OFFICE OF TASMANIAN ASSESSMENT, STANDARDS & CERTIFICATION

External Assessment 2021

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COMPUTER SCIENCE

ITC315118

Section A

Pages	12
Questions	3
Information sheet	1

Reading time: 15 minutes – you may begin writing during this time

Suggested working time: 36 minutes

Instructions

- Attempt **all** questions and **all** parts within each question.
- Write your answers in the spaces provided in this exam paper.
- Take care with presentation of answers and use **complete sentences** for questions needing explanations.
- **Show all working out** used in deriving answers and **use diagrams** where appropriate.
  - **Extra space for answering** is at the end of this booklet. If used, you **must** indicate you have done so next to the relevant question.
- All answers must be written in **English**.
- You **must** make sure your answers address:
  - Criterion 1 design, extend and improve algorithmic solutions to a range of problems.

Marks	
C1	**A+ to z rating**

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Guide to Exam Structure

	Questions available	How many questions to answer	Suggested working time	Final mark
Section A	3	3	36 minutes	All criteria are assessed using extended ratings of A+ to z
Section B	3	3	36 minutes	
Section C	3	3	36 minutes	
Section D	3	3	36 minutes	
Section E	3	3	36 minutes	
Totals	**15**	**15**	**180 minutes (3 hours)**	

Question 1

Marker use

The following applet is to be designed to measure a person's body mass index (BMI). The BMI is a ratio measure of weight to height which attempts to indicate weight categories. The user inputs their “height” in metres (e.g. 1.80) and their “weight” in kgs into corresponding TextFields. The user then presses a “calculate” button to get the result.

(Note numbers at the start of each line are for reference only.)

1. **Initially**
2. Set weight to 70
3. Set height to 1.75
4. **When** “calculate” button is pressed
5. Set weight to value in ‘weight’ TextField
6. Set height to value in ‘height’ TextField
7. BMI = (double) weight / (height*height)
8. display BMI

a) The BMI variable has not been given an initial value. **After** which lines could you enter the code to do this?

(Circle **all** correct answers.)

3 4 7 8

b) What would the BMI be for a person with the initial values used by the applet?

(Circle **all** correct answers.)

40 22.9 29.2 2.5

Question 1 continues

Marker use

c) The algorithm does not prevent division by zero, if zero is accidentally entered in the 'height' TextField. Show how this can be prevented by modifying the code in the "When calculate button is pressed". An error message should also be displayed.

When "calculate" button is pressed

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d) Add lines to also display the following information to the applet user:

BMI	**result**	**display BMI**
< 18.5	Underweight	.....
18.5 – 24.9	Healthy	.....
> 24.9	Overweight	.....

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Question 2

Marker use

The following algorithm is designed to simulate the action of a digital clock. When the clock is first turned on, it displays a default time of 6.00 am. The clock is equipped with a button which allows the user to set the time. When the 'Add minute' button is pressed, the current time should be incremented by one minute. The clock should keep track of whether the current time is before or after noon, and times should be displayed in 12-hour format (e.g. 15 minutes past 2 in the afternoon should be displayed as 2:15 pm, not 14:15).

(Note numbers at the start of each line are for reference only)

```
1.  Initially
2.  set hour to 6
3.  set minutes to zero
4.  set pm to false
5.
6.  When 'Add minute' button is pressed
7.  set minute to minute + 1
8.  if minute>59
9.  {
10.   set minute to zero
11. }
12. PRINT time (hour, minute, and am or pm)
```

a) This algorithm does not correctly track the current hour. What code would you insert to fix this and after which line would you insert it?

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Question 2 continues

Marker use

b) The current algorithm also fails to track whether the current time is am or pm. How would you modify the algorithm to address this problem?

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Question 3

Marker use

You are to design an algorithm for an applet to be used to calculate the score for a dice rolling game. A player continually rolls one dice until they reach a total of exactly 91. The score is the sum of all the dice rolls. If the player rolls the same number twice in a row (e.g. a 3 followed by a 3) then the next roll will be worth double its value (e.g. roll a 6 and it will be worth 12). The last roll must result in a score of 91 for the game to finish. Below is an example of the scoring in a game.

Roll number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Dice value	2	5	3	3	6	4	3	2	2	5	6	6	6	5	4	6	6	1
Score	2	7	10	13	25	29	32	34	36	46	52	58	70	80	84	90	90	91

The user will enter into the TextField called “roll” the value of each dice roll. The user then presses the “Calculate” button to process that roll. Once a score of 91 is reached, the number of rolls will be displayed. The user can then press the “reset” button to prepare for the next player. Note if the score gets to 90, a throw of one will end the game, regardless of the two previous throws being the same or not (as in the example provided).

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Question 3 continues

Marker use

Extra answer space:

[please write the question number you are answering in the box]

Marker use

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End of Section A

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COMPUTER SCIENCE

ITC315118

Section B

Pages	16
Questions	3
Information sheet	1

Suggested working time: 36 minutes

Instructions

- Attempt **all** questions and **all** parts within each question.
- Write your answers in the spaces provided in this exam paper.
- Take care with presentation of answers and use complete sentences for questions needing explanations.
- **Show all working out** used in deriving answers and **use diagrams** where appropriate.
  - **Extra space for answering** is at the end of this booklet. If used, you **must** indicate you have done so next to the relevant question.
- All answers must be written in **English**.
- You **must** make sure your answers address:
  - Criterion 2 create programs in a high level programming language.

Marks	
C2	**A+ to z rating**

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Guide to Exam Structure

	Questions available	How many questions to answer	Suggested working time	Final mark
Section A	3	3	36 minutes	All criteria are assessed using extended ratings of A+ to z
Section B	3	3	36 minutes	
Section C	3	3	36 minutes	
Section D	3	3	36 minutes	
Section E	3	3	36 minutes	
Totals	**15**	**15**	**180 minutes (3 hours)**	

Question 4

Marker use

a) Circle the correct answer for the following questions:

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

(Circle **the** correct answer.)

```
double a;
a = 4.0 + 12.0 / 3.0;
```

5.0 4.0 8.0 5.3333

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

(Circle **the** correct answer.)

```
int b;
b = 30 % 3;
```

0 0.0 10 10.0

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

(Circle **the** correct answer.)

```
double c = Math.pow(3, 2);
```

4.0 5.0 8.0 9.0

b)

i. What will be the final value of **d** after the following code is executed?

```
int d;
d = 17 / 4;
```

Final value of **d**: .....

Explanation: .....

.....

Question 4 continues

Marker use

ii. What will be the final value of **e** after the following code is executed?

```
char e = 'X';
char f = 'Y';
char temp;
temp = f;
f = e;
e = temp;
```

Final value of **e**: .....

Explanation: .....

.....

iii. Trace the following code and find the final value of the variable **g**.

```
int g = 3;
for (int i=2; i<=5; i++)
{
  if (g == i - 1)
   g = g * 2;
}
```

g	i

Final value of **g**: .....

Question 4 continues

Marker use

iv. Trace the following code and find the final value of the variable **x**.

```
int x = 21;
while (x > 0)
{
        x= x / 3;
}
```

x

Final value of **x**: .....

c) The following description of a method has been provided. Complete the missing code using correct Java syntax. Line numbers are provided for reference only. You do not need to use all the lines.

> This method accepts one parameter labelled “input”. Even numbers or zero should be doubled and have this result returned. Odd numbers should be multiplied by 5 and have this result returned.

```
1.  public int question4c(int input)
2.  // the value "input" is the value passed into the method.
3.  {
4.                  int output;
5.  .....
6.  .....
7.  .....
8.  .....
9.  .....
10.                 return output;
11. }
```

Question 5

Marker use

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

```
int r = 3;
int q = 5;
switch (r)
{
        case 1: q = 4;
        case 2: q = q + 1;
        case 3: q = q + 3;
        case 4: q = q + 5;
}
```

Final value of **q**: .....

Explanation: .....

.....

b) The following method can be used to check if the values passed as parameters form a right angled triangle. Write code to call the following method. Be sure to declare and initialise any variables that may be required to complete this task.

```
public boolean part5b(double x, double y, double z)
{
    return Math.abs(x * x + y * y - z * z) < 0.001
}
```

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Question 5 continues

Marker use

c)

i. Trace the following code and find the final values of the variables grid and **m**.

```
int m = 0;
int grid[4] [3];
for (int i = 0; i < 4; i++)
{
    m = m + 1;
    for (int j = 0; j <3; j++)
   {
       grid[i] [j] =m;
       m = m + 1;
    }
}
```


Final value of **m**: .....

ii. What error would occur in the program fragment above if the array grid was declared as int grid [3] [3]? Explain.

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Question 6

Marker use

The following questions relate to the applet found on the following pages. The applet takes four characters at a time from an input string of upper case letters and spaces and converts each to an integer between 0 and 26. This set of four integers is then coded (or decoded depending on the button used). The resulting coded integers are converted back to four characters and these characters are added to the end of the output string. This process continues until the whole input string has been coded (or decoded).

a) Use the applet to encode the input string of “FROG”. (Show working out/trace in rectangle boxes pages 10 and 11, then write your answer below.)

Encoded string is - .....

b) Indicate the purpose of the variable **p**.

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c) The variables p, input and batch are variables used in the method getBatch(). Explain why the variables input and batch can be parameters of this method, but the variable p cannot be a parameter of this method.

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Question 6 continues

Marker use

Applet

```
import java.applet.Applet;
import java.awt.*;
import java.awt.event.*;

public class questionSix extends Applet implements ActionListener {
//class to code and decode upper case letters

   Label in , out;
    TextField input, output;
    Button encode, decode;
    int p;
    String inStr, outStr;
    int[] key = { 3, 10,   2,  7  }, batch, code;

    public void init() {
       batch = new int[4];
       code = new int[4]; in = new Label("Input String:");
       out = new Label("Output String:");
       input = new TextField(20);
       output = new TextField(20);
       encode = new Button("Encode");
       decode = new Button("Decode");
       add( in );
       add(input);
       add(encode);
       add(decode);
       add(out);
       add(output);
       encode.addActionListener(this);
       decode.addActionListener(this);
    }
    public void getBatch(String input, int[] batch) {
       for (int i = 0; i < 4; i++)
           if (p == input.length())
               batch[i] = 26;
            else {
                if (input.charAt(p) == ' ')
                    batch[i] = 26;
               else
                    batch[i] = (int) input.charAt(p) - 65;
                p = p + 1;
```

Question 6 continues

Marker use

```
            }
        }
        public void adjustCode(int[] code) {
            for (int i = 0; i < 4; i++) {
                code[i] = code[i] % 27;
                if (code[i] < 0)
                    code[i] = code[i] + 27;
            }
        }
        public void encode(int[] key, int[] batch, int[] code) {
            code[0] = key[0] * batch[0] + key[1] * batch[2];
            code[1] = key[0] * batch[1] + key[1] * batch[3];
            code[2] = key[2] * batch[0] + key[3] * batch[2];
            code[3] = key[2] * batch[1] + key[3] * batch[3];
        }
        public void decode(int[] key, int[] batch, int[] code) {
            code[0] = key[3] * batch[0] - key[1] * batch[2];
            code[1] = key[3] * batch[1] - key[1] * batch[3];
            code[2] = -key[2] * batch[0] + key[0] * batch[2];
            code[3] = -key[2] * batch[1] + key[0] * batch[3];
        }
        public void outputCode(int[] code) {
            for (int i = 0; i < 4; i++)
                if (code[i] == 26)
                    outStr = outStr + " ";
                else
                    outStr = outStr + (char)(code[i] + 65);
        }
        public void actionPerformed(ActionEvent e) {
            inStr = input.getText();
            outStr = "";
            p = 0;
            while (p < inStr.length()) {
                getBatch(inStr, batch);
                if (e.getSource() == encode)
                    encode(key, batch, code);
                else
                    decode(key, batch, code);
                adjustCode(code);
                outputCode(code);
            }
            output.setText(outStr);
        }
    }
```

Extra answer space:

(please write the question number you are answering in the box)

Marker use

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End of Section B

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Section C

Pages	16
Questions	3
Information sheet	1

Suggested working time: 36 minutes

Instructions

- Attempt **all** questions and **all** parts within each question.
- Write your answers in the spaces provided in this exam paper.
- Take care with presentation of answers and use complete sentences for questions needing explanations.
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  - **Extra space for answering** is at the end of this booklet. If used, you **must** indicate you have done so next to the relevant question.
- All answers must be written in **English**.
- You **must** make sure your answers address:
  - Criterion 3 use appropriate objects in the design of programs.

Marks	
C3	A+ to z rating

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Guide to Exam Structure

	Questions available	How many questions to answer	Suggested working time	Final mark
Section A	3	3	36 minutes	All criteria are assessed using extended ratings of A+ to z
Section B	3	3	36 minutes	
Section C	3	3	36 minutes	
Section D	3	3	36 minutes	
Section E	3	3	36 minutes	
Totals	**15**	**15**	**180 minutes (3 hours)**	

Question 7

Marker use

Consider the following class definition:

```
public class Bicycle
{
    private int pedalRpm;
    private int gear;
    private double wheelDiameter;
    private int numberOfGears;

    public Bicycle(double wheelDiameter, int numberOfGears)
    {
        this.pedalRpm = 0;
        this.gear = 1;
        this.wheelDiameter = wheelDiameter;
        this.numberOfGears = numberOfGears;
    }
    public double getWheelDiameter()
    {
        return this.wheelDiameter;
    }
    public int getNumberOfGears()
    {
        return this.numberOfGears;
    }
    public int getGear()
    {
        return this.gear;
    }
    public int getPedalRpm()
    {
        return this.pedalRpm;
    }
    public void setPedalRpm(int pedalRpm)
    {
        this.pedalRpm = pedalRpm;
        if (this.pedalRpm <=0) this.pedalRpm = 0;
    }
    public void changeGear(int direction)
    {
        if (direction == 0){
            this.gear--;
            if (this.gear <=1) this.gear = 1;
        }
        else if (direction ==1){
            this.gear++;
        }
     }
    public double getSpeed()
    {
        double wheelCircumference = 3.14 * this.wheelDiameter;
        return this.pedalRpm * wheelCircumference / 60 * this.gear;
    }
}
```

Question 7 continues

Marker use

a) i Which of the following statements will create a Bicycle object that represents a 27.5 inch bicycle with 3 gears? (Circle **the** correct answer.)

Bicycle b = new Bicycle (27, 3);

Bicycle b = new Bicycle (27.5, 3);

Bicycle b = new Bicycle (27.5, 3.0);

Bicycle b = new Bicycle (27.5, true);

ii. How many parameters does the changeGear method have?

(Circle **all** correct answers.)

0 1 2 3

iii. What data type does the getSpeed method return?

(Circle **all** correct answers.)

void double int boolean

iv. Assuming that b1 is a bicycle object that has been declared and instantiated, which of the following statements will increase the object's gear instance variable by one.

(Circle **all** correct answers.)

b1.changeGear () = false;

b1.changeGear(1) = true;

b1.changeGear (1);

b1.changeGear (true);

b) Assuming that bike is a bicycle object that has been declared and instantiated to represent a 29 inch 9 speed bicycle with gear equal to 5 and pedalRPM = 60, what will be the value of **s** after the following code is executed?

int s = bike.getSpeed();

Value of **s**:.....

.....

Question 7 continues

Marker use

c) Add a setNumberOfGears method to the class definition that will allow the number of gears to be set.

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d) The changeGear method takes in one parameter. A parameter of 0 means decrease the current gear by 1 and a 1 means increase the current gear by 1. The method allows the user to set the gears to a number which is higher than the bike actually has (numberOfGears). What line of code is missing to rectify this and from where?

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Exam continues over the page

Question 8

Marker use

This class definition below defines a leg in a yacht race. Each leg has an ID, bearing (0 to 360^{o}), distance in nautical miles (NM) and the time taken in hours to complete the leg.

```
public class Leg
{
public char id;
public double distance, bearing, timeTaken;

public Leg(char newId, double newDistance, double newBearing)
{
  id = newId;
  distance = newDistance;
  bearing = newBearing;
}

public void setDistance(double newDistance)
{
  distance = newDistance;
}

public void setBearing(double newBearing)
{
  bearing = newBearing;
}

public void setTime(double newTime)
{
  time = newTime;
}

public double getDistance()
{
  return distance;
}

public double getBearing()
{
  return bearing;
}

public double getTime()
{
  return time;
}

public double bearingChange(Leg previousLeg)
{
  return previousLeg.getBearing() - bearing;
}
}
```

Question 8 continues

Marker use

a) i Write code to declare, instantiate, and initialise the following Leg objects:

leg1 – ID: A Bearing 33^{o} Distance 3.2NM

leg2 – ID: B Bearing 71^{o} Distance 5.3NM

……

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ii. Write code that uses one or more methods within the class to change the distance of leg1 to 4.1NM.

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……

iii. Write code that uses one or more methods within the class to calculate the average speed in knots (NM per hour) of leg2.

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iv. Write code that uses one or more methods within the class to find the bearing change between leg1 and leg2.

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b) Why doesn't this line from the Leg class definition have a return type?

Public Leg(char newId, double newDistance, double newBearing)

……

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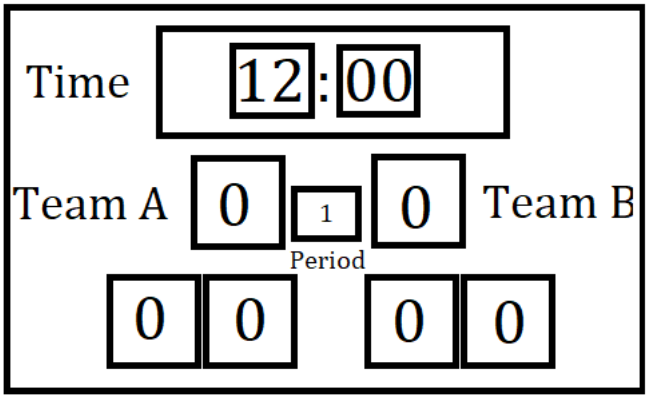
Question 9

Marker use

A basketball scoreboard is depicted below. The top value is the time remaining in the current period. The middle values are the number of team fouls for each team, with the current period value in between these two. The bottom values are the scores for each team. In its current state the scoreboard has been set ready to start a new game.



A class is needed for the user interface of an electronic basketball scoreboard. The information to be stored is the following:

Variable Name	Description	Type of data
minutes	Number of minutes remaining in quarter	integer
seconds	Number of seconds remaining in quarter	integer
scoreA	The score for team A (an integer from 0 to 99)	integer
scoreB	The score for team B (an integer from 0 to 99)	integer
teamFoulsA	The number of Team fouls for Team A	integer
teamFoulsB	The number of Team fouls for Team B	integer
period	Current quarter – values 1, 2, 3 or 4	integer

Question 9 continues

Marker use

The class will contain the following constructor and methods:

- A constructor method that will set the initial value for the scoreboard setting the minutes to 12, the period to 1 and all other values to 0.
- A method that will increase the score of selected team by either 1, 2 or 3 (points).
- A method that will decrease the score of selected team by either 1, 2 or 3 (points) in case of operator error.
- A method that will increase the foul count of selected team by 1.
- A method that will decrease the foul count of selected team by 1 in case of operator error.
- A method that allows the period to be incremented by 1 (e.g. end of first period, change value to 2) and resets clock and foul count.

Create a class to hold the required data that contains the constructor and methods specified.

You do not need to include any code which relates to how the timer counts down. The score only allows for two digits so your code should allow for this.

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Extra answer space:

(please write the question number you are answering in the box)

Marker use

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End of Section C

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Section D

Pages	16
Questions	3
Information sheet	1

Suggested working time: 36 minutes

Instructions

- Attempt **all** questions and **all** parts within each question.
- Write your answers in the spaces provided in this exam paper.
- Take care with presentation of answers and use complete sentences for questions needing explanations.
- **Show all working out** used in deriving answers and **use diagrams** where appropriate.
  - **Extra space for answering** is at the end of this booklet. If used, you **must** indicate you have done so next to the relevant question.
- All answers must be written in **English**.
- You **must** make sure your answers address:
  - Criterion 4 describe and apply knowledge of computer architecture.

Marks	
C4	A+ to z rating

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Guide to Exam Structure

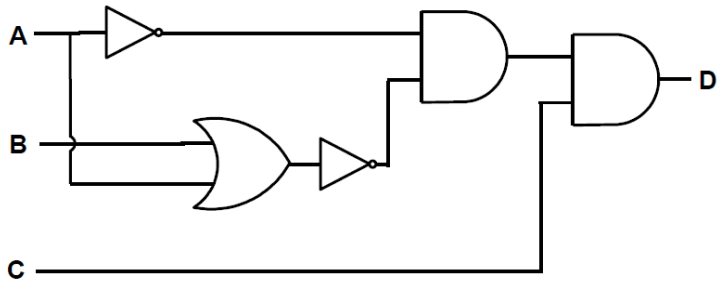
	Questions available	How many questions to answer	Suggested working time	Final mark
Section A	3	3	36 minutes	All criteria are assessed using extended ratings of A+ to z
Section B	3	3	36 minutes	
Section C	3	3	36 minutes	
Section D	3	3	36 minutes	
Section E	3	3	36 minutes	
Totals	**15**	**15**	**180 minutes (3 hours)**	

Question 10

Marker use

a) Circle **the** correct answer in the following questions.

i. Select the logic expression which represents the following circuit:



(Circle **the** correct answer.)

(~A ∧ ~ B V A) ∧ C

~A ∧ ~ (B V A) ∧ C

~ (A ∧ ~ B V A ∧ C)

~A ∧ ~ B V A ∧ C

ii. Fill in the table and circle the correct answer below.

A	**B**	**~ A V B**
F	F	
F	T	
T	F	
T	T	

(Circle **the** correct answer.)

~ A V B		**~ A V B**		**~ A V B**		**~ A V B**
F		F		T		T
T		T		F		T
F		F		F		F
T		F		F		T

iii. Circle the simplified expression for **A ∧ F**

A T A ∧ F F

Question 10 continues

Marker use

b) i. Complete the truth table for the following expression:

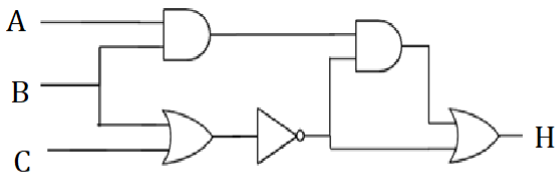
H ≡ ~ (A ∧ (~B V ~(B ∧ C))

A	B	C	(B∧C)	~(B∧C)	~B V ~(B∧C)	A ∧ (~B V ~(B∧C))	~(A ∧ (~B V ~(B∧C)))
0	0	0					
0	0	1					
0	1	0					
0	1	1					
1	0	0					
1	0	1					
1	1	0					
1	1	1					

ii. Draw the logic circuit for the expression for H:

H ≡ ~ (~A ∨ B) ∧ ~ (A ∨ C)

iii. Give the logic expression for H:



H ≡.....

Question 10 continues

Marker use

c) Consider the following TOY program. Fill in the pseudocode and explanation boxes to show what each line of code does.

Memory address	Contents	Pseudocode	Explanation
01	0009	data	mem[01] contains value 9
02	0002		
10	8A01		
11	8B02		
12	6CAB		
13	0000		

On program termination R[C] = ...

.....

Question 11

Marker use

a) i Produce a simple logic expression for H from the following Karnaugh map.

A \ C	00	01	11	10
00	0	1	1	0
01	1	0	0	1
11	1	0	0	1
10	1	1	1	0

B

D

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ii. Use logic laws to simplify the following logic expression:

(A ∧ B) V (A ∧ ~B)

Indicate which logic law(s) were applied to each stage of your answer.

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b) i In the TOY command branch positive - if (R[d] > 0) pc ← addr what does the term pc stand for?

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ii. Explain the role that the pc plays in ensuring programs are executed correctly.

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Question 12

Marker use

a) i Complete the following TOY program so that it will implement the Java code below.

```
x = 4;
if ( x > 0 )
        y = 3;
else
        y = 6;
```

Memory address	Contents	Pseudocode	Explanation
01	0004	data	Used for variable x
02	0000	data	Used for variable y
03	0003	data	Constant decimal 3
10	8A01	R[A] <- mem[01]	

Question 12 continues

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Exam continues over the page

Marker use

ii. Trace the TOY program below where the following values are input by the user (a trace table is provided on page 11):

5 3 -1

Memory address	Contents	Pseudocode	Explanation
01	0000		
10	8B01	R[B] ← mem[01]	R[B] = 0
11	8AFF		R[A] = character input from keyboard
12	CA17		Branch if R[A] = 0 to line 17
13	DA17		Branch if R[A] > 0 to line 17
14	8C01		R[C] = 0
15	9CFF		
16	0000		
17	2CAB		
18	DC20		
19	C010		
20	9A01		
21	C010		

What is the purpose of this program?

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Explain how the value of -1 would be entered into the TOY program.

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Question 12 continues

Marker use

Trace table for Question 12 a) ii

Mem Address	Contents	R[A]	R[B]	R[C]	mem[0]		

Question 12 continues

Marker use

b) Consider the following section of code:

```
int b = 100, c = 0, d = 5;

for (int i = 1; i < b; i++)

c = c + d;
```

i. Counting only the memory accesses used for loading and storing data, determine the number of memory accesses used by one iteration of the loop.

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ii. If the machine code for the loop was rewritten, the internal registers could be used to reduce the number of times memory is accessed. Using your understanding of the von Neumann bottleneck issue, discuss the effect this could have on the number of memory accesses used to load or save data during the execution of the loop.

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Extra answer space:

(please write the question number you are answering in the box)

Marker use

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End of Section D

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COMPUTER SCIENCE

ITC315118

Section E

Pages	12
Questions	3
Information sheet	1

Suggested working time: 36 minutes

Instructions

- Attempt **all** questions and **all** parts within each question.
- Write your answers in the spaces provided in this exam paper.
- Take care with presentation of answers and use complete sentences for questions needing explanations.
- **Show all working out** used in deriving answers and **use diagrams** where appropriate.
  - **Extra space for answering** is at the end of this booklet. If used, you **must** indicate you have done so next to the relevant question.
- All answers must be written in **English**.
- You **must** make sure your answers address:
  - Criterion 5 analyse how data are represented and stored.

Marks	
C5	A+ to z rating

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Guide to Exam Structure

	Questions available	How many questions to answer	Suggested working time	Final mark
Section A	3	3	36 minutes	All criteria are assessed using extended ratings of A+ to z
Section B	3	3	36 minutes	
Section C	3	3	36 minutes	
Section D	3	3	36 minutes	
Section E	3	3	36 minutes	
Totals	**15**	**15**	**180 minutes (3 hours)**	

Question 13

Marker use

a) i. When $5A_{16}$ is converted to binary the value is:

(Circle **all** correct answers.)

01101011_2 00111010_2 01011110_2 01011010_2

ii. When 110101_2 is converted to decimal the value is:

(Circle **the** correct answer.)

11 32 53 65

iii. What is the ASCII code (in decimal) for the character 'A'?

(Circle **the** correct answer.)

6 64 65 97

b) Fill in the four missing bits in the following binary addition.

	1	☐	0	☐	1
+	1	1	1	1	0
1	☐	1	☐	0	1

c) i. Using 8 bit two's complement representation, 97 is represented as:

01100001_2

How would 112 be represented?

112 .....

ii. Perform the following two's complement arithmetic: 112 – 97 (Show working out.)

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iii. Early computer systems used 8 bit graphics in their displays. How many different colours could be displayed in such a computer system?

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Question 14

Marker use

a) In a 4 bit two's complement system, the addition of 4 + 5 ($0100_2 + 0101_2$) will lead to an overflow error. Explain what an overflow error is, using the addition of 4 + 5 to illustrate your answer.

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b) Convert 0.1011_2 to decimal (show all working out).

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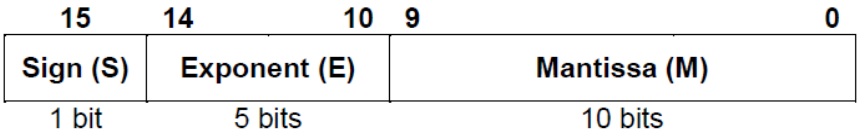
c) A 16 bit floating point representation uses a sign bit, 5 bits for the exponent (in two's complement) and 10 bits for the normalised mantissa (ie bit 9 must be a 1).



When 1024 is added to 0.25 in this representation, the answer is 1024. Using your knowledge of how floating point numbers are stored, explain this result.

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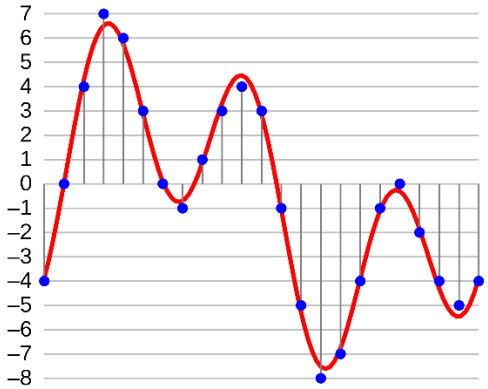
Question 15

Marker use

The following diagram represents the sampling of an audio signal. The x axis represents the sample frequency and the y axis represents the amplitude of the signal.



a) i. How many bits would be required to store each sample?

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ii. How many bits would be required to store 3.5 minutes if the sampling rate was 22,000 samples per second?

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b) Pulse-code modulation (PCM) is a method used to digitally represent sampled analogue (sound) signals. For an audio CD, the PCM file takes 44,100 samples a second and stores the numbers as 16 bit integers.

i. What would be the file size (in MB) if a 3.5 minute track was recorded using the above PCM format? (Show all working out.)

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ii. In order to decrease the file size it is proposed to store samples using a 10 bit floating point representation. Suggest a suitable floating point representation to store the required sound samples. (Show all working out.)

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Question 15 continues

Marker use

iii. Given your understanding of how floating point numbers are represented, explain the effect this may have on audio quality over the original integer format in **part b) i**

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c) A Computer Science student needs to store 15 integer values in their applet. They need to decided on whether to use a one-dimensional array or two-dimensional array (3 x 5) to store the values. A fellow student says that the one-dimensional array will use less memory.

Draw a diagram of the structure of each option to illustrate the storage requirements of each. Using this diagram, calculate if their friend is correct. Use **data** as the name of the array.

Extra answer space:

(please write the question number you are answering in the box)

Marker use

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End of Section E

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