the TicketSale entity. **2**

MARKS DO NOT WRITE IN THIS MARGIN

SECTION 2 - 85 marks

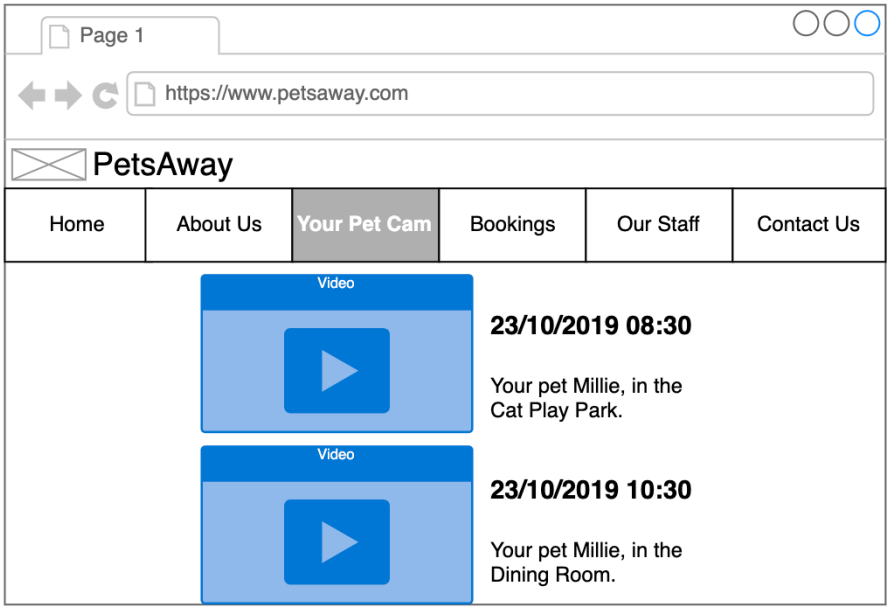
Attempt ALL questions

13. PetsAway is a new startup business which combines technology and care for pets while their owners are away on holiday. Pets are cared for in a multi-room pet "hotel". The company places tags on the collars of each animal it cares for.

When an animal enters rooms in the hotel, their presence is detected by sensors and video footage is recorded of the animal and the date, time and location in the hotel also stored. This footage can be viewed, via a website, by the owner, using a special code.

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

(b) During the development process a wireframe is created.



Describe how this wireframe could be used in usability testing. **2**

[Turn over

13. Continued

(c) The "Our Staff" web page shows the details of four members of staff. It shows their first and last names, jobs titles, an image of each of them and a fun fact.

Using this information, draw a wireframe design for the "Our Staff" web page. This should be consistent with the design for the site. **3**

(d) The site wireframes are developed into low-fidelity prototypes. Describe the key features of low-fidelity prototypes. **2**

13. Continued

(e) When the website is created, the following CSS rules are coded.

```
.menutext { margin-top: 10px; padding: 10px }
.videobox { margin-top: 5px; padding: 10px}
.videoheading { margin-top: 10px; padding: 10px}
.video-text { margin-top: 10px; padding: 10px }
#logo { margin-top: 10px: padding: 5px}
```

Using grouping selectors to remove any repetition, re-write this code to make it more efficient. **4**

[Turn over

13. Continued

(f) Some code from the "Your Booking" page is shown below.

```
<form action="processbooking.html" method="post">

Pet Name:
<input type="text" name="petname" size="40" required /><br><br>

Owner Name:
<input type="text" name="owner" size="40" required /><br><br>

Email Address:
<input type="text" name="email" size="45" maxlength="80"
Required /><br><br>

Type of animal:
<input type="radio" name="type" value="Dog" />
Dog
<input type="radio" name="type" value="Cat" />
Cat
<input type="radio" name="type" value="Rabbit" />
Rabbit
<input type="radio" name="type" value="Guinea Pig" />
Guinea pig
<input type="radio" name="type" value="Other" >
Other (tell us in "More Information" below.)
<br><br>

Your pet's vacinations:
<select name="vacinations">
<option selected="selected" value="done">My pet is fully
vacinated.</option>
<option value="willbedone">I will get my pet fully vacinated 2 to
4 weeks before staying.</option>
<option value="medicalsupport">Can you make arrangements for
me?</option>
</select><br><br>

Lenght of stay:
<input type="number" name="duration" /><br><br>

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

<input type="submit" onclick="checkType()"
value="Submit"><br><br>
</form>
```

(i) State the type of validation used for “Pet Name”. **1**

13. (f) Continued

(ii) A drop-down has been used to selected details of "Pet vacinations".

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

(iii) A user selects the radio button for "Dog" but then changes their selection to "Guinea Pig". When this happens the "Dog" radio button is deselected.

Explain, with reference to the HTML, why this happens. **2**

(iv) The pet hotel accepts bookings for between 1 and 21 nights.

Amend the HTML for "duration" so that the number of days is restricted as required.

1

[Turn over

14. A security company has a record of customers and the alarm system that each customer has installed. A sample from the company database is shown below. This shows the alarm systems currently installed for each customer.

Customer

CustomerID	CustomerName	Address	Post Code
1896	Smith, J	3 West St, St Johns	WR2 4BF
1897	Mackay, C	546 Union Row, Leeds	LS1 1DN
1898	Watson, C	1FL, Welling Road, Coventry	CV1 1EJ
1899	Crans, B	29 Welks Road, Bingley	CV3 2EA
1900	Elliott, B	87 Canal St, Shipley	BD10 8UL
1901	Zang, H	119 Gaisby Land, Shipley	BD18 2AS

Installation

CustomerID	AlarmSystem	InstalledOn
1896	EP7-191	19/08/2019
1897	ZD-Intruder-10	20/10/2018
1898	EP7-191	15/11/2018
1899	EP7-191	15/11/2018
1900	ZD-Intruder-10	19/11/2018
1901	Pointer 109A	03/01/2019

Alarm

AlarmSystem	Manufacturer	RRP	InStock
EP7-191	i-Protect	399.00	Yes
ZD-Intruder-10	Venisure	495.95	Yes
Pointer 109A	ADT	490.00	Yes
Zandar Nova 01	Wolfman	799.99	No

(a) Draw an entity relationship diagram to represent the relationships that exist in this database.

Your answer should show the entity names and cardinality. Attributes are not required on the diagram. 3

14. (continued)

(b) A partially complete data dictionary for the database is shown below.

Entity: Customer

Name	Key	Type	Size	Validation
CustomerID	PK	Number	-	
CustomerName	-	Text	45	
Address	-	Text	80	
Post Code	-	Text	9	

Entity: Installation

Name	Key	Type	Size	Validation
CustomerID	A	Number	-	C
AlarmSystem	B	Text	20	
InstalledOn	-	Date		

Entity: Alarm

Name	Key	Type	Size	Validation
AlarmSystem	PK	Text	20	
Manufactuer	-	Text	30	
RRP	-	Number	-	
InStock	-	D		

(i) Complete the entries for the data dictionary from A to D below. **4**

A _____

B _____

C _____

D _____

(ii) A change is required which means that the system will now store information about the alarm systems that customers had previously installed as well as the ones they currently have installed.

Describe how the keys for the entity "Installation" would be changed to allow this to happen. **2**

_____

_____

_____

_____

_____

[Turn over

14. (continued)

(c) A query is required to show the total spent by customers from 01/10/2018 to 31/10/2018, for each different alarm system.

Design this query using the layout below which has been partially completed for you. **3**

Fields(s) and calculation(s)	
Table(s)	
Search criteria	WHERE InstalledOn ≥ '01/10/2018' AND Installed On ≤ '31/10/2018'
Grouping	
Sort Order	

(d) State the part of the processor that that would calculate the total spend for each alarm system. **1**

(e) The customer "Zang, H" has changed address. She has a new address of 42 Robertson St, Otley, OT19 8UW.

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

(f) The text data in the database is stored using Unicode. Describe an advantage of using Unicode over extended ASCII. **1**

15. A program is being developed to store contacts on a mobile phone. It is proposed that a record structure is used to represent a contact.

```
RECORD contact IS {
      STRING name,
      STRING email,
      STRING imageFile INITIALLY "",
      INTEGER callsToday INITALLY 0,
      BOOLEAN spam INITIALLY false,
      STRING mobileNumber
}
```

(a) Using pseudocode, or a programming language of your choice, declare a variable, called contactData, that can store up to 500 contacts. **2**

(b) Explain the purpose of the line

```
BOOLEAN spam INITIALLY false
```

in the record code. **2**

(c) Explain why a record structure is proposed rather than separate arrays. **2**

[Turn over

15. (continued)

(d) A function is developed to be used when searching for a particular contact. The function code is shown below.

```
Line
201  FUNCTION MatchContact ( STRING valueToCheck,
202                          STRING valueToFind )
203           RETURNS BOOLEAN
204     SET strLen TO length(valueToFind)
205     SET valueToCheck TO valueToCheck[1,strLen]
206     IF valueToFind = valueToCheck THEN
207       RETURN true
208     ELSE
209       RETURN false
210     END IF
211  END FUNCTION
```

(i) State two parameters used by this programme. **2**

_____

_____

(ii) Using a recognised design technique design an efficient solution, making use of this function, which:

- allows search text to be entered
- finds email addresses or names matching this text
- displays the name, email and mobile number for matches.

5

15. (d) (continued)

(iii) Explain the purpose of lines 205 and 206 in the function. **2**

(e) All the images used with the program are bit-mapped rather than vector graphics.

Describe two advantages of bit-mapped graphics over vector graphics for this purpose. **2**

[Turn over

MARKS | DO NOT WRITE IN THIS MARGIN

16. A professional makeup company is developing a web site. A horizontal navigation bar will include links to pages for Lips, Face, Eyes, and Your Account. Each makeup page links to a "professional" and a "foundation" range of make-up for sale.

(a) Design a multi-level structure for the makeup company web site. **3**

16. (continued)

(b) The "Your Account" page should include a form to allow users to update their account details. A user's account has the following information.

Firstname
Lastname
Date of Birth
Membership Code (16-characters)
Membership Type (Silver, Gold or Professional)

Using this information, draw a wireframe design for the form on the Your Account page. **4**

[Turn over

16. (continued)

(c) A program is used to identify which customer, with a "professional" membership type, has spent the most on the company web site. The program imports data from a text file containing:

- membership type
- firstname
- lastname
- total spent

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

Silver, Kiera, Long, 467.25
Professional, Helen, Budge, 289.00
…

The top-level algorithm for the program is:

1. Import customer data
2. Find the highest spending customer
3. Display customer details

(i) The table below has the data flow completed for steps 1 and 3 of the algorithm.

Complete the missing data flow for step 2. **2**

Step	IN/OUT	Data flow
1	IN	
	OUT	membershiptype[], firstname[], lastname[], totalspent[]
2	IN	
	OUT	
3	IN	location, membershiptype[], firstname[], lastname[], totalspent[]
	OUT	

16. (c) (continued)

(ii) Step 2 finds the position of the highest spending customer with a professional membership type.

Using a recognised design technique, design this step. **5**

16. (continued)

(d) As part of the execution of the program, an instruction in memory location 37612 is to be fetched and executed. Complete the missing steps of the fetch-execute cycle shown below. **2**

1. _____

_____

2. The processor activates the read line on the control bus.

3. _____

_____

_____

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

(e) The company discover that an employee has accessed the system and modified information to get products for free.

State two different offences the employee has committed under the Computer Misuse Act 1990. **2**

_____

_____

_____

_____

_____

_____

_____

_____

17. Arbitrary Letter Substitution is a simple encryption method that takes each letter in a message and substitutes it for another, based on a cipher alphabet.

For example, using the table below, the letter F, which has an ASCII code of 70, is replaced with the letter P, which is in the same position as F (6) in the cipherAlphabet.

Alphabet	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
ASCII Code	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90
Index	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	25	25	26
cipherAlphabet	T	A	R	L	Y	P	O	S	D	F	J	N	X	U	E	M	B	G	V	K	I	W	C	H	Z	Q

The program below asks the user to enter a message which is then encrypted.

```
Line
050  FUNCTION encrypt (STRING: message) RETURNS STRING
051    DECLARE cipherText INITIALLY ""
052    DECLARE cipherAlphabet INITIALLY "TARLYPOSDFJNXUEMBGVKIWCHZQ"
053    FOR letter = 1 TO length(message) DO
054      SET character TO message[letter]
055      SET tempASC TO <ascii value of character>
056      SET cipherIndex TO tempASC – 64
057      SET cipherCharacter TO cipherAlphabet[cipherIndex]
058      SET cipherText TO cipherText & cipherCharacter
060    END FOR
061    RETURN cipherText
062  END FUNCTION
  …
120  RECEIVE message from STRING KEYBOARD
121  SET message TO encrypt(message)
122  DISPLAY message
```

(a) A breakpoint is set at line 060.

The function is tested by entering the following message.

Message: CAT

Complete the table below to show the values of cipherIndex and cipherText each time execution is stopped. **3**

Break in execution	cipherIndex	cipherText
First		
Second		
Third		

[Turn over

17. (continued)

(b) The program was initially tested using a "dry run".

Describe what is meant by a dry run when testing a program. **2**

(c) Using a programming language of your choice, state the pre-defined function used to convert.

(i) A text character to ASCII **1**

(ii) ASCII to a text character **1**

(d) An error occurs if the message is not typed in uppercase letters.

(i) Explain why this error occurs. **2**

(ii) State which type of error this is. **1**

MARKS DO NOT WRITE IN THIS MARGIN

17. (continued)

(e) An evaluation of the program is carried out. It finds that the code is not maintainable.

Describe two ways of improving the maintainability of the program. **2**

(f) The encryption program was developed for a client, using an agile development approach.

Describe the role of the client when developing software using agile methodologies. **2**

[END OF QUESTION PAPER]

ADDITIONAL SPACE FOR ANSWERS

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