

External Assessment 2025

# COMPUTER SCIENCE

ITC315118

## Section **A**

Pages: 16

Questions: 3

Information Booklet: 1

**Preparation time for this exam:** 15 minutes

**Suggested working time:** 36 minutes

### Instructions:

- Answer **all** questions and **all** items 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** questions is included at the end of the section. If used, you **must** indicate you have done so next to the relevant question.
- The Computer Science Information Booklet can be used throughout this exam.
- The exam is **three (3) hours** in length. The suggested working time for this section is **approximately 36 minutes**.
- All answers must be written in **English**.
- You **must** make sure your answers address the listed criterion.

Marker use	
C1	/ 36

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# Guide to Exam Structure

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	Questions available	Questions to answer	Suggested working time	Marks available
Section <b>A</b>	3	3	36 minutes	36 marks
Section <b>B</b>	3	3	36 minutes	36 marks
Section <b>C</b>	3	3	36 minutes	36 marks
Section <b>D</b>	3	3	36 minutes	36 marks
Section <b>E</b>	3	3	36 minutes	36 marks
<b>Totals</b>	<b>15</b>	<b>15</b>	<b>180 minutes (3 hours)</b>	<b>180 marks</b>

## Criterion

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You **must** make sure your answers address:

- Criterion 1 design, extend and improve algorithmic solutions to a range of problems.

# Additional Instructions for Candidates

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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 page has been provided in the back of this section for you to use if required. If you use the spare answer page, you **must** indicate you have done so in your answer to that question.

## Question 1

Marker use

a) Consider the following algorithm:

**Initially**

`number = 1`

**When button A is pressed**

`number = number + 3`

**When button B is pressed**

`number = number * 2`

i. What is the initial value of `number`?

(Circle the correct answer)

0                      1                      2                      3

/1

ii. What is the value of `number` after only button A is pressed?

(Circle the correct answer)

1                      2                      3                      4

/1

iii. Which sequence of button presses will give `number` the value of 5?

(Circle the correct answer)

AA                      AB                      BA                      BB

/2

iv. What is the value of `number` when the buttons are pressed in the sequence A, B, A?

(Circle the correct answer)

8                      11                      12                      54

/2

Question 1 continues

## Question 1 continued

Marker use

Consider the following algorithm:

```
count = 0
while count <= 10
    add one to the value of count
```

b) The final value of `count` is

(Circle the correct answer)

0                                      1                                      10                                      11

c) An algorithm is to be written to manage a recycling collection machine. The user logs in, inserts bottles and cans, and if they scan correctly, the machine credits \$0.10 to their account.

A partial algorithm is as follows:

```
1 Initially
2   payout = $0
3 When a can or bottle is inserted
4   bottle or can is scanned
5   if bottle or can is scanned correctly
6     payout = $0.10
7 When the Pay My Account button is pressed
8   payout is placed in user's bank account
9   payout = $0
```

/2

Question 1 continues

**Question 1 continued**

Marker use

- i. The algorithm currently does not pay the user the correct amount if they successfully insert two or more bottles or cans, then press the Pay My Account button.

/2

Edit the code to correct this.

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.....

- ii. If the user successfully adds 10 bottles or cans, they receive a bonus \$0.50 added to their account. The bonus is only paid once, no matter how many more bottles or cans are inserted.

/2

Add code to the algorithm to accommodate the bonus \$0.50.

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**Total  
Q1  
/12**

## Question 2

Marker use

Hundreds of competitors will take part in a local running event. As each competitor finishes, they will be given a token indicating the position in which they finished. The competitors then head to one of two officials, giving them their token and their event registration with their name.

Once the race is completed, the officials will have lists, similar to the following:

List1	
Position	Name
2	Harry
5	Tina
7	John
8	Chloe

Table 1

List2	
Position	Name
3	Megan
1	Tony
6	Josh
4	Frank

Table 2

An algorithm is to be written to merge the two lists into a single list, called `ListFinal`, in ascending order of position.

Note that some competitors like to rest before heading to the officials, so the positions are not necessarily in ascending order in each list.

Below is an algorithm to merge the lists:

```
1  Set pos to 1
2  While List1 or List2 are not empty
3      search List1
4      if pos is found in List1
5          remove pos and the corresponding name from List1
6          add pos and corresponding name to next row of ListFinal
7      search List2
8      if pos is found in List2
9          remove pos and the corresponding name from List2
10         add pos and corresponding name to next row of ListFinal
11        increase pos by 1
```

**Question 2 continues**

Question 2 continued

Marker use

a) Trace the algorithm and give the final contents of ListFinal.

/4

ListFinal	
Position	Name

Table 3

b) A few days before the event, it is decided that **three (3)** officials will be needed rather than two (2) to handle the numbers. Modify the code to implement this change.

/4

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**Question 2 continued**

Marker use

- c) Currently the algorithm will always search all **three (3)** lists, even if the current position has been found in the first or second list.

/4

Describe how you would change the algorithm so that it stops searching further lists when it finds the current position in a list.

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Total  
Q2  
/12

### Question 3

A new fast food outlet is being built. When team members take orders from customers, they will enter the order on a touch screen display, then press Calculate to find out the cost of the order.

The following board in the store shows the menu available:

- Burger \$10
- Chips: Small \$3, Large \$4
- Drink: Small \$2.50, Large \$3.50
- Small Meal: Burger, Small Chips and Small Drink \$14.50
- Large Meal: Burger, Large Chips and Large Drink \$15.50

The following restrictions are placed on orders:

- Each order is for only **one (1)** of each item.
- Only one size of chips and one size of drink can be purchased.

The company always wants to offer the cheapest price for customers:

- If a customer orders individually a Burger, Small Chips **and** Small Drink, the order will be changed to a Small Meal.
- If a customer orders individually a Burger, Large Chips **and** Large Drink, the order will be changed to a Large Meal.
- If they order one small **and** one large item with their burger, it will automatically be upsized to a Large Meal.

### Question 3 continued

The touch screen interface after initialisation will look like the following:

Burger		off	
Small Meal	off	Large Meal	off
Small Chips	off	Large Chips	off
Small Drink	off	Large Drink	off
Calculate		\$ 0.00	

Table 4

The team member can turn on or turn off each button as the customer gives their order.

Also, some buttons may be turned on or off automatically by the algorithm, e.g. the Small Meal button being turned on if a customer has ordered a Burger, Small Chips and Small Drink.

Partial code for the algorithm is as follows:

```
1  Initially
2    Cost = $0.00
3    Burger button is off
4    Small Meal button is off
5    Large Meal button is off
6    Small Chips button is off
7    Large Chips button is off
8    Small Drink button is off
9    Large Drink button is off
10 When the Burger button is pressed
11   if the Burger button is now off
12     Large Meal button is turned off
13     Small Meal button is turned off
14   else
15     ...
```









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External Assessment 2025

# COMPUTER SCIENCE

ITC315118

## Section **B**

Pages: 16

Questions: 3

Information Booklet: 1

**Suggested working time:** 36 minutes

### Instructions:

- Answer **all** questions and **all** items within each question.
- Write your answers in the spaces provided in this exam paper.
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Marker use	
C2	/ 36

# Guide to Exam Structure

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	Questions available	Questions to answer	Suggested working time	Marks available
Section <b>A</b>	3	3	36 minutes	36 marks
Section <b>B</b>	3	3	36 minutes	36 marks
Section <b>C</b>	3	3	36 minutes	36 marks
Section <b>D</b>	3	3	36 minutes	36 marks
Section <b>E</b>	3	3	36 minutes	36 marks
<b>Totals</b>	<b>15</b>	<b>15</b>	<b>180 minutes (3 hours)</b>	<b>180 marks</b>

## Criterion

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You **must** make sure your answers address:

- Criterion 2 create programs in a high level programming language.

# Additional Instructions for Candidates

---

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.

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## Question 4

Marker use

a)

i. The value 'A' is of type:

(Circle the correct answer)

String      boolean      char      int

/1

ii. The following code is executed:

```
int a = 3 + 5 * 2;
```

a will now have the value

(Circle the correct answer)

10      13      16      30

/1

iii. The value of (char) 66 is equal to:

(Circle the correct answer)

"66"      '66'      'B'      "B"

/1

iv. The value of (double) 3 is equal to:

(Circle the correct answer)

3.0      3      6      6.0

/1

b)

i. What is the value of b after the following code is executed?

```
int b = 12 / 5 + 25 % 8;
```

Answer: .....

.....

.....

/2

Question 4 continues

**Question 4 continued**

Marker use

ii. What is the value of `t` after the following code is executed?

```
String s = "abcde";  
String t = s.substring(0, 2)+'C'+s.substring(3);
```

Answer: .....

.....  
.....

/2

iii. What is the value of `b` after the following code is executed?

```
int b = 3;  
int c = 6;  
b++;  
c--;  
b + = c;
```

Answer: .....

.....  
.....

/2

**Question 4 continues**

**Question 4 continued**

Marker use

/2

iv. What will be the final value of *j* after the following code is executed?

```
int j = 3;
while (j < 17) {
    if (j * 5 < 18)
        j = j + 2;
    else
        j = j + 10;
}
```

Provide a trace of your working:

j

Table 5

Final value of *j*:

.....

Total  
Q4  
/12

### Question 5

The method `isPrime` returns true if `n` is prime (it has no factors other than itself and 1) and false otherwise.

```
1 public boolean isPrime(int n) {
2     boolean prime = true;
3     for (int j = 2; j < n; j++) {
4         if (n % j == 0)
5             prime = false;
6     }
7     return prime;
8 }
```

- a)
- i. Provide a trace of the method to show that 7 is prime, i.e. calculate the return value of the call `isPrime(7)`:

/2

n	j	n % j	prime	isPrime(7)

Table 6

**Question 5 continued**

Marker use

ii. Provide a trace of the program to show that 9 is not prime, i.e. calculate the return value of the call `isPrime(9)`:

/2

n	j	n % j	prime	isPrime(9)

Table 7

iii. The value `j` in the code need only search as high as  $\sqrt{n}$  for factors.

Use the method `double Math.sqrt(double a)` to alter line 3 to implement this change.

/2

.....

.....

iv. Currently, the code continues to check for factors, even after one has been found. This code is inefficient.

Change this method to be more efficient.

/2

.....

.....

.....

.....

.....

**Question 5 continues**

**Question 5 continued**

b) The two dimensional array `code` is defined and initialised as follows:

```
char[][] code = {{'B','N', 'L', 'O', 'T', 'S', 'D', 'S'},  
                {'R', 'B', 'H', 'D', 'M', 'B', 'F','Y'},  
                {'H', 'R', 'W', 'E', 'T', 'O', 'Y', 'Y'}};
```

/4

Calculate the values in the array `code` after the following code fragment has been executed:

```
for (int j = 0; j < code.length; j++) {  
    for (int k = 0; k < code[0].length; k++) {  
        if ((j+k) > 6)  
            code[j][k]--;  
        else  
            code[j][k]++;  
    }  
}
```

Final values in the array `code`:


*Table 8*

Total  
Q5  
/12

## Question 6

Marker use

An application has been written to give all the possible seating allocations for a group of people who wish to sit together in the same aisle at a concert, where some seats have already been allocated.

Positions in the aisle start with number 0.

`seats` is the array containing the current allocation of seating. Note that:

- 'E' denotes a seat is currently empty
- 'X' denotes a seat has already been taken.

```
1 public class Exam2025Q6
2
3     public static int people = 2;
4     public static char [] seats = {'E','E','E','X','E','E','X'};
5
6     public static void printSeats() {
7         for(int j=0; j < seats.length; j++) {
8             System.out.print(seats[j]);
9         }
10        System.out.println();
11    }
12
13    public static boolean findSeats(int loc) {
14        for(int pos = loc; pos < people+loc; pos++) {
15            if(seats[pos]=='X')
16                return false;
17        }
18        return true;
19    }
20
21    public static void main(String[] args) {
22        System.out.println("Current seating:");
23        printSeats();
24        for(int loc=0; loc < seats.length-people+1; loc++) {
```

**Question 6 continues**

**Question 6 continued**

Marker use

```
25         if(findSeats(loc))
26             System.out.println(people+" can sit at pos "+loc);
27     }
28 }
29 }
```

With the current values of `seats` and `people`, the following output will be generated:

Current seating:

EEEXEEX

2 can sit at pos 0

2 can sit at pos 1

2 can sit at pos 4

a) Trace the output of the following code:

```
findSeats(1)
```

where `seats[]={'X', 'E', 'X', 'E', 'X'}` and `people=3`.

/3

people	loc	pos	seats[pos]	findSeats(1)

Table 9

b) Line 18 is `return true`. Under what circumstances would this method return true?

/2

.....

.....

.....

Question 6 continues

**Question 6 continued**

c) Explain how the code would need to be altered if `people` was declared in the `main` method rather than at the beginning of the class.

/2

.....  
.....  
.....

d) When searching along the row of seats in the `main` method, the method `findSeats` does not need to be called if the seat at position `loc` is already occupied.

/2

Add code to the `main` method to include this improvement.

.....  
.....  
.....  
.....

At the end of the application, a method called `finish` is called with a parameter `answer`.

```
public static void finish(int answer) {  
    for(int pos=0; pos<people; pos++)  
        seats[answer+pos]='X';  
}
```

e) Using the values `seats={'E','E','E','X','E','E','X'}` and `people=2`, trace the method `finish`, given that `answer=1`. Provide the final values in the array `seats[ ]`.

Question 6 continued

Marker use

people	answer	pos	seats[answer+pos]

Table 10

Final values in array seats [] :

--	--	--	--	--	--	--	--

/3

Total  
Q6  
/12



End of Section B  
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# COMPUTER SCIENCE

ITC315118

## Section **C**

Pages: 20

Questions: 3

Information Booklet: 1

**Suggested working time:** 36 minutes

### Instructions:

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- You **must** make sure your answers address the listed criterion.

Marker use	
C3	/ 36

Blank Page

# Guide to Exam Structure

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	Questions available	Questions to answer	Suggested working time	Marks available
Section <b>A</b>	3	3	36 minutes	36 marks
Section <b>B</b>	3	3	36 minutes	36 marks
Section <b>C</b>	3	3	36 minutes	36 marks
Section <b>D</b>	3	3	36 minutes	36 marks
Section <b>E</b>	3	3	36 minutes	36 marks
<b>Totals</b>	<b>15</b>	<b>15</b>	<b>180 minutes (3 hours)</b>	<b>180 marks</b>

## Criterion

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You **must** make sure your answers address:

- Criterion 3 use appropriate objects in the design of programs.

# Additional Instructions for Candidates

---

Show the methods used in deriving answers.

Take care with the presentation of your answers, which should be complete and to the point.

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## Question 7

Marker use

a)

i. The method header

```
public String getAnswer(int f, double g)
```

returns a value of type:

**(Circle the correct answer)**

String                      void                      int                      double

/1

ii. The method `print` has a header defined as

```
public void print(String s, String t)
```

Which of the following is a correct call to the method `print`?

**(Circle the correct answer)**

```
print(2.0, "there");
```

```
print("hello ", 'T');
```

```
print('hello ', 3);
```

```
print("hello ", "T");
```

/1

Question 7 continues

## Question 7 continued

Marker use

b) The user defined class `Monster` is defined as follows:

```
public class Monster {  
    String name;  
    int hitPoints;  
    public Monster(String n, int hp) {  
        name = n;  
        hitPoints = hp;  
    }  
    public Monster() {  
    }  
    public void setName(String n) {  
        name = n;  
    }  
    public void setHitPoints(int hp) {  
        hitPoints = hp;  
    }  
}
```

Question 7 continues

## Question 7 continued

Marker use

- i. Which of the following is the correct way to define an object `dragon` of the type `Monster`?

(Circle the correct answer)

```
dragon dragon = new dragon ("dragon",72);
```

```
Monster dragon = new Monster ("dragon",72);
```

```
dragon Monster = new Monster ("dragon",72);
```

```
Monster dragon = new dragon ("dragon",72);
```

- ii. Which of the following is the correct way to define and initialise an object `griffon` of the type `Monster`?

(Circle the correct answer)

```
Monster griffon = new Monster();
```

```
griffon.setName('griffon');
```

```
griffon.setHitPoints('65');
```

```
Monster griffon = new Monster();
```

```
griffon.setName(griffon);
```

```
griffon.setHitPoints("65");
```

```
Monster griffon = new Monster();
```

```
griffon.setName("griffon");
```

```
griffon.setHitPoints(65);
```

```
Monster griffon = new Monster();
```

```
griffon.setName("griffon");
```

```
griffon.setHitPoints("65");
```

/1

/1

Question 7 continues

**Question 7 continued**

c) The `Rectangle` object in Java defines a rectangle, with the following constructor method:

```
Rectangle(int x, int y, int width, int height)
```

Where  $(x, y)$  gives the position of the top-left corner of the rectangle.

i. Define and instantiate a rectangle called `rect1` with position  $(100, 200)$ , width 300 and height 400.

.....  
.....  
.....

/2

ii. Given the screen output below, define and instantiate the two rectangles `rect2` and `rect3`.

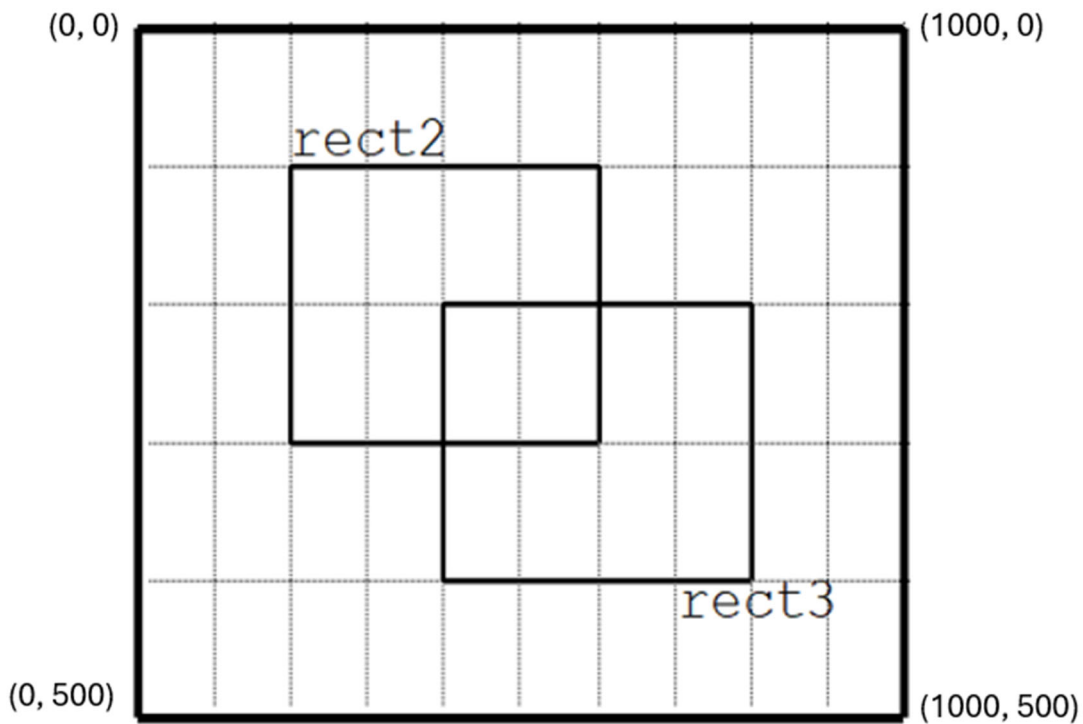


Figure 1

.....  
.....  
.....  
.....

/4

**Question 7 continued**

Marker use

iii. The method `intersects` in the `Rectangle` class is given by:

```
public boolean intersects(Rectangle r)
```

It returns `true` if the given rectangle has any crossover with this rectangle.

Provide a call to this method that determines whether `rect2` and `rect3` intersect.

.....

.....

/2

Total  
Q7  
/12

## Question 8

Marker use

An application is being used to track fish sightings around Tasmania. The application uses a class called `FishMap` defined as follows:

```
public class FishMap {
    double lat, lon;
    String species;
    int length; // length measured in cm

    public FishMap(String species, double lat, double lon) {
        this.lat = lat;
        this.lon = lon;
        this.species = species;
    }

    public double getLat () {
        return lat;
    }

    public double getLon () {
        return lon;
    }

    public void setLength(int len) {
        length = len;
    }

    public double distanceToFish(double la, double lo) {
        // distance measured in km
        return Math.sqrt(Math.pow(lat-la,2.0)
            +Math.pow(lon-lo,2.0))*111.0;
    }
}
```

**Question 8 continues**

**Question 8 continued**

Marker use

a) Write code to define and instantiate variables `fish1` and `fish2` of type `FishMap` with the following values:

/4

Variable Name	Species	Latitude	Longitude
fish1	Flathead	-42.72	148.05
fish2	Whiting	-42.88	147.99

Table 11

.....

.....

.....

.....

.....

b) Use the `FishMap` class to assign `fish1` a length of 34 (cm) and `fish2` a length of 27 (cm).

/2

.....

.....

c) A fisherman wants to use the data to find good places to fish. He is currently in Marion Bay, at a location given by the Latitude -42.82 and Longitude 147.87.

/2

Use the `FishMap` class to find the distances to travel to both `fish1` and `fish2` (in km), from his location.

.....

.....

d) How far apart are `fish1` and `fish2` (use method calls to `FishMap` in your answer)?

/2

.....

.....

**Question 8 continues**

**Question 8 continued**

Marker use

- e) Some users of FishMap would like to be able to just enter the species and length information, then enter the latitude and longitude later.

/2

Explain what could be added to the code so that information could be entered in both the existing way and this new way.

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.....

.....

.....

Total  
Q8  
/12

## Question 9

Marker use

A database is being developed for Ricky Warne to contain information about his cricket career.

For each of the 76 times he batted in a game, the information is stored, for that innings, in the following way:

String	ground	The location where the innings was played.
int	runs	The number of runs scored in that innings.
int	balls	The number of balls faced.
double	strikeRate	Runs scored divided by balls faced for that innings times 100, where the strike rate is 0 if the number of balls faced are 0.
boolean	out	True if he was out at the end of their innings.

Table 12

The following table contains the information for **five (5)** innings played by Ricky Warne.

ground	runs	balls	strike rate	out
SCG	120	137	$= 100.0 \times 120 / 137 = 87.59$	True
MCG	135	145	$= 100.0 \times 135 / 145 = 93.10$	False
Bellerive	0	0	$= 0.0$	True
MCG	115	60	$= 100.0 \times 115 / 60 = 191.67$	False
MCG	8	10	$= 100.0 \times 8 / 10 = 80.00$	True

Table 13

Question 9 continues

**Question 9 continued**

a) Write a public class called `Innings` which stores the information for an innings and which contains:

- the five (5) variables listed in Table 12
- a constructor method that inputs the ground, runs, balls and the value of out. The constructor method also needs to calculate the strike rate
- the method `getOut` which returns whether the player was out in that innings
- the method `getRunsScored` which returns the number of runs scored in that innings
- the method `getBallsFaced` which returns the number of balls faced in that innings
- the method `getGround` which returns the ground for that innings
- the method `calculateStrikeRate` which calculates the strike rate for that innings
- the method `getStrikeRate` which returns the strike rate for that innings.

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**Question 9 continued**

Complete the code so that for the ground "MCG", the program will access the `career` array using the methods in part a) to produce the output below.

Output:

Career of Ricky Warne at MCG:

- 1: MCG, SR 93.10, out? No
- 2: MCG, SR 191.67, out? No
- 3: MCG, SR 80.00, out? Yes

Note that SR is an abbreviation for strike rate.

The data from Table 13 has been entered using the method `enterData`.

Use calls to the class `Innings` in your answer, for example:

```
career[4].getGround()
```

Note: You are **not** required to round the strike rate to two (2) decimal places in your code.

Complete the main method below:

```
public static void main(String[ ] args) {  
    Innings[] career = new Innings[5];  
    String ground="MCG";  
    enterData(career);  
}
```

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/6





End of Section C  
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# COMPUTER SCIENCE

ITC315118

## Section **D**

Pages: 16

Questions: 3

Information Booklet: 1

**Suggested working time:** 36 minutes

### Instructions:

- Answer **all** questions and **all** items 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** questions is included at the end of the section. If used, you **must** indicate you have done so next to the relevant question.
- The Computer Science Information Booklet can be used throughout this exam.
- The exam is **three (3) hours** in length. The suggested working time for this section is **approximately 36 minutes**.
- All answers must be written in **English**.
- You **must** make sure your answers address the listed criterion.

Marker use	
C4	/ 36

# Guide to Exam Structure

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	Questions available	Questions to answer	Suggested working time	Marks available
Section <b>A</b>	3	3	36 minutes	36 marks
Section <b>B</b>	3	3	36 minutes	36 marks
Section <b>C</b>	3	3	36 minutes	36 marks
Section <b>D</b>	3	3	36 minutes	36 marks
Section <b>E</b>	3	3	36 minutes	36 marks
<b>Totals</b>	<b>15</b>	<b>15</b>	<b>180 minutes (3 hours)</b>	<b>180 marks</b>

## Criterion

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You **must** make sure your answers address:

- Criterion 4 describe and apply knowledge of computer architecture.

# Additional Instructions for Candidates

---

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 page has been provided in the back of this section for you to use if required. If you use the spare answer page, you **must** indicate you have done so in your answer to that question.

**Question 10**

Marker use

a)

i. When coding with TOY, the term PC refers to:

(Circle the correct answer)

Personal Computer

Police Constable

Program Counter

Politically Correct

/1

ii. Which logic equation does the following circuit correspond to?

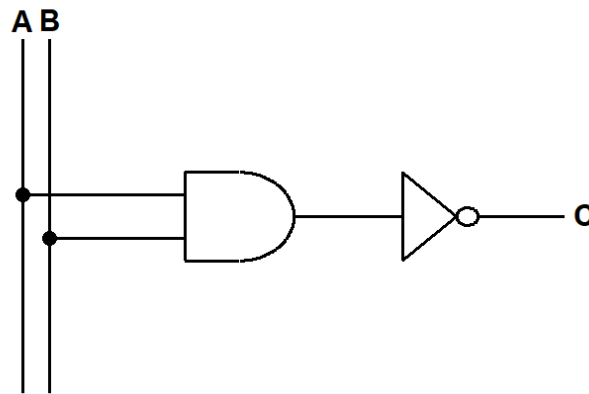


Figure 2

/1

(Circle the correct answer)

$C \equiv \sim A \wedge B$

$C \equiv \sim A \wedge \sim B$

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

$C \equiv A \wedge \sim B$

iii. The value  $\sim\sim\sim A$  is equivalent to:

(Circle the correct answer)

T

$\sim A$

A

F

/1

iv. Which is the correct truth table for the logic expression  $X \equiv A \wedge B$ ?

(Circle the correct answer)

A	B	X
0	0	1
0	1	0
1	0	0
1	1	1

A	B	X
0	0	0
0	1	1
1	0	1
1	1	0

A	B	X
0	0	0
0	1	1
1	0	1
1	1	1

A	B	X
0	0	0
0	1	0
1	0	0
1	1	1

/1

Question 10 continues

Question 10 continued

Marker use

b) Write the logic equation for the following circuit

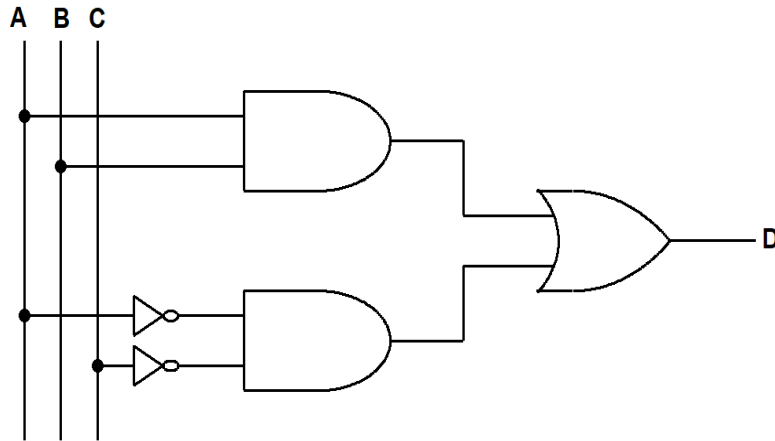


Figure 3

/2

.....

.....

c)

i. Complete the following two truth tables:

A	B	$\sim A$	$\sim B$	$\sim A \vee \sim B$
0	0			
0	1			
1	0			
1	1			

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

/4

Table 14

ii. Is it true that  $\sim A \vee \sim B \equiv \sim(A \vee B)$ ?

Explain your answer using part c) i.

/2

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Total  
Q10

/12

**Question 11**

a) In a TOY program, Memory Address 02 contains 1ABC as shown:

02	1ABC
----	------

/1

Why is this considered to be the data "1ABC" and not an add instruction?

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.....

b) i. Figure 4 is a Karnaugh Map for the variable X:

Produce a simple logic equation for X, **then** draw the circuit for X.

(Remember to show your groupings on the Karnaugh Map)

/4

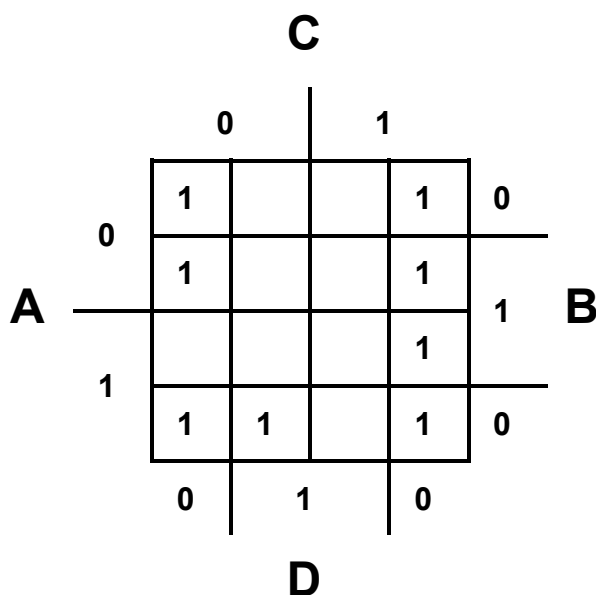


Figure 4

Logic equation for X:

.....

Circuit for X:

**Question 11 continued**

ii. For the following truth table, complete the Karnaugh Map, **then** write a logic equation for Y.

A	B	C	D	Y
0	0	0	0	1
0	0	0	1	0
0	0	1	0	1
0	0	1	1	0
0	1	0	0	1
0	1	0	1	0
0	1	1	0	1
0	1	1	1	0
1	0	0	0	1
1	0	0	1	0
1	0	1	0	1
1	0	1	1	0
1	1	0	0	1
1	1	0	1	0
1	1	1	0	1
1	1	1	1	0

Table 15

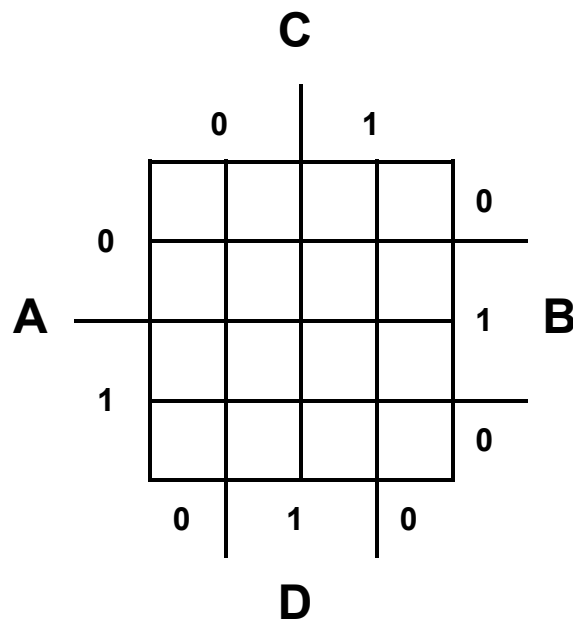


Figure 5

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**Question 11 continued**

Marker use

c) Use the logic laws to simplify the following expression

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

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**Total**  
**Q11**  
**/ 12**

Exam continues over the page

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**Question 12**

- a)
- i. The TOY instruction with OPCODE “3” is “bitwise and”. Complete the execution of the instruction 3CAB by completing the contents of Register R[C] in Table 16.

/1

R[A]	1	0	1	0	0	0	1	1	0	1	0	1	1	0	0	1
R[B]	0	0	1	1	1	1	0	0	1	0	0	1	0	1	0	1
R[C]	0	0	1	0	0	0	0	0								

Table 16

The questions in parts ii) and iii) refer to the TOY code in Table 17.

Memory Address	Value	Pseudocode	Explanation
01	0001	Data	
10	8AFF	read R[A]	User input is stored in Register A
11	8101	R[1] ← mem[01]	Set Register 1 to the contents of memory location 01
12	CA20	if (R[A]==0) PC←20	If Register A contains 0, goto 20
13	3CA1	R[C] ← R[A] && R[1]	Bitwise “and” of Registers A and 1 is stored in Register C.
14	CC16	if (R[C]==0) PC←16	If Register C contains 0, goto 16
15	1BB1	R[B] ← R[B] + R[1]	Increase Register B by 1
16	6AA1	R[A] ← R[A] >> R[1]	Shift right the contents of R[A] by 1
17	C012	if (R[0]==0) PC←12	Goto 12
20	9BFF	write R[B]	Output the contents of Register B

Table 17

It will aid understanding of the program if the contents of Registers 1, A and C are written in binary. To save writing many 0s, 4 bit binary can be used for R[1], R[A] and R[C].

**Question 12 continues**









End of Section D  
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# COMPUTER SCIENCE

ITC315118

## Section **E**

Pages: 12

Questions: 3

Information Booklet: 1

**Suggested working time:** 36 minutes

### Instructions:

- Answer **all** questions and **all** items 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** questions is included at the end of the section. If used, you **must** indicate you have done so next to the relevant question.
- The Computer Science Information Booklet can be used throughout this exam.
- The exam is **three (3) hours** in length. The suggested working time for this section is **approximately 36 minutes**.
- All answers must be written in **English**.
- You **must** make sure your answers address the listed criterion.

Marker use	
C5	/ 36

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# Guide to Exam Structure

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	Questions available	Questions to answer	Suggested working time	Marks available
Section <b>A</b>	3	3	36 minutes	36 marks
Section <b>B</b>	3	3	36 minutes	36 marks
Section <b>C</b>	3	3	36 minutes	36 marks
Section <b>D</b>	3	3	36 minutes	36 marks
Section <b>E</b>	3	3	36 minutes	36 marks
<b>Totals</b>	<b>15</b>	<b>15</b>	<b>180 minutes (3 hours)</b>	<b>180 marks</b>

## Criterion

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You **must** make sure your answers address:

- Criterion 5 analyse how data are represented and stored.

# Additional Instructions for Candidates

---

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.

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**Question 13**

Marker use

a)

i. The value  $0101\ 1010_2$  in binary is equal to what value in hexadecimal?

(Circle the correct answer)

$3A_{16}$

$36_{16}$

$56_{16}$

$5A_{16}$

/1

ii. The value  $73_{10}$  in decimal is equal to what in 8-bit unsigned binary?

(Circle the correct answer)

$0100\ 1001_2$

$1001\ 0010_2$

$0111\ 0101_2$

$0100\ 1000_2$

/1

iii. Place binary digits in the boxes to complete this addition:

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

/2

b)

i. Convert  $1100\ 0111$  in unsigned binary to decimal.

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.....

/1

ii. Add  $0001\ 0000$  to part b) i.

$$\begin{array}{r} 1100\ 0111 \\ +\ 0001\ 0000 \\ \hline \end{array}$$

/1

iii. Convert your answer to decimal. Verify your calculation in part ii is correct.

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/2

**Question 13 continues**

**Question 13 continued**

**Marker use**

iv. The number 1001 1101 is stored in 8-bit two's complement representation.  
Find the decimal value of this number.

/2

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v. What is the largest positive value that can be represented in 8-bit two's complement representation?

/2

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**Total  
Q13  
/12**

**Question 14**

Marker use

a) The variable `dice` can hold one of the following values:

1, 2, 3, 4, 5, 6.

How many bits would be required to store the value of the variable `dice`?

.....

b) Using the same floating-point representation as described in the Information Booklet:

i. Interpret the following 16-bit word as a decimal number

1 00010 1100000000

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ii. Show how the value  $-0.25_{10}$  would be represented



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iii. If the mantissa is zero, any value for the sign and exponent could be interpreted as zero. In this case, how many ways can we represent the number 0?

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c) A sound file is to be recorded using a 44.1KHz sampling rate, with 16 bits per sample for 45 seconds. Calculate the file size in bytes.

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/3

/3

/2

/2

**Total**  
**Q14**  
**/12**

**Question 15**

a) A college will send home August reports for their 1 000 students.

Each student is attempting **four (4)** different subjects.

Each subject contains:

- a string of 10 characters for the subject code
- up to 10 internal criteria, with a code being used to store the result for each criterion. The code represents an award chosen from the 13 values:

Z	t-	t	t+	C-	C	C+	B-	B	B+	A-	A	A+
---	----	---	----	----	---	----	----	---	----	----	---	----

- text comment, consisting of up to 1 000 characters
- a boolean value for whether a parent evening interview is required.

The front cover of the report contains:

- a photo of the student, which will be a 24-bit colour image of size 200 x 300 pixels
- the name of the student, which will be a 256-character string.

Note: All characters and strings are using 16-bit representation.

Calculate the maximum number of bits required to store all of the information required to generate the reports.

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**Question 15 continues**

**Question 15 continued**

Marker use

b) A 3D computer game is made to create a world that is 64 blocks long, 64 blocks wide and 16 blocks high.

Each block can be one of 8 materials: Sky, Wood, Iron, Lava, Water, Stone, Gold and Silver.

i. How many bits would be required to store the data for the current state of the whole world?

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.....

/1

ii. In most worlds, many of the blocks are of material Sky. Using this information, the data is stored as follows:

- There is a 64x64 array, where each location represents a tower of single blocks in the world.
- Each location in the array contains the number of non-Sky blocks in that tower and the data for the non-Sky blocks in that tower.

If everywhere in the world currently has a height of 5 non-Sky blocks, above this being Sky, how much space would be saved by this compression of the representation?

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/3

iii. The compression method in part ii) can be said to be lossless compression. Explain why this is the case.

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/2

**Total  
Q15**

**/12**



End of Section E  
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