Mark: **[50]**

CANDIDATE NAME	

COMPUTER SCIENCE

PRACTICE SCHOLARSHIP PAPER

Candidates answer on the Question Paper.

Time allowed: 60 minutes

No additional materials or *calculators* allowed

READ THESE INSTRUCTIONS FIRST

Write your name at the top of this page

Write in dark blue or black pen

Do not use staples, paper clips, glue or correction fluid

Answer all questions. Check your answers before the end of the allocated time, if you finish earlier.

The number of marks is given in brackets [] at the end of each question or part question

The maximum mark for this paper is 50

Q	
1	**/ 7**
2	**/ 6**
3	**/ 10**
4	**/ 6**
5	**/ 8**
6	**/ 10**
7	**/ 3**
Total	**/ 50**

QUESTION 1	[7 marks]

18 A school has 1500 students. It is conducting a survey on their music preferences. Each student uses a computer and inputs their name and then chooses one of 5 options:

- rock (input value 1)
- soul (input value 2)
- pop (input value 3)
- jazz (input value 4)
- classical (input value 5)

Write an algorithm, using pseudocode **or** a flowchart, which:

- inputs the choice of all 1500 students (values 1 to 5)
- outputs all the names of the students who chose classical music
- outputs the percentage who chose **each** option.

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QUESTION 2	[6 marks]

The algorithm, represented using pseudo-code in **Figure 1**, describes a method to test whether an integer greater than 2 is prime or not.

Figure 1

```
INPUT Number
Root ← 1
WHILE (Root * Root) < Number
  Root ← Root + 1
ENDWHILE
d ← 2
FactorFound ← FALSE
WHILE (FactorFound = FALSE) AND (d <= Root)
  r ← Number MOD d
  IF r = 0 THEN
    FactorFound ← TRUE
  ENDIF
  d ← d + 1
ENDWHILE
IF FactorFound = FALSE THEN
  OUTPUT "Prime"
ELSE
  OUTPUT "Not prime"
ENDIF
```

The `MOD` operator calculates the remainder resulting from an integer division, for example, `10 MOD 3 = 1`.

1 Complete **Table 3** by hand-tracing the algorithm in **Figure 1**. Use `5` as the input value. You may not need to use all the rows in **Table 3**.

Table 3

Number	Root	d	FactorFound	r	Output

[3 marks]

2 Complete **Table 4** by hand-tracing the algorithm in **Figure 1**. Use `25` as the input value. You may not need to use all the rows in **Table 4**.

Table 4

Number	Root	d	FactorFound	r	Output

[3 marks]

QUESTION 3	[10 marks]

6 A gas fire has a safety circuit made up of logic gates. It generates an alarm (X = 1) in response to certain conditions.

Input	Description	Binary value	Conditions
G	gas pressure	1	gas pressure is correct
		0	gas pressure is too high
C	carbon monoxide level	1	carbon monoxide level is correct
		0	carbon monoxide level is too high
L	gas leak detection	1	no gas leak is detected
		0	gas leak is detected

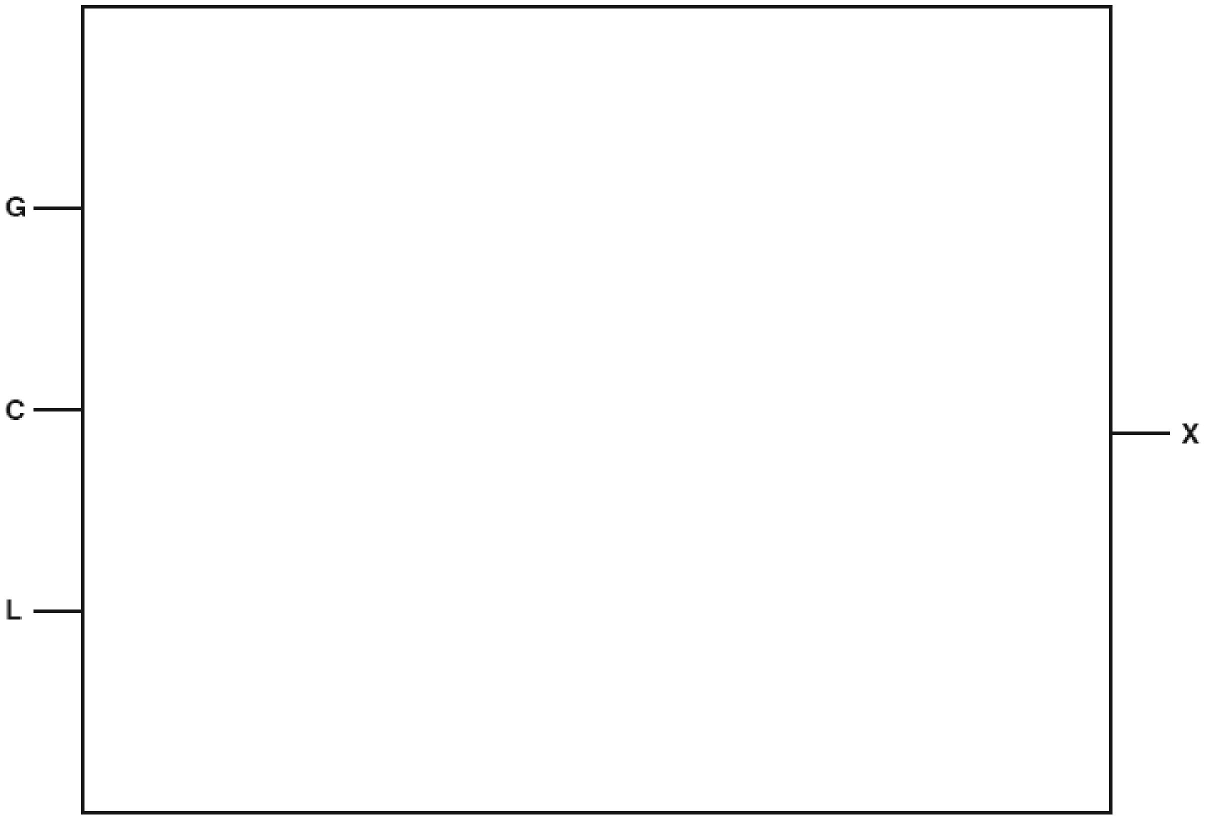
The output X = 1 is generated under the following conditions:

gas pressure is correct **AND** carbon monoxide level is too high

OR

carbon monoxide level is correct **AND** gas leak is detected

(a) Draw a logic circuit for this safety system.



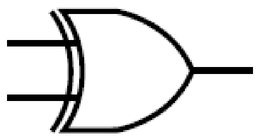
[5]

(b) Complete the truth table for the safety system.

G	C	L	Workspace	X
0	0	0		
0	0	1		
0	1	0		
0	1	1		
1	0	0		
1	0	1		
1	1	0		
1	1	1		

[4]

(c) Complete the truth table for the XOR gate:



A	B	C
0	0	
0	1	
1	0	
1	1	

[1]

QUESTION 4	[6 marks]

An algorithm is written in pseudocode:

```
INPUT Number
IF Number > 100
   THEN OUTPUT "The number is too large"
   ELSE OUTPUT "The number is acceptable"
ENDIF
```

(a) Describe the purpose of the algorithm.

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....[2]

(b) (i) The algorithm only allows one attempt at inputting an acceptable value.

State how you would change the algorithm so that it continues until a suitable input is supplied.

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....[1]

(ii) Re-write the algorithm in full, using pseudocode, to implement your answer to **part (b)(i).**

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....[3]

QUESTION 5	[8 marks]

A group of friends: 2 women (Alice and Babs) and 2 men (Zach and Yabu) like to go out on dates to cool restaurants in pairs.
There are four combinations they date in: Alice-Zach, Alice-Yabu, Babs-Zach and Babs-Yabu.

The favourite restaurant of one of the men and one of the women is a place called Quonk.
However if those two eat together they always try new restaurants as do the other pair if together.
Therefore, when exactly one and only one of the particular man and woman in question is on a date, they eat at Quonk.

When Alice goes out with Zach they go to Quonk.

Which, if any, other pair eat at Quonk?

Alice and Yabu eat at Quonk
Babs and Zach eat at Quonk
Babs and Yabu eat at Quonk
None of the other pairs eat at Quonk.

NOTE: it is more important that you explain your reasoning and analysis of this puzzle, than it is to find the correct answer

QUESTION 6	[10 marks]

Alice, Bob and Charlie are well-known expert logicians.

(i) The King places a hat on each of their heads. Each of the logicians can see the others' hats, but not his or her own.

The King says "Each of your hats is either black or white, but you don't all have the same colour hat".

All four are honest, and all trust one another.

The King now asks Alice "Do you know what colour your hat is?".

Alice says "Yes, it's white".

What colour are the others' hats? [Hint: think about how Alice can deduce that her hat is white.]

(ii) The King now changes some of the hats, and again says "Each of your hats is either black or white, but you don't all have the same colour hat". He now asks Alice "Do you know what colour your hat is?".

Alice replies "No"

Can Bob work out what colour his hat is? Explain your answer. [Hint: what can Bob deduce from the fact that Alice can't tell what colour her hat is?]

(iii) The King now changes some of the hats, and then says "Each of your hats is either black or white. At least one of you has a white hat."

He now asks them all "Do you know what colour your hat is?". They all simultaneously reply "No".

What can you deduce about the colour of their hats? Explain your answer.

(iv) He again asks "Do you know what colour your hat is?" Alice says "No", but Bob and Charlie both say "Yes" (all three answer simultaneously).

What colour are their hats? Explain your answer.

QUESTION 7	**[3 marks]**

The following algorithm inputs 1000 numbers and then should output how many were negative, how many were positive and how many were zero.

```
negative ← 1
positive ← 1

for x ← 0 to 1000
    input number
    if number < 0 then
        negative ← negative + 1
        if number > 0 then
            positive ← positive + 1
        endif
    endif
next

print negative, positive
```

There are several errors in this code (remember that examiners are looking for your logic understanding, and not layout).

Locate and state where three of these errors are, and suggest a corrected piece of code for each error.

1 ……

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2 ……

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3 ……

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[3]

CS practice Scholarship paper; total: 50

QUESTION 1 [7 marks]

18 marking points:

- initialisation of all 5 totals
- loop to control input for all 1500 students
- input choice and name of student <u>inside</u> the loop
- check student choice …
- … increment the appropriate total
- output name of student who likes classical music
- find the 5 percentages (either using /15 or (*100/1500)) <u>outside</u> the loop
- output the 5 percentages <u>outside</u> the loop (must have some processing)
- error checking

sample algorithm (in pseudocode)

NOTE: many students may make use of the **case … of … endcase** construct here rather than five IF statements

```
rock = 0: soul = 0: pop = 0: jazz = 0: classical = 0              1 mark

for student = 1 to 1500                                           1 mark

    input choice, pupil_name                                      1 mark
        if choice = 1 then rock = rock + 1
        if choice = 2 then soul = soul + 1
        if choice = 3 then pop = pop + 1                          2 marks
        if choice = 4 then jazz = jazz + 1
        if choice = 5 then classical = classical + 1
        if choice = 5 then output pupil_name                      1 mark

next student
percent1 = rock/15
percent2 = soul/15
percent3 = pop/15                                                 1 mark
percent4 = jazz/15
percent5 = classical/15
output percent1, percent2, percent3, percent4, percent5           1 mark
```

```
(sample pseudocode showing a possible case … of construct:
(alternative to rows 4 to 9 in above algorithm)
case of choice:
1: rock = rock + 1
2: soul = soul + 1
3: pop = pop + 1                                                  2 marks
4: jazz = jazz + 1
5: classical = classical + 1
output pupil_name                                                 1 mark
endcase)                                                                       [5]
```

QUESTION 2 [6 marks]

Qu		Marks	
02	1	All marks for A02 (apply)	3

Number	Root	d	FactorFound	r	Output
5	1				
	2				
	3				
		2	FALSE	1	
		3		2	
		4			Prime

1 mark for correct columns `Root` **and** `d`
1 mark for correct column `r`
1 mark for correct columns `FactorFound` **and** `Output`

Max 2 marks if any incorrect values written in table

3

I. Annotation indicating 'no value'
I. Indication of repeating values
I. Quotes
I. Case & spelling for FactorFound & Output
A. T, F instead of True False

Qu		Marks	
02	2	All marks for A02 (apply)	3

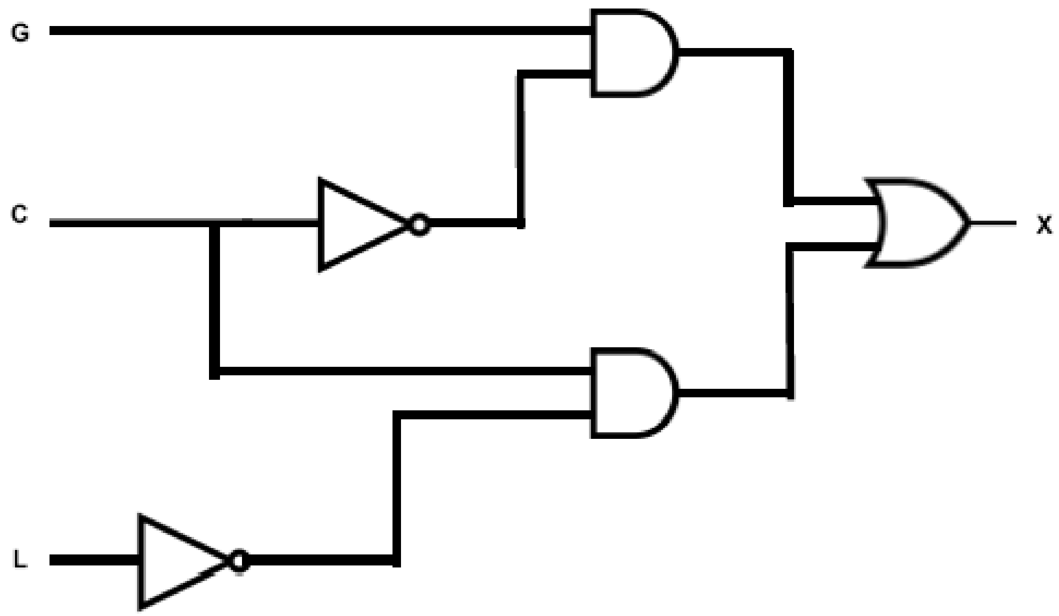
Number	Root	d	FactorFound	r	Output
25	1				
	2				
	3				
	4				
	5	2	False	1	
		3		1	
		4		1	
		5		0	
			True		
		6			Not prime

1 mark for correct columns `Root` **and** `d`
1 mark for correct column `r`
1 mark for correct columns `FactorFound` **and** `Output`

Max 2 marks if any incorrect values written in table

QUESTION 3	[10 marks]

6 (a) 1 mark per correct logic gate, correctly connected



[5]

(b)

G	C	L	Workspace	X	
0	0	0		0	1 mark
0	0	1		0	
0	1	0		1	1 mark
0	1	1		0	
1	0	0		1	1 mark
1	0	1		1	
1	1	0		1	1 mark
1	1	1		0	

[4]

(c) check correct output for C

QUESTION 4	[6 marks]

Question	Answer	Marks
4(a)	Any **two** from: • Expects a number to be input • Checks if the number is greater than 100 • Outputs the result of the test • Specific output example	2
4(b)(i)	**One** mark for correct answer e.g. Use a (condition controlled) loop	1

4(b)(ii)	**One** mark for each point
	• Initialisation of Number variable
	• Correct loop statements
	• Correct INPUT and OUTPUT
	e.g.
	`INPUT Number`
	`WHILE Number > 100 DO`
	`  OUTPUT "The number is too large"`
	`  INPUT Number`
	`ENDWHILE`
	`OUTPUT "The number is acceptable"`
	or
	`INPUT Number`
	`REPEAT`
	`  IF Number > 100`
	`    THEN`
	`      OUTPUT "The number is too large"`
	`  ENDIF`
	`  INPUT Number`
	`UNTIL Number <= 100`
	`OUTPUT "The number is acceptable"`
		3

QUESTION 5	[8 marks]

Answer: Babs and Yabu also eat at Quonk!
Surprised? If not your logic is excellent! Most people think no other pair eat at Quonk. The Vulcans would be proud of you if you got it right! Why is that the answer?
We know Alice and Zach eat together at Quonk. That means that EITHER

- the woman who likes to eat there is Alice OR
- the man who likes to eat there is Zach.

It is not BOTH Alice and Zach who like to eat there as then they would have eaten somewhere else.
This means that the woman and man in question is EITHER

- Alice and Yabu OR
- it is Babs and Zach.

We cannot tell which though. Luckily, that does not matter, we have enough information. In both cases we get the same conclusion.
If it is Alice and Yabu that like Quonk, then:

- Babs and Yabu **would** eat there because of Yabu.
- Alice and Yabu **wouldn't** because both are there.
- Babs and Zach **wouldn't** because neither Babs nor Zach eat there.

If it is Babs and Zach that like Quonk then:

- Babs and Yabu **would** eat there because of Babs.
- Alice and Yabu **wouldn't** because neither Babs or Zach are there.
- Babs and Zach **wouldn't** because both are there.

So whichever the pair is:

- Babs and Yabu **would** eat there.
- Alice and Yabu **wouldn't** eat there.
- Babs and Zach **wouldn't** eat there.

QUESTION 6	**[10 marks]**

6. (i) The three hats are not all of the same colour. If Alice sees a black and white hat then she cannot conclude anything about her own — but in the event she see two hats of the same colour she can conclude that her own must be of the opposite colour. So Alice can see two black hats and herself wears a white one.

(ii) If Bob and Charlie have the same coloured hats then Alice can deduce what she is wearing. As she cannot then Bob and Charlie must be wearing different hats. As Bob can see Charlie's hat then he can deduce his own is of the opposite colour.

(iii) If there were two black hats and one white one then, as in part (i), one of the three would be able to deduce that they were wearing a white hat. Hence there must be one or no black hats.

(iv) If there were three white hats then on the second time of questioning all three would again be unsure about the colour of their own hat. If there is one black hat then the two who can see it know that it is the only black hat and that they are wearing white. Given the responses we know that Alice is wearing black, and that Bob and Charlie are each wearing white.

QUESTION 7 **[3 marks]**

Any 3 of:

- For x ← 0 to 1000 should be 1 to 1000
- First IF should close after negative increment (or equivalent explanation)
- Number of zeros not counted / output; should be another IF with an increment of the zero variable
- Initial values should start at 0