



Level 3 Technical Level Programming Maths for Programmers

Unit T/507/6469

SPECIMEN

Time allowed: 2 hours

Materials

For this paper you must have:

- pens
- pencils
- simple drawing instruments
- scientific calculator (non-programmable).

Instructions

- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided.
- Do not write outside the box around each page or on blank pages.
- Do all rough work in this book.
- Cross through any work you do not want to be marked.

Information

- There are two sections to this paper.
- Both sections should be attempted.
- Candidates should spend approximately 60 minutes on Section A and 60 minutes on Section B.
- The maximum mark for this paper is 80.
- The marks for the questions are shown in brackets.

Advice

- Please read each question carefully before starting.

For Examiner's Use	
Examiner's Initials	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	
21	
TOTAL	

Please write clearly in block capitals.

Centre number

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Candidate number

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Surname

Forename(s)

Candidate signature

Section A

Answer **all** questions in this section.**Total for this section: 50 marks**

In the multiple choice questions, only **one** answer per question is allowed.

For each answer completely fill in the circle alongside the appropriate answer.

CORRECT METHOD



WRONG METHODS



If you want to change your answer you must cross out your original answer as shown. 

If you wish to return to an answer previously crossed out, ring the answer you now wish to select as shown. 

0 1

Which one of the following is also known as Base 8?

A Denary

☐

B Binary

☐

C Octal

☐

D Hexadecimal

☐
[1 mark]

0 2

Convert 111111112 into hexadecimal

A FF00

☐

B 377

☐

C 255

☐

D FF

☐
[1 mark]

0 3

In languages such as C, what is the prefix used to support the hexadecimal representation of constants?

A 0x

☐

B +

☐

C =

☐

D &H

☐

[1 mark]

0 4

A message with multiple parts in MIME format is likely to be encoded in

A Base 8

☐

B Base 2

☐

C Base 64

☐

D Base 10

☐

[1 mark]

0 5

A computer is programmed to guess an integer between 1 and 50 inclusive. What is the probability of guessing the correct number twice in a row?

A 2/50

☐

B 2/100

☐

C 1/2500

☐

D 1/250

☐

[1 mark]

0 6

A binary value of 10010100 is stored in a CPU's register. Convert this value to denary, interpreting it as:

6.1 an unsigned integer

6.2 two's complement

6.3 an unsigned binary fraction with a fixed central binary (radix) point

Use appropriate base notation in your answers.

[4 marks]

0	7
---	---

Calculate the original base and the denary equivalent for each of the following:

7.1 $10101101_2 + 01011_2$

[2 marks]

7.2 $2416 - A16$

[2 marks]

7.3 $75_8 - 47_8$

[2 marks]

0 8

8.1 Complete the following truth table.

[3 marks]

X	Y	$X.Y$	$X.Y + X$	$\overline{X.Y + X}$
0	0			
0	1			
1	0			
1	1			

8.2 Identify the three logical operations used in the final column.

[1 mark]

0 9

Convert the following signed 8-bit binary numbers to their decimal equivalent.

9.1 10010001

[1 mark]

9.2 00001111

[1 mark]

1	0
---	---

This is a 16-bit diagnostic code:

0xCC12

10.1 Convert the diagnostic code to binary.

[1 mark]

Bits 14 and 15 indicate a fault condition. If both are True, there is a memory error.

10.2 What are the values of Bits 14 and 15?

[1 mark]

10.3 State whether there is a memory error and explain your reasons.

[2 marks]

1	1
---	---

State the three rules of recursion.

[3 marks]

1 2

12.1 Describe how an odd parity check works.

[2 marks]

12.2 Complete the following truth table for an odd parity generator.

[1 mark]

4-bit received message				Parity error check
A	B	C	P	
0	0	0	0	
0	0	0	1	
0	0	1	0	
0	0	1	1	

1 3

13.1 Convert the following arithmetic expression to Reverse Polish notation (RPN).

$$3 * 2 + 5$$

[1 mark]

13.2 What is another name for RPN?

[1 mark]

1 4

Solve the following equation using the factorisation method.

$$2x^2 + 5x = 12$$

[3 marks]

1 5

Express the following equation using the function notation.

$$y = x^2 + 5$$

[2 marks]

1 6

Name each type of matrix shown below.

[3 marks]

16.1 $[10 \quad 20 \quad 30]$

16.2 $\begin{bmatrix} 10 \\ 20 \\ 30 \end{bmatrix}$

16.3 $\begin{bmatrix} 10 & 20 \\ 30 & 40 \end{bmatrix}$

1	7
---	---

Solve the following expression

[3 marks]

$$2x - y$$

where

$$x = \begin{bmatrix} 7 & 8 \\ -5 & 0 \end{bmatrix} \text{ and } y = \begin{bmatrix} 2 & 4 \\ 7 & 8 \end{bmatrix}$$

Show your working.

1	8
---	---

Interpret the following:

$$\sum_{m=3}^7 2m$$

18.1 Name the symbol used and state its purpose.

[2 marks]

18.2 State the purpose of 'm'.

[1 mark]

18.3 State the start term and end term.

[1 mark]

18.4 Calculate the total of the sequence.

[2 marks]

Section B

Answer **all** questions in this section.

Total for this section: 30 marks

1	9
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You have been asked to incorporate an Exclusive OR (EOR/XOR) in a project's key circuit. Unfortunately, no Exclusive OR components are available.

You can build the exclusive OR logical operator using a combination of the following types of gate:

- 2 x NOT gates
- 2 x AND gates
- 1 x OR gate

- 19.1 Manipulate these gates into a working logic circuit which simulates an Exclusive OR. Label/annotate each gate's output.

[6 marks]

- 19.2 Complete a truth table, with entries for each gate, that proves the circuit is simulating the Exclusive OR correctly.

[2 marks]

- 19.3 Build the same Exclusive OR circuit using only NOR gates.

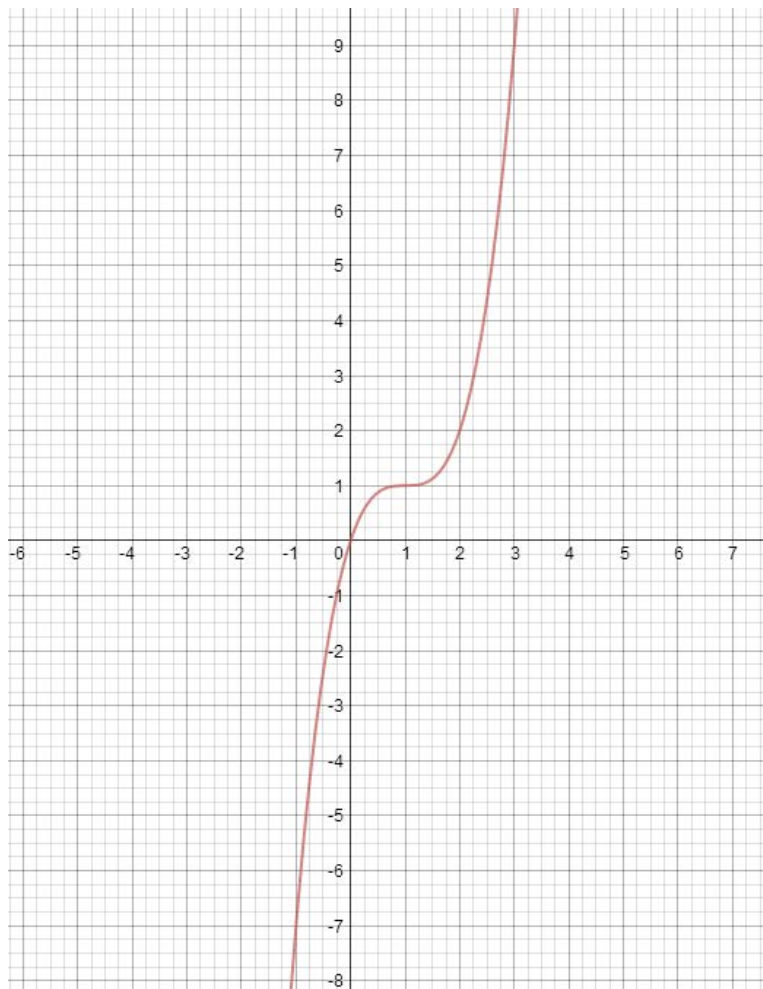
Note: you are not required to label this circuit.

[4 marks]

20

Examine the following graph which has been generated from the function

$$f(x) = (x - 1)^3 + 1 \text{ on typical } x \text{ and } y \text{ axes:}$$



20.1 Complete the following table for this equation:

[6 marks]

x	$f(x)$	(x, y)
-1	-7	
0		
1		(1,1)
2		

20.2 Calculate the value of $f(3)$. Show your working.

[2 marks]

20.3 State two differences between a function and an equation.

[2 marks]

2	1
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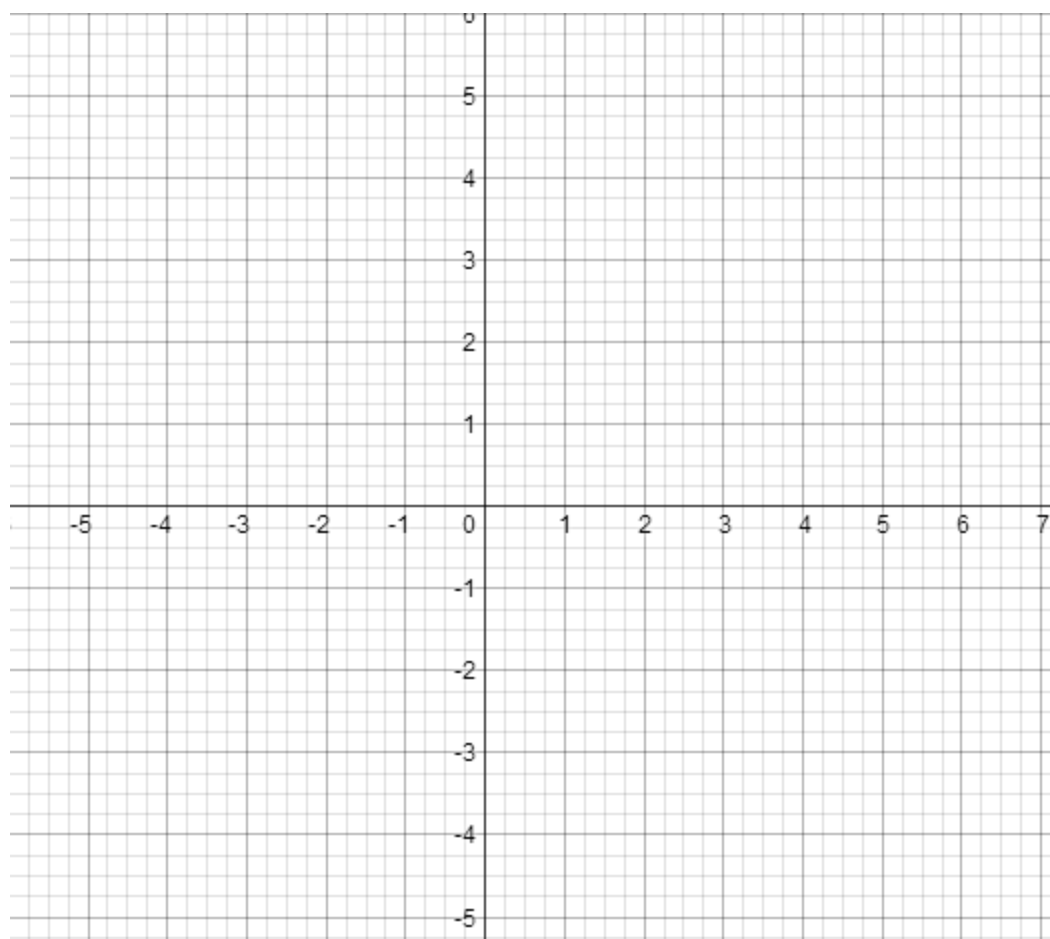
A graphics programmer is designing routines to transform simple line- based graphics using matrix transformations.

They have plotted a simple square using the following co-ordinates which are stored in a 4-column matrix.

$$\begin{bmatrix} x1 & x2 & x3 & x4 \\ y1 & y2 & y3 & y4 \end{bmatrix} = \begin{bmatrix} 2 & -2 & -2 & 2 \\ 2 & 2 & -2 & -2 \end{bmatrix}$$

21.1 Plot this square on the graph below, annotating each co-ordinate (x1, y1, etc) clearly.

[2 marks]



- 21.2 Transform the square using the following reflection matrix to calculate its new co-ordinates:

$$\begin{bmatrix} 1 & 0 \\ 0 & -1 \end{bmatrix}$$

[2 marks]

- 21.3 Plot the new square on the same graph, showing the adjusted co-ordinates.

[2 marks]

- 21.4 State the type of reflection matrix that has been applied.

[1 mark]

- 21.5 Show the transformation matrix required to translate the square:

$$x + 3 \text{ and } y + 4$$

[1 mark]

End of Questions