

External Assessment 2023

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 | / Alpha |

Guide to Exam Structure

| | Questions available | Questions to answer | Suggested working time | Marks available |
|------------------|---------------------|---------------------|----------------------------------|--|
| Section A | 3 | 3 | 36 minutes | 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) | A+ to z rating |

Criterion

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

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

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Question 1

Marker use

The following is a **partially completed** algorithm to work out the amount of each ingredient required to make crêpes. The user enters the number of crêpes and the algorithm calculates the amount of each ingredient required to make that number of crêpes.

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

1. **Initially**
2. set crepes = 4
3. set flour = 136
4. set eggs = 1
5. set milk = 48
- 6.
7. **When** a number is entered into the "Number of crepes?"
Textfield
8. set crepes to value in "Number of crepes?" TextField
9. if crepes less than 4
10. set crepes = 4
11. display crepes
- 12.
13. **When** the "Calculate" button is pressed
14. set flour = crepes * 34
15. set milk = crepes * 12
16. if crepes less than 5
17. set eggs = 1
18. else
19. set eggs = 2
20. display "Ingredients:" flour "g of flour and " eggs "eggs
and " milk "ml of milk"

Question 1 continues

Question 1 continued

Marker use

a) What is the minimum number of crêpes that can be made? (Circle correct answer).

4

6

7

12

b) What is the minimum amount of flour that can be used? (Circle correct answer)

0

34

136

238

c) The recipe only allows for a maximum of 12 crêpes. Modify the algorithm so that the number of crêpes entered is limited to 12.

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d) One (1) egg is required for every four (4) crêpes. Currently the algorithm will not calculate correctly for 9, 10, 11 or 12 crêpes. Modify the algorithm to allow for up to three (3) eggs to be used.

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Question 2

The following is a **partially completed** algorithm to be used to calculate the score for a dice rolling game. The player rolls one dice 10 times and the score is the sum of all the dice rolls. If the player rolls the same number twice in a row (e.g. a 4 followed by a 4) then the next roll will be worth double its value (e.g. roll a 6 and it will be worth 12). Below is an example of the scoring in a game.

| | | | | | | | | | | |
|-------|---|---|----|----|----|----|----|----|----|----|
| Rolls | 2 | 4 | 4 | 6 | 2 | 1 | 5 | 4 | 2 | 3 |
| Score | 2 | 6 | 10 | 22 | 24 | 25 | 30 | 34 | 36 | 39 |

The user will enter the value of the dice roll. The algorithm will then calculate the score after each roll.

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

1. **Initially**
2. roll = 0
3. last_roll = -1
4. second_last_roll = -2
5. score = 0
6. count = 0
7. **When** a number is entered into "roll" TextField
8. Set roll to value in "roll" TextField
9. Display "Roll is " roll

10. **When** the "Calculate" button is pressed
11. if (count < 10)
12. score = score + roll * 2
13. else
14. score = score + roll
15. Display "Score is " score
16. count = count + 1

- a) The number entered into "roll" TextField is not validated. Modify the algorithm to ensure that it will only work with values from 1 to 6.

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Question 2 continues

Question 2 continued

Marker use

b) Each time the calculation is done the **second_last_roll** needs to be given the value of the **last_roll** and the **last_roll** needs to be given the value of the **roll**. The algorithm does not currently do this. Add this to the algorithm.

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Question 2 continues

Question 2 continued

Marker use

- c) If the last two rolls have the same value (that is the 9th and 10th rolls) then the player is given an extra roll so that the double score can be added. In the example below, the extra roll (shaded) is doubled and added to the score.

| | | | | | | | | | | | |
|-------|---|---|----|----|----|----|----|----|----|----|----|
| Rolls | 2 | 4 | 5 | 6 | 2 | 1 | 5 | 1 | 6 | 6 | 3 |
| Score | 2 | 6 | 11 | 17 | 19 | 20 | 25 | 26 | 32 | 38 | 44 |

Add this feature to the algorithm.

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Question 3

Marker use

A local mountain bike rental firm specialises in group bookings. The owner wishes to calculate what to charge for the rental of their bikes based on the number of participants (adult/children), the type of bike (electric or normal) and the distance to where the bikes will be delivered.

Each vehicle and bike trailer can carry 18 bikes. The business has two (2) vehicles with trailers (max 36 bikes).

The delivery fee is \$50 plus \$2 per kilometre per vehicle.

Bike Hire Cost

| Type | Per hour | Half day (4 hours) | Full Day (8 hours) |
|--------------|----------|--------------------|--------------------|
| Adult bike | 15 | 50 | 80 |
| Adult e-bike | 25 | 100 | 160 |
| Child bike | 10 | 35 | 55 |
| Child e-bike | 20 | 60 | 100 |

Table 1

Guides can also be hired for the duration of the rental. Each guide can take up to 12 people in their group.

The cost for each guide is \$50 per hour.

Notes:

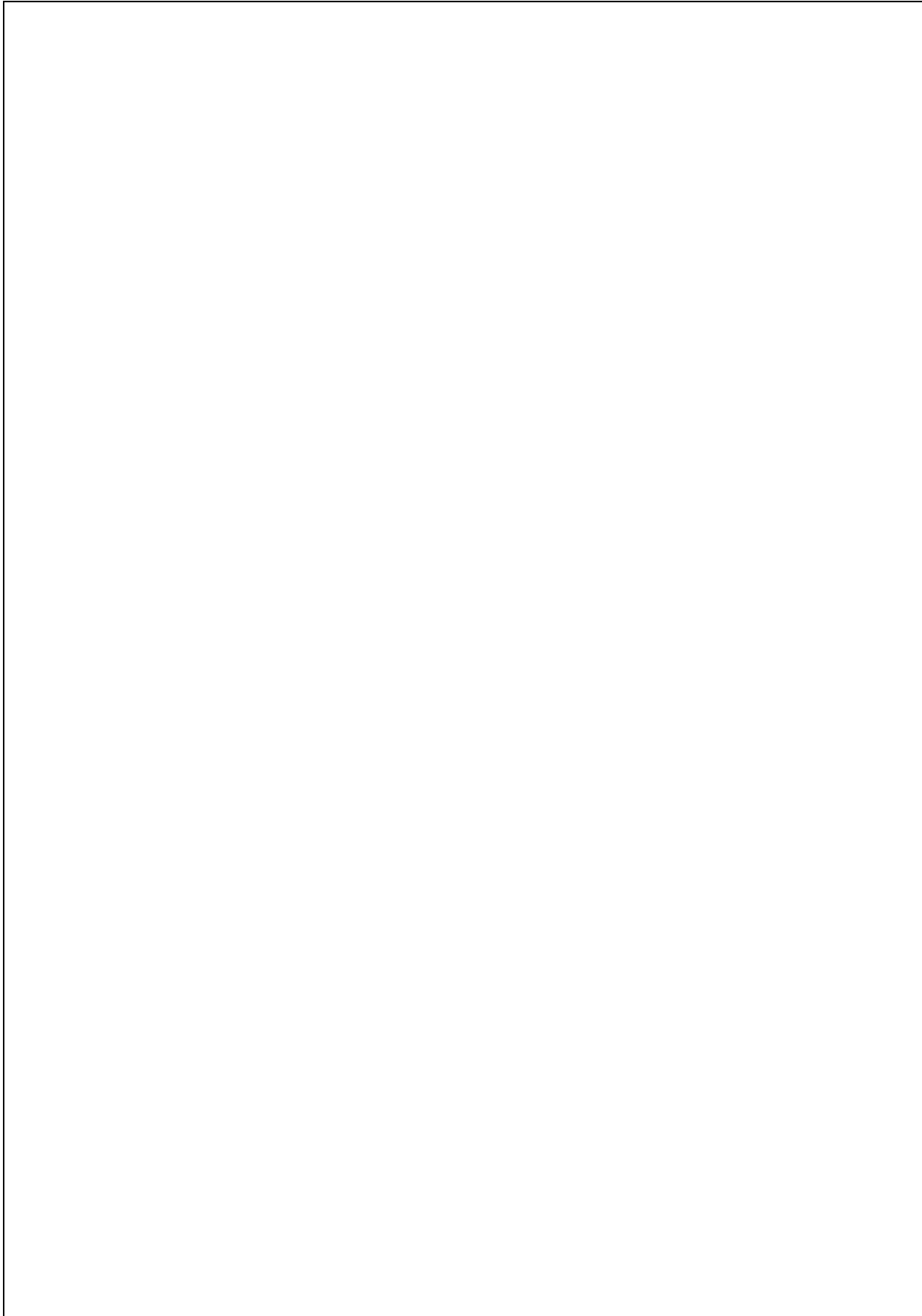
- The algorithm should work correctly no matter what order the buttons or TextFields are used.
- It can be assumed that all data entered is the appropriate type for each TextField.
- Appropriate variable names are to be used.

Question 3 continues

Question 3 continued

Marker use

- a) Design a GUI identifying all of the Labels, TextFields and/or Buttons that will be required to allow the owner to enter and calculate the required cost.



Question 3 continues

End of Section A
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External Assessment 2023

COMPUTER SCIENCE

ITC315118

Section **B**

Pages: 20

Questions: 3

Information Booklet: 1

Suggested working time: 36 minutes

Instructions:

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| Marker use | |
|------------|---------|
| C2 | / Alpha |

Guide to Exam Structure

| | Questions available | Questions to answer | Suggested working time | Marks available |
|------------------|---------------------|---------------------|----------------------------------|--|
| Section A | 3 | 3 | 36 minutes | 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) | A+ to z rating |

Criterion

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

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

Blank Page

Question 4

Marker use

a) Circle the correct answer for the following questions:

i. What will be the value of **b** and **c** after the following code is executed?

```
int a,b,c;  
a = 5;  
b = a / 3 + 6;  
c = a % 3;
```

(Circle the correct answers)

| | | | | |
|----------|---|---|---|---|
| b | 5 | 6 | 7 | 9 |
| c | 2 | 3 | 4 | 5 |

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

```
double b;  
b = 5.0 / 4;
```

(Circle the correct answer)

| | | | |
|---|-----|------|-----|
| 1 | 1.0 | 1.25 | 2.0 |
|---|-----|------|-----|

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

```
int c = 128;  
while (c > 30)  
{  
    c = c/2;  
}
```

(Circle the correct answer)

| | | | |
|----|----|----|---|
| 64 | 16 | 32 | 8 |
|----|----|----|---|

Explanation:

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Question 4 continues

- b)
- i. There are **two (2)** errors in the following Java code. Circle them and explain each error.

```
int d = 1;
for (x = 1; x<=5; x++)
{
    if (x%2==0) && (d<4)
    {
        d = d + 5;
    }
}
```

Error 1:

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Error 2:

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

```
int e = 6;
if (e > 0) {
    e = e * 3;
    if (e > 10) {
        e = e - 2;
    }
}
```

Final value of **e**:

.....

Explanation:

.....

.....

Question 4 continued

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

```
int f = 3;
for (int i = 0; i <= 7; i++) {
    if (i >= 2 && i < 5)
    {
        f = f + 2;
    }
}
```

| i | f |
|---|---|
| | |
| | |
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| | |

Final value of **f**:

.....

Question 4 continued

Marker use

- c) The following description of a method has been provided. Complete the required code using correct Java syntax.

This method accepts two parameters labelled “**cost**” and “**margin**”, representing the wholesale cost of an item and the required markup. The method should return the sale price of the item.

For example:

```
retailCost = question4c (5.00, 50);
```

retailCost would equal 7.50

```
public double question4c (double cost, int margin){
```

```
    return salePrice;
```

```
}
```

Question 5

Marker use

a)

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

```
int g;  
g = (int)(15.0/4.0);
```

Value of **g**:

Explanation:

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.....

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

```
int h;  
h = (int)('3')-(int)Math.round(3.6);
```

Value of **h**:

Explanation:

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Question 5 continues

Question 5 continued

b) Trace the following code and find the final values in the array **card**.

```
char[] card = {'A', 'K', 'Q', 'J'};
for (int i = 0; i < (card.length - 1); i++)
{
    card[i] = (char)((int)card[i] + 1);
}
```

Trace the above code and find the final value of the variable **card**:

| i | card | | | |
|---|------|---|---|---|
| | 0 | 1 | 2 | 3 |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

Final values in the array **card**:

| card | | | |
|------|---|---|---|
| 0 | 1 | 2 | 3 |
| | | | |

Question 5 continued

Marker use

c) Trace the following code to find the final contents of the array **x**.

```
int [][] x = new int[4][5];  
int q = 4;  
for (int i = 0; i < 4; i++)  
    for(int j = 0; j < 5; j++)  
    {  
        x[ i ][ j ] = q % 4 + 1;  
        q = q + 1;  
    }
```

i. Final values in the array **x**:

| | | | | |
|--|--|--|--|--|
| | | | | |
| | | | | |
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| | | | | |

ii. Explain what error would occur if the array was defined as:

```
int[][] x = new int[5][4];
```

Exam continues over the page

Blank Page

Question 6

Marker use

This question relates to the program on page 15.

a) Trace the program and write the output in the lines below.

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b) Explain why the method **sort** does not need to return the array at the conclusion of the method.

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Question 6 continues

Question 6 continued

Marker use

c) If the array declaration was changed to:

```
static int[] list = {2, 4, 8, 6, 3, 5, 1, 7};
```

and the program compiled and executed, what error would occur? Explain what additional change would ensure that this error does not reoccur when the size of the array is changed.

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Question 6 continues

Question 6 continued

Marker use

```
class question6 {
    static int[] list = {4,6,3,7,1,5,2};
    static int listLength = 7;
    static int target = 8;

    public static void findAndPrintMin(int[] list) {

        int indexOfMin = 0;
        for (int i = 1; i < listLength; i++) {
            if (list[i] < list[indexOfMin]) {
                indexOfMin = i;
            }
        }
        System.out.println("The index of the smallest element was
" + indexOfMin);
    }

    public static void findAndPrintPairs(int[] list, int target) {
        for (int i = 0; i < listLength; i++) {
            for (int j = i + 1; j < listLength; j++) {
                if (list[i] + list[j] == target) {
                    System.out.println("The two elements at indices " +
i + " and " + j + " are " + list[i] + " and " +
list[j] + " add up to " + target);
                }
            }
        }
    }

    public static void sort(int[] list) {
        for (int i = 0; i < listLength; i++)
            for (int j = 0; j < listLength - i - 1; j++) {
                if (list[j] > list[j + 1]) {
                    int temp = list[j];
                    list[j] = list[j + 1];
                    list[j + 1] = temp;
                }
            }
    }

    public static void showList(int[] list) {
        for (int i = 0; i < listLength; i++)
            System.out.print(list[i] + " ");
        System.out.println();
    }

    public static void main(String[] args) {
        findAndPrintMin(list);
        findAndPrintPairs(list, target);
        sort(list);
        showList(list);
    }
}
```


End of Section B
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External Assessment 2023

COMPUTER SCIENCE

ITC315118

Section **C**

Pages: 12

Questions: 3

Information Booklet: 1

Suggested working time: 36 minutes

Instructions:

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- Write your answers in the spaces provided in this exam paper.
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| Marker use | |
|------------|---------|
| C3 | / Alpha |

Guide to Exam Structure

| | Questions available | Questions to answer | Suggested working time | Marks available |
|------------------|---------------------|---------------------|----------------------------------|--|
| Section A | 3 | 3 | 36 minutes | 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) | |

Criterion

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

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

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Question 7

Marker use

This question relates to the class definition below. Each object of the class Cat will store a cat's name, its age in years, its gender, and whether or not it is a purebred.

```
public class Cat{

    private String name;
    private int age;
    private String gender;
    private boolean isPureBred;

    public Cat(String newName, int newAge, String newGender){
        name = newName;
        age = newAge;
        sex = newGender;
        isPureBred = true;
    }

    public void setName(String newName){
        name = newName;
    }

    public String getName(){
        return name;
    }

    public void setAge(int newAge){
        age=newAge;
    }

    public int getAge(){
        return age;
    }

}
```

Question 7 continues

Question 7 continued

Marker use

a) Which of the following statements will create a Cat? (Circle the correct answer.)

Cat c = new Cat ("Tom", 6, "male", TRUE);

Cat c = new Cat ("Tom", 6, "male", FALSE);

Cat c = new Cat ("Tom", 6, "male");

Cat c = new Cat (Tom, 6, male);

b) What data type does the getName method return? (Circle the correct answer.)

void

String

int

Boolean

c) Create a method to set a **Cat's** breeding as either PureBred or Mixed Breed, and another method to return this value when required.

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d) Give examples of how you would call the two (2) methods you created in item c).

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Question 8

The class definition below defines a college timetable which has five (5) days and three (3) sessions per day.

Note: for ease of interpretation, the first elements in each array will not be used, e.g.: ttable[2][3] represents day 2 period 3.

```
public class TimeTable
{
    String [][] ttable = new String [6][4];
    public TimeTable ( )
    {
        for (int i=1; i <= 5; i++)
            for (int j=1; j <= 3; j++)
                ttable[i][j] = "";
    }
    public void setSubject(int day, int period, String subject)
    {
        ttable[day][period] = subject;
    }
}
```

- a) Using the class definition, write code to declare and instantiate a TimeTable for a **student**.

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- b) Using the method contained within the class, assign the **student** "Computer Science" for Wednesday period 2.

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Question 8 continued

Marker use

c) Write a method called `getSubject` that returns the subject for a **student** on a given day and period.

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d) Write a method that would display all the subjects that the **student** has on a selected day.

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e) Write code that will use your method from item d) to output the **student's** timetable for the whole week.

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Question 9

Marker use

A class is needed to process players' scores from a local basketball competition which has two (2) divisions.

The information to be processed is as follows:

| Data Item | Type of Data |
|--------------|---------------------------|
| Division | Integer 1 or 2 |
| Score | Integer between 0 to 100 |
| HighestScore | Integer between 0 and 100 |
| LowestScore | Integer between 0 and 100 |
| Spread | Integer between 0 and 100 |

Table 2

The class will contain the following methods:

- A constructor method that will set the initial value for **Score** using a parameter. The **HighestScore** and **LowestScore** should be set to **Score**.
- A method that will set the value of **Spread** within the class using the following formula:
 - **$Spread = (HighestScore - LowestScore)$**
- A method that will return the current value of **Spread** for the required division.
- A method that will set **Score** to a value given as a parameter to the method. The method will also set **HighestScore**, **LowestScore** and **Spread** for the required division as described below:
 - If **Score** is greater than **HighestScore** it will become the new **HighestScore**
 - If **Score** is less than **LowestScore** it will become the new **LowestScore**
 - **Spread** must then be recalculated.

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

Question 9 continues

Question 9 continued

Marker use

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Section **D**

Pages: 16

Questions: 3

Information Booklet: 1

Suggested working time: 36 minutes

Instructions:

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| Marker use | |
|------------|---------|
| C4 | / Alpha |

Guide to Exam Structure

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|------------------|---------------------|---------------------|----------------------------------|--|
| Section A | 3 | 3 | 36 minutes | 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) | |

Criterion

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

- Criterion 4 describe and apply knowledge of computer architecture.

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Question 10

a) Circle the correct answer in the following questions.

i. Select the logic expression which represents Figure 1:

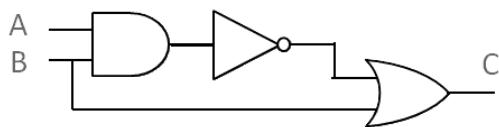


Figure 1: Circuit.

(Circle the correct answer.)

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

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

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

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

ii. Fill in Table 3 and circle the correct answer below.

| A | B | $\sim A \vee B$ |
|---|---|-----------------|
| F | F | |
| F | T | |
| T | F | |
| T | T | |

Table 3

(Circle the correct answer.)

| $\sim A \vee B$ |
|-----------------|
| F |
| T |
| F |
| T |
| |

| $\sim A \vee B$ |
|-----------------|
| F |
| T |
| F |
| F |
| |

| $\sim A \vee B$ |
|-----------------|
| T |
| F |
| F |
| F |
| |

| $\sim A \vee B$ |
|-----------------|
| T |
| T |
| F |
| T |
| |

iii. Circle the simplified expression for $A \wedge T$

T

$A \vee F$

A

F

Question 10 continues

Question 10 continued

Marker use

b)

i. Complete the truth table (Table 4) for the following expression:

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

| A | B | C | $\sim A$ | $\sim A \wedge C$ | $A \wedge B$ | D |
|---|---|---|----------|-------------------|--------------|---|
| 0 | 0 | 0 | | | | |
| 0 | 0 | 1 | | | | |
| 0 | 1 | 0 | | | | |
| 0 | 1 | 1 | | | | |
| 1 | 0 | 0 | | | | |
| 1 | 0 | 1 | | | | |
| 1 | 1 | 0 | | | | |
| 1 | 1 | 1 | | | | |

*Table 4*ii. Draw the logic circuit for the expression for **E**:

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

Question 10 continues

Question 10 continued

iii. Give the logic expression for **G**:

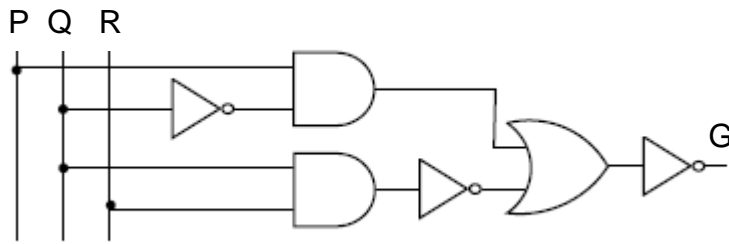


Figure 2: Circuit.

c) Consider the following TOY program. What is the value of register C upon program termination?

| Memory Address | Contents | Pseudocode | Explanation |
|----------------|----------|---------------------|---|
| 01 | 0009 | data | contains value 9 |
| 02 | 0002 | data | contains value 2 |
| 10 | 8A01 | R[A] ← mem[01] | Set register A to the contents of location 01 |
| 11 | 8B02 | R[B] ← mem[02] | Set register B to the contents of location 02 |
| 12 | 6CAB | R[C] ← R[A] >> R[B] | Set register C to register A right shifted 2 places |
| 13 | 0000 | exit | |

Table 5

On program termination R[C] =.....

Question 11

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

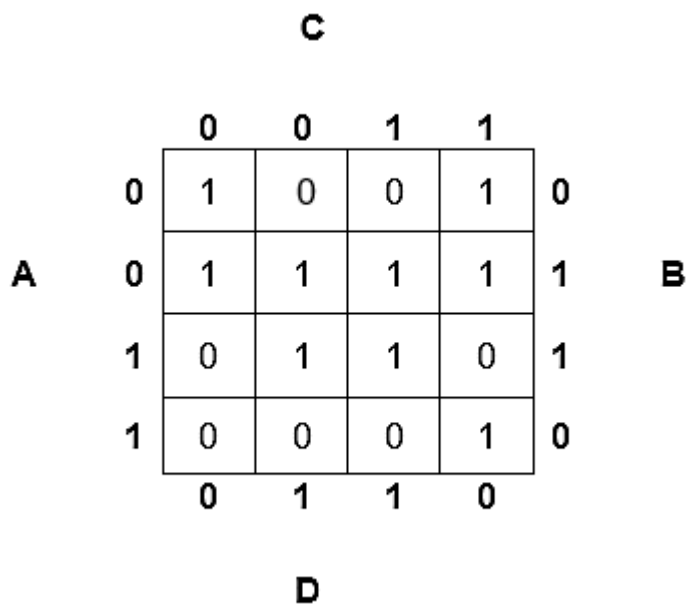


Figure 3: Karnaugh map.

H ≡

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

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

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

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Question 11 continues

Question 11 continued

b) In TOY, the command ADD uses format 1:

| | | | |
|--------|-----------------|------------|------------|
| opcode | destination (d) | source (s) | source (s) |
|--------|-----------------|------------|------------|

whereas the command LOAD uses format 2:

| | | |
|--------|-----------------|----------------|
| opcode | destination (d) | address (addr) |
|--------|-----------------|----------------|

i. Explain why TOY needs to use two (2) different formats for its instructions. Use the two (2) commands ADD and LOAD to explain your answer.

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ii. Early electronic computing devices such as ENIAC were programmed by altering the wiring of the computer. What change occurred to the way programs were modified when computers began using the Von Neumann architecture?

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Question 11 continues

Question 11 continued

Marker use

iii. Why can't instructions be fetched at the same time as data and why is this considered a problem with this architecture?

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Question 12 continued

b) Trace the following TOY code program and determine the final content in memory location 06.

| Memory Address | Contents | Pseudocode | Explanation |
|----------------|----------|---------------------------|---|
| 01 | 0001 | data | (0000 0000 0000 0001 ₂ , 1 ₁₀) |
| 03 | 0003 | data | (0000 0000 0000 0011 ₂ , 3 ₁₀) |
| 04 | 0007 | data | (0000 0000 0000 0111 ₂ , 7 ₁₀) |
| 06 | 0000 | data | (0000 0000 0000 0000 ₂ , 0 ₁₀) |
| | | | |
| 10 | 8101 | R[1] ← mem[01] | Set register 1 to the contents of location 01 |
| 11 | 8303 | R[3] ← mem[03] | Set register 3 to the contents of location 03 |
| 12 | 8404 | R[4] ← mem[04] | Set register 4 to the contents of location 04 |
| 13 | 8606 | R[6] ← mem[06] | Set register 6 to the contents of location 06 |
| 14 | C318 | if (R[3] == 0) goto 18 | If register 3 equals 0 go to 18 |
| 15 | 1664 | R[6] ← R[6] + R[4] | Set register 6 to register 6 + register 4 |
| 16 | 2331 | R[3] ← R[3] - R[1] | Set register 3 to register 3 - register 1 |
| 17 | C014 | goto 14 | goto 14 |
| 18 | 9606 | mem[06] ← R[6] | Store register 6 into location 06 |
| 19 | 0000 | halt | |

Table 7

Question 12 continues

End of Section D
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External Assessment 2023

COMPUTER SCIENCE

ITC315118

Section **E**

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 | |
|------------|---------|
| C5 | / Alpha |

Guide to Exam Structure

| | Questions available | Questions to answer | Suggested working time | Marks available |
|------------------|---------------------|---------------------|----------------------------------|--|
| Section A | 3 | 3 | 36 minutes | 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) | A+ to z rating |

Criterion

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

- Criterion 5 analyse how data are represented and stored.

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Question 13

Marker use

a)

i. When $8A_{16}$ is converted to binary the value is:

(Circle the correct answer.)

10011011_2 10001010_2 10001100_2 10011010_2

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

(Circle the correct answer.)

49 52 53 55

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

(Circle the correct answer.)

4 65 68 100

b) Fill in the **four (4)** missing bits in the following binary addition.

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

c)

i. Using 8 bit two's complement representation, 84 is represented as:

01010100_2

How would 99 be represented?

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ii. What is the representation of -84 using 8 bit two's complement representation?

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Question 13 continues

Question 13 continued

Marker use

iii. Perform the following two's complement arithmetic: $99 - 84$. (Show working out.)

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d) Convert $4A7_{16}$ to binary.

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e) Explain why 0.11_2 is equal to 0.75_{10} .

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Question 14

Marker use

a) Convert 0.1101_2 to decimal. (Show working out.)

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b) A rainbow game uses a pack of 70 cards. The pack is made up of seven sets of 10 cards with each set a different colour. The 10 cards in each set are given values from 1 to 10.

The game needs to store the colour and value of a card using the minimum number of bits.

The colour is to be stored using the index in Table 9.

| Index | Colour |
|-------|--------|
| 0 | Red |
| 1 | Orange |
| 2 | Yellow |
| 3 | Green |
| 4 | Blue |
| 5 | Indigo |
| 6 | Violet |

Table 9

What is the minimum number of bits required to store the data for a card?

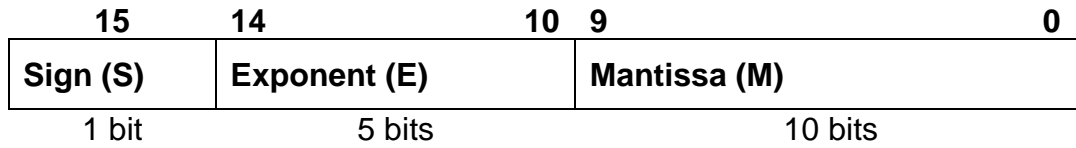
(Show working out.)

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Question 14 continues

Question 14 continued

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



- i. What would the representation of 1024 be?

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- ii. What would the representation of 0.125 be?

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- d) The following two (2) Java fragments are designed to determine if the three (3) values for a, b and c form a right-angled triangle.

```
1 if (a * a + b * b - c * c == 0)
```

```
    System.out.println ("It is a right angled triangle", 10, 100);
```

```
2 if (Math.abs(a * a + b * b - c * c) < 0.00001)
```

```
    System.out.println ("It is a right angled triangle", 10, 150);
```

Fragment 1 will work correctly when **a**, **b** and **c** are declared as **int** but not when they are declared as **double**.

Explain why Fragment 2 is required to ensure that the correct answer is always returned when **a**, **b** and **c** are declared as **double**.

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Question 15

Marker use

a) A program will be created to record passport information.

The following data will need to be stored by the program:

- First Name - max. of 50 characters
- Middle Name - max. of 50 characters
- Surname - max. of 50 characters
- Nationality - max. of 50 characters
- Date of Birth - e.g. 29 MAR 2001
- Gender - M, F or X
- Document Number - Capital Letter followed by 6 digits e.g. L899034
- Date of Issue - e.g. 29 MAR 2023
- Expiry Date - e.g. 29 MAR 2033
- Image - 150 x 150 pixels with 24 bit colour

All characters are to be stored in Unicode (16 bits).

Calculate the number of bits required to store the data for one passport.

Show all working out and state any assumptions you make.

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Question 15 continues

Question 15 continued

b) Examine the following code fragment.

Note: **byte** is an 8 bit integer representation that uses two's complement to represent positive and negative integers.

```
for (byte i = 0 ; i < 128; i++) {  
    System.out.println(i);  
}
```

What would the result of executing this fragment be? Explain.

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c) Figure 4 on the following page is a representation of the 2D array **data**.

It is defined by the statement:

```
int [ ][ ] data = new int[3][3];
```

The following Java statements are executed.

```
data[0][2] = 4;
```

```
data[1][1] = 5;
```

```
data[2][0] = data[0][2] + data [1][1];
```

Complete Figure 4 showing the final state of the array **data** after the above statements have been executed. (Assume all array elements are initialised as 0 when the array is defined.)

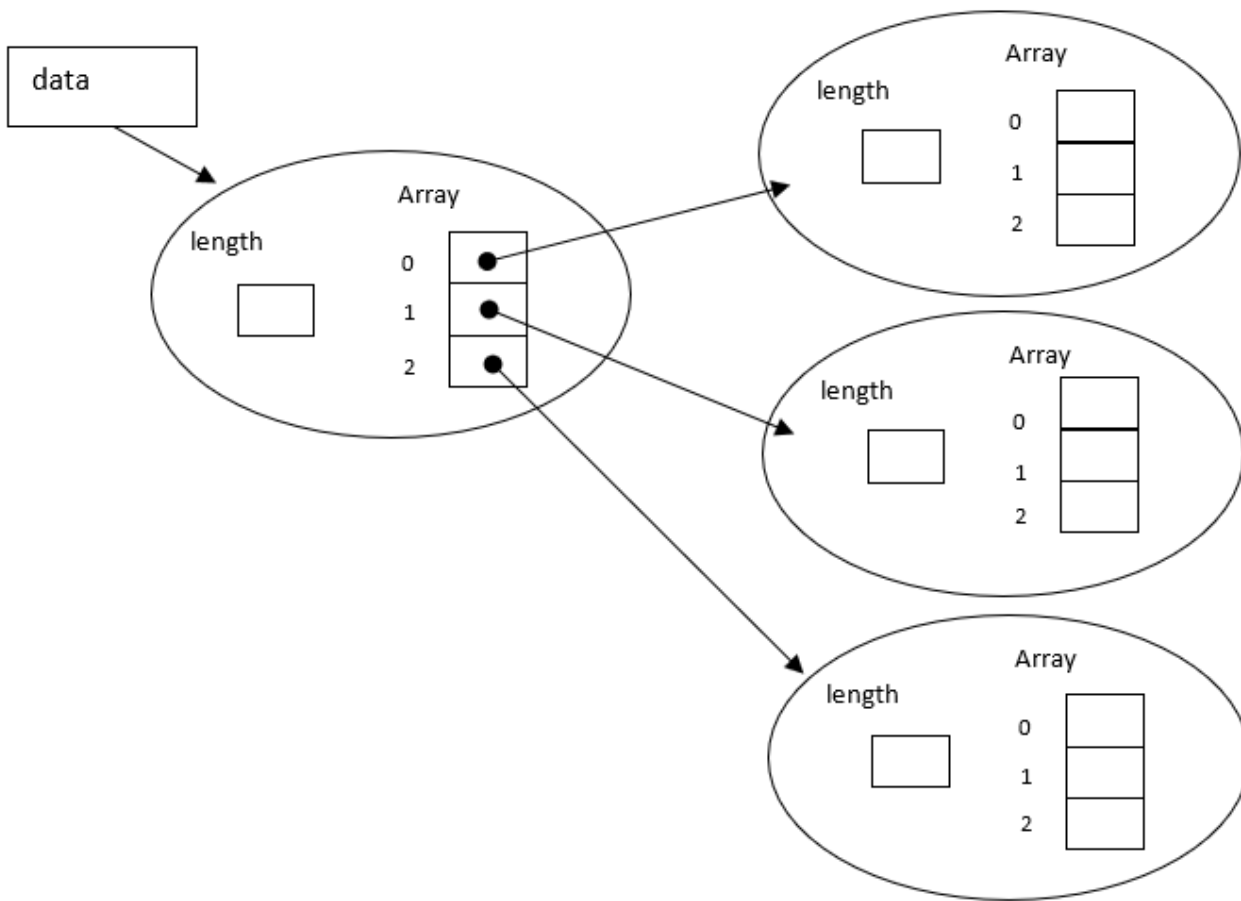


Figure 4: Diagram to complete answer to Question 15 c).

End of Section E
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