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ASSESSMENT, STANDARDS
& CERTIFICATION

Tasmanian Certificate of Education
External Assessment 2017

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COMPUTER SCIENCE

(ITC315113)

SECTION A

Time: 36 minutes

Pages:	12
Questions:	3
Attachments:	Information Booklet

Candidate Instructions

1. You **MUST** make sure that your responses to the questions in this examination paper will show your achievement in the criterion being assessed.
2. Answer **ALL** questions. Answers must be written in the spaces provided on the examination paper.
3. You should make sure you answer all parts within each question so that the criterion can be assessed.
4. This examination is 3 hours in length. It is recommended that you spend approximately 36 minutes in total answering the questions in this booklet.
5. The 2017 External Examination Information Booklet for Computer Science can be used throughout the examination.
6. All written responses must be in English.

On the basis of your performance in this examination, the examiners will provide results on the following criterion taken from the course statement:

Criterion 1 Design and evaluate algorithmic solutions to a range of problems.

Additional Instructions for Candidates

To be considered for a 'C' rating on a criterion, you must provide a satisfactory answer to at least the first question of the relevant section.

To be considered for a 'B' rating on a criterion, you must provide a satisfactory answer to at least the first two questions of the relevant section.

To be considered for an 'A' rating on a criterion, you must provide a satisfactory answer to all three questions of the relevant section.

Show the methods used in deriving answers.

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Question 1

The following is a *partially completed* algorithm to work out the cost of a pizza based on the items added to a basic pizza.

The numbers on the left of the algorithm are provided for reference purposes.

```
1      Initially
2          set toppings = 1
3          set cost = 0

4      When the "More Toppings" button is pressed
5          set toppings = toppings + 1
6          display "Number of toppings" toppings

7      When the "Less Toppings" button is pressed
8          set toppings = toppings - 1
9          if toppings equals -1
10             set toppings = 0
11             display "Number of toppings" toppings

12     When the "Calculate" button is pressed
13         set extra_toppings = 0
14         if toppings greater than 3
15             set extra_toppings = toppings - 3
16         set cost = 11 + extra_toppings * 2
17         display "Cost of pizza is $" cost
```

(a) (i) What is the cost of the basic pizza without any extra items added?

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.....

(ii) How many toppings can be added without adding to the basic cost?

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(b) The maximum number of toppings allowed is 7. Adjust the algorithm so that any attempt to increase above 7 toppings will fail and it will stay at 7 toppings.

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Question 1 continues.

Question 1 (continued)

- (c) The algorithm needs to allow for the choice of having a stuffed crust. The extra cost for a stuffed crust is \$3. Complete the two “When” statements below and indicate any other changes needed to implement this addition to the algorithm.

**For
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When the “Stuffed Crust” button is pressed

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When the “Not Stuffed Crust” button is pressed

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Other changes to the algorithm.

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Question 2

The following is a *partially completed* algorithm to play a card game. In the game the player is given a hand of three cards and each card can have the value of 1, 2 or 5.

The player is then given a score based on the values of the cards in the hand. The player is given the opportunity to swap a card in the hand for a new card.

The numbers on the left of the algorithm are provided for reference purposes.

```
1      Initially  
2          set card_number = 1  
3          set card_1 to random value selected from 1, 2 or 5  
4          set card_2 to random value selected from 1, 2 or 5  
5          set card_3 to random value selected from 1, 2 or 5  
6          set score = 0  
7          display "card 1:" card_1 " card 2:" card_2 " card 3:" card_3  
  
8      When a number is entered into the "Card Number" Textfield  
9          set card_number to value in "Card Number" TextField  
10         if card_number equals 1  
11             set card_1 to random value selected from 1, 2 or 5  
12         if card_number equals 2  
13             set card_2 to random value selected from 1, 2 or 5  
14         if card_number equals 3  
15             set card_3 to random value selected from 1, 2 or 5  
16         display "card 1:" card_1 " card 2:" card_2 " card 3:" card_3  
  
17     When the "Score" button is pressed  
18         set sum = card_1 + card_2 + card_3  
19         if sum equals 8  
20             set score = 400  
21         if sum equals 3, 6 or 15  
22             set score = 200  
23         display "card 1:" card_1 " card 2:" card_2 " card 3:" card_3 " and Score is : " score
```

(a) Under what condition will the player get the maximum score for a hand of cards?

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(b) Only some of the possible hands of cards have been assigned a score by the **Score Button** code. All other possible hands of cards are to be assigned a score of zero. Indicate the changes to the algorithm needed to implement this.

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Question 2 continues.

Question 3

A university student wishes to create an applet that can be used to determine how long it will take to get to university from the moment they arrive at a bus stop outside home.

The applet will be given the moment the student will reach the bus stop and will then calculate how long it will be until the student arrives at university.

The student has examined the situation and has collected the following data.

- 1 The student will only travel to university from Monday to Friday.
- 2 The student will be at the bus stop to leave for university from 7:00 am until 11:00 am.
- 3 The bus timetable during this time has buses leaving the home bus stop every 20 minutes starting at 7:00 am.
- 4 The travel time in minutes on the bus varies at different times as shown in the table below:

Times	Monday	Tuesday	Wednesday	Thursday	Friday
From 7:00 am but before 8:00 am	13	13	10	10	10
From 8:00 am but before 10:00 am	18	18	15	15	15
From 10:00 am	13	13	10	10	10

The student wishes to be able to enter the moment of arrival at the home bus stop and know how long it will be before reaching the university.

By answering parts (a) and (b), you are to create an algorithm to implement this applet.

Notes:

- The applet should work correctly no matter in what order the buttons or textfields are used.
- It can be assumed that all data entered is the appropriate type for each textfield.
- Appropriate variable names are to be used.

Question 3 continues.

Question 3 (continued)

**For
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- (a) Design a possible screen for this applet, identifying all the textfields and/or buttons to be used.



- (b) Using the Initially/When model, write an algorithm for this applet.

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Question 3 continues.



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SECTION B

Time: 36 minutes

Pages:	12
Questions:	3
Attachments:	Information Booklet

Candidate Instructions

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On the basis of your performance in this examination, the examiners will provide results on the following criterion taken from the course statement:

Criterion 2 Demonstrate knowledge of a high level programming language.

Additional Instructions for Candidates

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Question 4

(a) (i) What will be the value of **a** after the following code is executed?

```
double a;  
a = 4.0 + 11.0 / 2.0;
```

Value of **a**:

Explanation:

.....
.....

(ii) What will be the value of **b** after the following code is executed?

```
int b;  
b = 20 % 3;
```

Value of **b**:

Explanation:

.....
.....

(iii) What will be the value of **c** after the following code is executed?

```
String c;  
c = "2" + "5";
```

Value of **c**:

Explanation:

.....
.....

Question 4 continues.

Question 4 (continued)

**For
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Only**

(b) (i) What will be the value of **d** after the following code is executed?

```
int d = 0;
if (d == 0)
{
    d = 1;
}
if (d == 1)
{
    d = 2;
}
```

Final value of **d**:

Explanation:

.....
.....

(ii) Trace the following code and find the final value of the variable **e**.

```
int e = 10;
for (int i = 2; i < 5; i++)
{
    e = e + i;
}
```

<i>i</i>	<i>e</i>

Final value of **e**:

(iii) Trace the following code and find the final value of the variable **f**.

```
int f = 20;
while (f > 2)
{
    f = f / 2;
}
```

<i>f</i>

Final value of **f**:

Question 4 continues.

Question 4 (continued)

**For
Marker
Use
Only**

(c) Trace the following code and find the final value of the variable ***h***.

```
int t = 3;
int u = 6;
int h = 100;
if (t > u)
{
    while (t > u)
    {
        t = t - 1;
        h = h - t;
    }
}
else
{
    while (u > t)
    {
        t = t + 1;
        h = h + t;
    }
}
```

<i>t</i>	<i>u</i>	<i>h</i>

Final value of ***h***:

Question 6

For
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This question relates to the applet below. The **word1** array is the input to the applet. This is processed to produce the output in the **word2** array.

The numbers on the left are not part of the program and are provided for reference purposes.

```
1  import java.awt.*;
2  import java.applet.Applet;
3  public class Question6 extends Applet
4  {
5      char length5[] = {'S','E','A','O','I','U','Y','H'};
6      char length6[] = {'E','A','I','O','U','S','Y'};
7      char length7[] = {'E','I','A','O','U','S'};
8      char word1[] = {'P','I','A','Z','Z','A'}; // Applet input
9      char word2[] = new char[word1.length]; // Applet output
10     char letters[];
11     public void init()
12     {
13         for(int i = 0; i < word2.length; i++)
14             word2[i] = '_';
15     }
16     public void selectLength(int size)
17     {
18         switch (size)
19         {
20             case 5: letters = length5;
21                     break;
22             case 6: letters = length6;
23                     break;
24             case 7: letters = length7;
25                     break;
26         }
27     }
28     public boolean find(char[] word1, char[] word2)
29     {
30         selectLength(word1.length);
31         boolean found = false;
32         int i = 0;
33         while (!found && i < letters.length)
34         {
35             for(int j = 0; j < word1.length; j++)
36                 if (word1[j] == letters[i])
37                 {
38                     found = true;
39                     word2[j] = word1[j];
40                 }
41             i = i + 1;
42         }
43         return found;
44     }
45     public void paint(Graphics g)
46     {
47         g.drawString("Word 1: ", 20, 10);
48         for(int i = 0; i < word1.length; i++)
49             g.drawString(word1[i]+"", 70+i*20, 10);
50         if (find(word1, word2))
51         {
52             g.drawString("Word 2: ", 20, 50);
53             for(int i = 0; i < word2.length; i++)
54                 g.drawString(word2[i]+"", 70+i*20, 50);
55         }
56         else
57             g.drawString("Find failed.", 20, 50);
58     }
59 }
```

Question 6 continues.

Question 6 (continued)

**For
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(b) (i) The array **word1** is the input to the applet. If the input array has a length of 6, under what input condition will the message "Find failed." be displayed by the applet?

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(ii) What is the scope of the variable **found**?

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(iii) If the array **letters** was added as a parameter to the method **find** would the applet still work correctly?

Explain your answer.

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(ITC315113)

SECTION C

Time: 36 minutes

Pages:	12
Questions:	3
Attachments:	Information Booklet

Candidate Instructions

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On the basis of your performance in this examination, the examiners will provide results on the following criterion taken from the course statement:

Criterion 3 Use appropriate objects in the design of programs.

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Additional Instructions for Candidates

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Show the methods used in deriving answers.

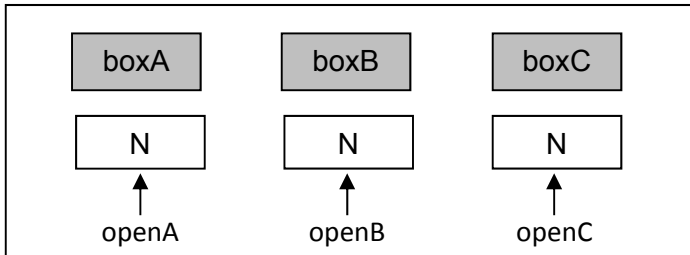
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Question 7

The following diagram shows an applet window with three text fields (openA, openB and openC) and three Buttons (boxA, boxB and boxC). The ActionListener has been added to all the Buttons.



The **actionPerformed** method for the applet is as follows:

```
public void actionPerformed(ActionEvent e)
{
    char a = openA.getText().charAt(0);
    char b = openB.getText().charAt(0);
    char c = openC.getText().charAt(0);

    if (e.getSource() == boxA)
        if (a == 'Y')
            openA.setText("N");
        else
            openA.setText("Y");

    if (e.getSource() == boxB)
        if (a == 'Y' && c == 'Y')
            if (b == 'Y')
                openB.setText("N");
            else
                openB.setText("Y");

    if (e.getSource() == boxC)
        if (a == 'Y')
            if (c == 'Y')
                openC.setText("N");
            else
                openC.setText("Y");
}
```

(a) (i) What will be displayed in the text fields if the values in the text fields are those displayed at the top of this page and the **boxA** button is clicked?

openA: openB: openC:

(ii) What will be displayed in the text fields if the values in the text fields are those displayed at the top of this page and the **boxC** button is clicked?

openA: openB: openC:

(iii) What order do the buttons need to be clicked so that all the text fields contain **Y**?

.....

Question 7 continues.

Question 7 (continued)

- (b) (i) Show the value of the variable **string1** after the execution of the following section of code.

```
String string1 = "two are necessary";  
string1 = "onen" + string1.substring(11,14);
```

Final value of **string1**:

.....

- (ii) Show the value of the variable **string2** after the execution of the following section of code.

```
String string2 = "Counting on it";  
string2 = string2 + "=" + string2.length();
```

Final value of **string2**:

.....

- (iii) Show the value of the variable **string3** after the execution of the following section of code.

```
String string3 = "Shout OUT!";  
string3 = string3.toUpperCase().replace('u', 'r');
```

Final value of **string3**:

.....

Question 8

This question relates to the class definition below. It defines a student in a class and their test percentages. The data stored is the **name** of the student, the percentage for **test 1** and the percentage for **test 2**.

```
public class Student
{
    public String name;
    public int test1, test2;

    public Student(String newName)
    {
        name = newName;
        test1 = -1;
        test2 = -1;
    }
    public void setTest1(int test)
    {
        test1 = test;
    }
    public void setTest2(int test)
    {
        test2 = test;
    }
    public String getName()
    {
        return name;
    }
    public int average()
    {
        return (int)(test1 + test2) / 2;
    }
    public int highAverage(int high)
    {
        if (high > this.average())
            return high;
        else
            return this.average();
    }
}
```

- (a) (i) Using the class definition, write code to declare and instantiate two variables one for a student named **Mike** and one for a student named **Sophie**.

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Question 8 continues.

Question 8 (continued)

**For
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- (a) (ii) When the variables were instantiated in part (a)(i) what values were assigned to **test1** and **test2**?

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- (iii) Write code that uses the methods within the class to assign the following test results:

Student	Test 1	Test 2
Mike	52	65
Sophie	56	68

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- (b) Write code that uses the methods within the class to display the average percentage for each student.

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- (c) Write code that uses the method **highAverage** within the class to find the highest average percentage for the two students.

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Question 9

A class is needed by a student to record the rating for each criterion of a subject.

The information to be stored is the following:

- 1 *Name* of the subject.
- 2 Rating for *Criterion 1*.
This is a number between 0 and 4.
- 3 Rating for *Criterion 2*.
This is a number between 0 and 4.
- 4 Rating for *Criterion 3*.
This is a number between 0 and 4.
- 5 Rating for *Criterion 4*.
This is a number between 0 and 4.

The class will contain the following methods:

- A constructor method that will set subject name from a parameter and set all criterion ratings to 0.
- A method that will return the name of the subject.
- A method that will set the rating for a criterion given the criterion number and the rating as parameters.
- A method that will return an **award** based on the sum of the criteria ratings as indicated in this table:

Sum of ratings	Award
from 0 up to 4	N
from 5 up to 11	P
from 12 to 16	C

Create a class to hold data on the criteria for a subject and contains the methods specified.

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Question 9 continues.

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SECTION D

Time: 36 minutes

Pages:	12
Questions:	3
Attachments:	Information Booklet

Candidate Instructions

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Criterion 4 Demonstrate knowledge and understanding of computer architecture.

Additional Instructions for Candidates

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Question 10

(a) (i) Complete the truth table for the logic expression:

$$E \equiv A \wedge (B \vee (\sim A \wedge \sim B))$$

A	B	$\sim A$	$\sim B$	$\sim A \wedge \sim B$	$B \vee (\sim A \wedge \sim B)$	E
0	0					
0	1					
1	0					
1	1					

(ii) Using the information in the truth table, give a simple expression for E.

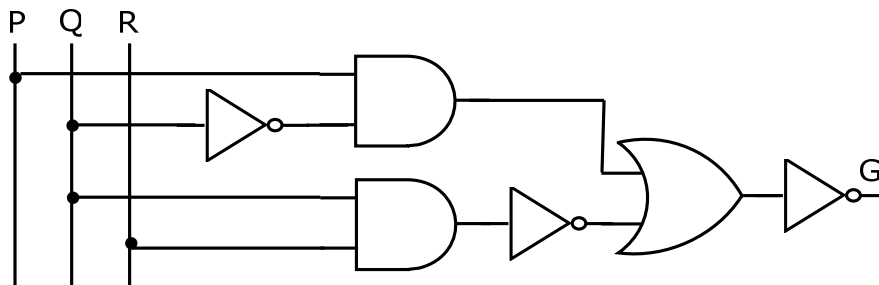
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(b) (i) Draw the logic circuit for the expression:

$$F \equiv \sim(A \wedge (\sim B \vee \sim(B \wedge C)))$$

(ii) Give the logic expression for the following circuit.

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(c) Most processor CPUs do not have a multiplication circuit. Using the example of 3 x 5 explain how this is done without using multiplication.

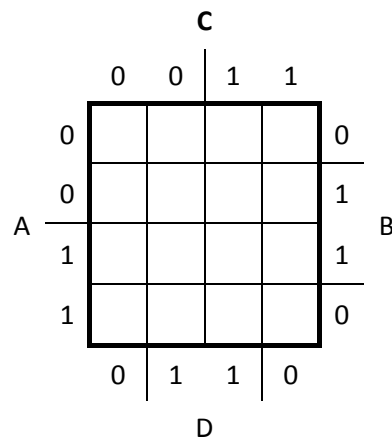
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Question 11

- (a) This is a truth table for a logic device that has inputs **A**, **B**, **C** and **D** and a single output **H**.

A	B	C	D	H
0	0	0	0	1
0	0	0	1	1
0	0	1	0	1
0	0	1	1	1
0	1	0	0	1
0	1	0	1	1
0	1	1	0	0
0	1	1	1	1
1	0	0	0	1
1	0	0	1	0
1	0	1	0	0
1	0	1	1	0
1	1	0	0	1
1	1	0	1	1
1	1	1	0	0
1	1	1	1	0

- (i) Complete the Karnaugh Map for the above truth table for **H**.



- (ii) Use your answer to part (i) to produce a simple logic expression for **H**.

.....

Question 11 continues.

Question 11 (continued)

(b) (i) In the TOY branch zero instruction **if (R[d] == 0) pc ← addr**, what does the “pc” stand for?

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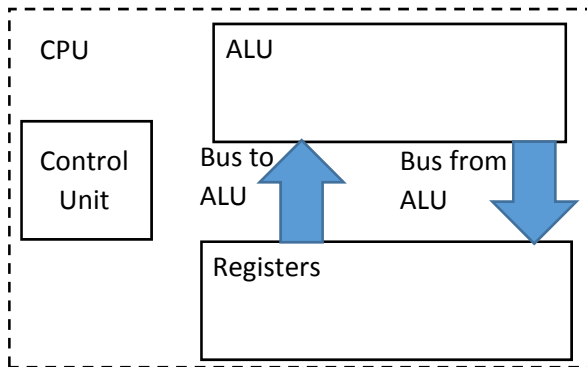
(ii) Explain the purpose of the “pc”.

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(c) The **add** instruction is a TOY instruction with pseudocode of $R[d] \leftarrow R[s] + R[t]$.

Describe the movement of data within the CPU during the execution of this instruction.

You can write notes in the diagram of the CPU below and/or write a separate description for your answer.



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Tasmanian Certificate of Education
External Assessment 2017

PLACE YOUR CANDIDATE
LABEL HERE

COMPUTER SCIENCE

(ITC315113)

SECTION E

Time: 36 minutes

Pages:	12
Questions:	3
Attachments:	Information Booklet

Candidate Instructions

1. You **MUST** make sure that your responses to the questions in this examination paper will show your achievement in the criterion being assessed.
2. Answer **ALL** questions. Answers must be written in the spaces provided on the examination paper.
3. You should make sure you answer all parts within each question so that the criterion can be assessed.
4. This examination is 3 hours in length. It is recommended that you spend approximately 36 minutes in total answering the questions in this booklet.
5. The 2017 External Examination Information Booklet for Computer Science can be used throughout the examination.
6. All written responses must be in English.

On the basis of your performance in this examination, the examiners will provide results on the following criterion taken from the course statement:

Criterion 5 Demonstrate knowledge and understanding of data representation and storage.

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Additional Instructions for Candidates

To be considered for a 'C' rating on a criterion, you must provide a satisfactory answer to at least the first question of the relevant section.

To be considered for a 'B' rating on a criterion, you must provide a satisfactory answer to at least the first two questions of the relevant section.

To be considered for an 'A' rating on a criterion, you must provide a satisfactory answer to all three questions of the relevant section.

Show the methods used in deriving answers.

Take care with the presentation of your answers, which should be complete and to the point. Diagrams should be used where appropriate. Complete sentences should be used in questions involving explanations. You are reminded that poor handwriting, spelling and expression that make it difficult for the examiners to understand what you mean may lead to lower marks.

A spare answer sheet has been provided in the back of the answer booklet for you to use if required.

If you use a spare answer sheet, you MUST indicate you have done so in your answer to that question.

Question 13

(a) Fill in the three missing bits in the following binary addition.

$$\begin{array}{rcccccc} & 1 & 1 & 0 & 0 & 1 \\ + & 1 & \square & 0 & 1 & \square \\ \hline 1 & \square & 0 & 0 & 1 & 1 \\ \hline \end{array}$$

(b) (i) A computer uses an 8-bit word and Twos Complement representation.

Given that $91_{10} = 01011011_2$ and $103_{10} = 01100111_2$.

Explain how the computer would calculate $103 - 91 = 12$

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(ii) Convert $2A3D_{16}$ to binary.

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(iii) Explain why the largest value that can be represented in an 8-bit Twos Complement representation is 127.

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Question 13 continues.

Question 13 (continued)

**For
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Use
Only**

- (c) (i) Computers have been designed to store numbers in binary.

How do computers store characters like the letters of the alphabet if they are designed to store numbers?

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- (ii) What is the minimum number of bits required to store a boolean value?

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Question 14

(a) Car registration plates have an identification code in the form:

letter – digit – digit – letter – letter

The letters are A to Z and the digits are 0 to 9.

In storing the identification code the system uses the following index table for the letters:

Index	0	1	2	3	4	5	6	7	8	9	10	11	12
Letter	A	B	C	D	E	F	G	H	I	J	K	L	M
Index	13	14	15	16	17	18	19	20	21	22	23	24	25
Letter	N	O	P	Q	R	S	T	U	V	W	X	Y	Z

What is the minimum number of bits required to store identification codes? Explain your calculation.

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(b) A floating point representation has a 15 bit mantissa. If this representation was used to store the number 0.9 the mantissa would contain the binary fraction for 0.9.

Calculate what would be stored in the 15 bits of the mantissa. Clearly indicate the most significant bit in the answer.

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Question 14 continues.

Question 14 (continued)

(c) (i) What is the advantage of using an unsigned integer representation compared to a signed integer representation?

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(ii) Give an example of the use of an unsigned integer representation.

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Question 15

**For
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- (a) A sound file format stores the data using a series of data frames. Each frame is made up of a Data Header and a Data Block as shown below.

Sound file format:

Data Header
Data Block
Data Header
Data Block
Data Header
Data Block

The file uses as many frames as required to store the sound data.

The Data Header is 28 bits and the Data Block is 384 **samples** of the sound.

The sample size is 16 bits and the sampling is 32 kHz (32 000 samples a second).

Calculate the size of the file required to store one minute of sound. Give your answer as a number of bits.

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Question 15 continues.

Question 15 (continued)

**For
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- (b) The following code segment uses floating point numbers and the code behaves differently depending on the floating point value used for *r*.

```
double r = 7.2; // or 11.25
double c = 0;

while (c != 360)
{
    c = c + r;
}
```

If *r* = 11.25 the while loop terminates correctly and *c* = 360.0.

If *r* = 7.2 the while loop does not terminate correctly.

- (i) Using your knowledge of the storage of floating point numbers, explain the reason for the difference.

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- (ii) Indicate the change needed to the code so that it will work for both values of *r*.

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