

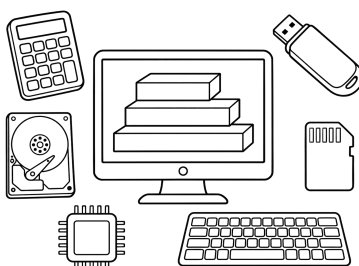
TEACHER GUIDE

ANSWERS AND MARKS

GRADE 10 · INFORMATION AND COMMUNICATION TECHNOLOGY

UNIT 3

Data Representation Methods in the Computer System



! FOR THE TEACHER ONLY

This booklet has the answers to every exercise in the Unit 3 Student Workbook, in the same order. The exercise letters match the workbook.

i WHAT IS IN THIS GUIDE

- **Marks and pacing** - every exercise and its marks
- **Class marks record** - one page to copy for each class
- **Practicals at a glance** - what to check in Practical 1 - 5, textbook links, an oral quiz
- **Answers** - chapters 1 to 5, in the same order as the workbook
- **Unit 3 Test** - the marking scheme and the common mistakes
- **Extra** - homework ideas, a practical test and board practice

★ BEFORE THE FIRST LESSON

- ☐ Every computer opens the Calculator, and its Programmer mode works.
- ☐ Notepad and MS Word open; one pen drive is ready for Practical 4.
- ☐ The projector works, so you can show each conversion step by step.

"When students check each answer on the Calculator, they stop guessing and start knowing."

TEACHER GUIDE

Marks and Pacing

You decide how much class time each part needs

Chapter	Exercise	Marks
Chapter 1	A Fill in the blanks	6
	B Check the digits	6
	C Complete the table	8
	D Weighting factors	8
	E True or false	5
	F Answer these	4
Chapter 2	A Find the MSD and LSD	8
	B Find the MSB and LSB	8
	C Convert to binary	6
	D Convert to octal and hex	8
	E Choose the correct answer	3
	F Answer these	6
Chapter 3	A Complete the table	8
	B Convert to decimal	8
	C Go through binary	8
	D Make the clusters	8
	E Write each digit in bits	8
Chapter 4	A Fill in the blanks	8
	B Match them	6
	C Answer these	4
	D Calculate	10
Chapter 5	A Write in BCD	7
	B ASCII codes	6
	C Decode the message	5
	D Which coding system?	6
	E Crossword	10
	F Answer these	6
	G True or false	7
End	Unit 3 Test	40
TOTAL		231

! SUGGESTED SHAPE OF ONE CHAPTER

READ	Teach the chapter pages. Students read with you and underline the key words.
DO	The practical tasks on real computers, in pairs.
WRITE	The written exercises. Walk around and help.
MARK	Mark the work together. Fill the tick boxes.



TEACHER GUIDE

Class Marks Record

Copy this page for each class

No	Student name	Ch 1 (37)	Ch 2 (39)	Ch 3 (40)	Ch 4 (28)	Ch 5 (47)	Test (40)	Total (231)
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
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23								
24								
25								
26								
27								
28								
29								



TEACHER GUIDE

Practicals at a Glance

Textbook activities used in the five practicals

No	Students do	Check that ...
1	Colour codes (Activity, page 82)	they used DEC and read HEX: light pink #FFB6C1 ; sky blue #3299CC ; green #00FF00 ; yellow #FFEE00 .
2	Decimal to binary, octal and hex (Activities, pages 86, 87)	$37 = 100101_2 = 45_8 = 25_{16}$; $85 = 1010101_2 = 125_8 = 55_{16}$; $125 = 1111101_2 = 175_8 = 7D_{16}$.
3	Checking conversions (Activities, pages 89 - 96)	$101001_2 = 41_{10}$; $374_8 = 252_{10}$; $10101010110_2 = 2526_8$; $3DF_{16} = 111101111_2$.
4	Disk and pen drive capacity (Observation, page 99)	capacity in bytes divided by 1024 three times gives the GB value; the pen drive shows a little less than its label (1000 was used instead of 1024).
5	ASCII and Unicode (Activity, page 105)	ICT = 73, 67, 84 = 1001001, 1000011, 1010100; POT = 80, 79, 84; 0D85 + Alt X gives a Sinhala letter and 0B85 + Alt X a Tamil letter.

Textbook links

Workbook	Textbook	Activities
Chapter 1 - Number systems in the computer	pages 73 - 82 (3.1, 3.2)	page 82
Chapter 2 - Significant digits and decimal conversions	pages 83 - 87 (3.3, 3.4)	pages 84, 86, 87
Chapter 3 - Converting among number systems	pages 88 - 97 (3.5)	pages 89 - 97
Chapter 4 - Data storage capacity	pages 98 - 102 (3.6)	page 99
Chapter 5 - Coding systems	pages 103 - 108 (3.7)	pages 104, 105, 108
ASCII and EBCDIC codes	pages 109 - 112 (Appendix)	-

? QUICK ORAL QUIZ - START OR END A LESSON WITH IT

Ask the class ...	Answer
1. What is the base of the octal number system?	8
2. Which hexadecimal digit stands for 13?	D
3. What is the weighting factor of the 1 in 100_2 ?	$2^2 (= 4)$
4. What is the LSD of 3290?	0
5. Into how many bits does one octal digit go?	3
6. What is 1111_2 in hexadecimal?	F
7. What is 10_8 in decimal?	8
8. How many bits are in a nibble?	4
9. Which is faster: cache memory or RAM?	Cache memory
10. How many characters can 7-bit ASCII show?	128



ANSWERS

Chapter 1

Number systems in the computer

A Fill in the blanks

6 marks

1. voltage levels	2. binary	3. quantum
4. qubit	5. radix	6. place value

B Check the digits

6 marks

1. 1201_2 NO (2 is not a binary digit)	2. 386_8 NO (8 is not an octal digit)
3. $9A_{16}$ YES (both are hexadecimal digits)	4. 75_8 YES (7 and 5 are octal digits)
5. $1G_{16}$ NO (G is not a hexadecimal digit)	6. 101_2 YES (1 and 0 are binary digits)

C Complete the table

8 marks

Number system	Base	Digits used	Largest digit
Binary	2	0, 1	1
Octal	8	0 to 7	7
Decimal	10	0, 1, 2 ... 9	9
Hexadecimal	16	0 to 9 and A to F	F

1 mark for each answer in bold (8 blanks).

D Weighting factors

8 marks

1. 4065_{10} $10^3 \ 10^2 \ 10^1 \ 10^0$ 4065	2. 101101_2 $2^5 \ 2^4 \ 2^3 \ 2^2 \ 2^1 \ 2^0$ 101101	3. 3075_8 $8^3 \ 8^2 \ 8^1 \ 8^0$ 3075	4. $2AF_{16}$ $16^2 \ 16^1 \ 16^0$ 2AF
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2 marks each; 1 mark if one weighting factor is wrong. The last digit is always the base to the power 0.

E True or false

5 marks

1. T	2. F	3. T	4. T	5. F	
------	------	------	------	------	--

★ TEACHING TIP

- Before Practical 1, open the Calculator on every computer and check that Programmer mode is there.



F Answer these

4 marks

1. A number is written as 23_y . To which of the four number systems can it belong? Explain. (2 marks)

Octal ($y = 8$), decimal ($y = 10$) or hexadecimal ($y = 16$) - 1 mark. It cannot be binary, because 2 and 3 are not binary digits (binary has only 0 and 1) - 1 mark.

2. Why does the computer also use the hexadecimal number system? Give one use of it. (2 marks)

Binary numbers are long and hard for humans to read. One hexadecimal digit can replace 4 bits, so it is easier to use (1 mark). Uses: memory addresses, colour codes such as #871F78 (1 mark).

ANSWERS

Chapter 2

Significant digits and decimal conversions

A Find the MSD and LSD

8 marks

1. 56870_{10} : MSD 5 , LSD 0	2. 154.01_{10} : MSD 1 , LSD 1
3. 23.080_{16} : MSD 2 , LSD 8	4. $AD239_{16}$: MSD A , LSD 9
5. 0.00110_8 : MSD 1 , LSD 1	6. 720.05 : MSD 7 , LSD 5
7. 440 : MSD 4 , LSD 0	8. 120_8 : MSD 1 , LSD 0

1 mark for each number when both digits are right. Remember: in a whole number the LSD may be 0; after a point, the last digit that is not 0.

B Find the MSB and LSB

8 marks

1. 1000_2 : MSB 1 (2^3), LSB 0 (2^0)	2. 011101_2 : MSB 1 (2^4), LSB 1 (2^0)
3. 0.11001_2 : MSB 1 (2^{-1}), LSB 1 (2^{-5})	4. 1.0010_2 : MSB 1 (2^0), LSB 1 (2^{-3})
5. 0.00110_2 : MSB 1 (2^{-3}), LSB 1 (2^{-4})	6. 1011_2 : MSB 1 (2^3), LSB 1 (2^0)
7. 0.1_2 : MSB 1 (2^{-1}), LSB 1 (2^{-1})	8. 0.10_2 : MSB 1 (2^{-1}), LSB 1 (2^{-1})

1 mark for each number when both bits and their weighting factors are right.

★ TEACHING TIPS

- Write the powers of 2, 8 and 16 on the board at the start of every lesson in Chapters 1 to 3.
- After every conversion, ask students to check it the other way round: binary back to decimal.



ANSWERS

Chapter 3

Converting among number systems

A Complete the table

8 marks

Decimal	Binary	Octal	Hexadecimal
29	11101	35	1D
100	1100100	144	64
63	111111	77	3F
255	11111111	377	FF

1 mark for each answer in bold (8 blanks).

B Convert to decimal

8 marks

- $111011_2 = 32 + 16 + 8 + 0 + 2 + 1 = \mathbf{59}_{10}$
- $221_8 = 128 + 16 + 1 = \mathbf{145}_{10}$
- $12B_{16} = 256 + 32 + 11 = \mathbf{299}_{10}$
- $A49_{16} = 2560 + 64 + 9 = \mathbf{2633}_{10}$

2 marks each: 1 mark for the working (digit $\times$ weighting factor), 1 mark for the answer.

C Go through binary

8 marks

- $76_8 = 111\ 110 = 0011\ 1110 = \mathbf{3E}_{16}$
- $452_8 = 100\ 101\ 010 = 0001\ 0010\ 1010 = \mathbf{12A}_{16}$
- $96_{16} = 1001\ 0110 = 010\ 010\ 110 = \mathbf{226}_8$
- $15F_{16} = 0001\ 0101\ 1111 = 101\ 011\ 111 = \mathbf{537}_8$

2 marks each: 1 mark for the binary, 1 mark for the new clusters and the answer.

D Make the clusters

8 marks

- $10011001_2 = 010\ 011\ 001 = \mathbf{231}_8$
- $111100111_2 = 111\ 100\ 111 = \mathbf{747}_8$
- $11011010_2 = 1101\ 1010 = \mathbf{DA}_{16}$
- $11111001101_2 = 0111\ 1100\ 1101 = \mathbf{7CD}_{16}$

2 marks each: 1 mark for the clusters (from the right, 0s added on the left), 1 mark for the number.



TIP: Say "the base tells the family" each time you write a subscript. Soon the class says it with you.



E Write each digit in bits

8 marks

Number	Each digit in bits	Binary number
245_8	010 100 101	10100101₂
706_8	111 000 110	111000110₂
$B2C_{16}$	1011 0010 1100	101100101100₂
78_{16}	0111 1000	1111000₂

2 marks each: 1 mark for the bits of each digit, 1 mark for the binary number. 0s at the left end may be left out.



ANSWERS

Chapter 4

Data storage capacity

A Fill in the blanks

8 marks

1. bit	2. nibble	3. eight	4. kilobyte
5. gigabit	6. access	7. Register	8. tape

B Match them

6 marks

1. Register memory → B	2. Cache memory → F	3. Compact Disc (CD) → D
4. DVD → A	5. Hard disk → E	6. Magnetic tape → C

C Answer these

4 marks

1. Write these from the fastest to the slowest: hard disk, register memory, CD, RAM. (2 marks)

Register memory, RAM, hard disk, CD. 2 marks for the right order; 1 mark if one is in the wrong place.

2. Hashini's pen drive is 32 GB and her brother's hard disk is 1 TB. How many such pen drives can the hard disk hold? Show your working. (2 marks)

1 TB = 1024 GB (1 mark). $1024 \div 32 = \mathbf{32 \text{ pen drives}}$ (1 mark).

★ TEACHING TIPS

- Remind students that a remainder is always smaller than the base: 0 or 1 for base 2, 0 to 15 for base 16.
- Let pairs swap books and mark the conversions with the Calculator in Programmer mode.



D Calculate

10 marks

1. 3 bytes = $3 \times 8 = \mathbf{24}$ bits	2. 6 nibbles = $6 \div 2 = \mathbf{3}$ bytes
3. 2 KB = $2 \times 1024 = \mathbf{2048}$ bytes	4. 5 MB = $5 \times 1024 = \mathbf{5120}$ KB
5. 4096 MB = $4096 \div 1024 = \mathbf{4}$ GB	6. 1 TB = $1024 \times 1024 = \mathbf{1\ 048\ 576}$ MB
7. 512 MB = $512 \div 1024 = \mathbf{0.5}$ GB	8. 2 GB = $2 \times 1024 \times 1024 = \mathbf{2\ 097\ 152}$ KB
9. 16 bits = $16 \div 8 = \mathbf{2}$ bytes	10. 3 PB = $3 \times 1024 = \mathbf{3072}$ TB

ANSWERS

Chapter 5

Coding systems

A Write in BCD

7 marks

Number	Decimal value	BCD code
302	302	0011 0000 0010
2136	2136	0010 0001 0011 0110
7295	7295	0111 0010 1001 0101
4506	4506	0100 0101 0000 0110
11101_2	29	0010 1001
$2B_{16}$	43	0100 0011
43_8	35	0011 0101

1 mark for each BCD code. For 11101_2 , $2B_{16}$ and 43_8 the decimal value must be found first.

B ASCII codes

6 marks

Character	Decimal code	ASCII code (7 bits)
P	80	1010000
O	79	1001111
T	84	1010100

1 mark for each decimal code, 1 mark for each 7-bit code.

C Decode the message

5 marks

$1001011 = \mathbf{K}$ $1000001 = \mathbf{A}$ $1001110 = \mathbf{N}$ $1000100 = \mathbf{D}$ $1011001 = \mathbf{Y}$

The city is **KANDY**. 1 mark for each letter.



TIP: Show 100 in the four bases (100 two, 100 eight, 100 ten, 100 sixteen) and ask which is the biggest.



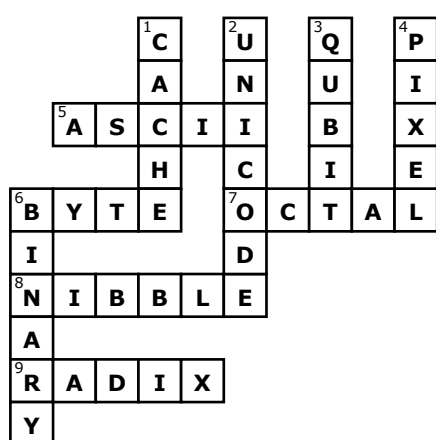
D Which coding system?

6 marks

The use	BCD	ASCII	Unicode
Shows the digits on a digital clock	☒	☐	☐
A Sinhala newspaper website	☐	☐	☒
Uses 7 bits for 128 characters	☐	☒	☐
Writes each decimal digit with 4 bits	☒	☐	☐
Uses 16 bits for 65 536 symbols	☐	☐	☒
Designed and approved by ANSI	☐	☒	☐

E Crossword

10 marks



Across: 5 ASCII, 6 BYTE, 7 OCTAL, 8 NIBBLE, 9 RADIX

Down: 1 CACHE, 2 UNICODE, 3 QUBIT, 4 PIXEL, 6 BINARY

F Answer these

6 marks

- What is the largest digit that one BCD code can show? Write its code. (2 marks)
9, written as **1001** (BCD codes go only from 0000 to 1001). 1 mark each.
- In ASCII, the letter A is 1000001. What is the ASCII code of F? Show how you found it. (2 marks)
 $A = 1000001_2 = 65$. F is 5 letters after A, so $F = 70 = \mathbf{1000110}$. 1 mark for 70, 1 mark for the code.
- Convert 45_8 to a BCD number. Show your working. (2 marks)
 $45_8 = (4 \times 8) + (5 \times 1) = 37_{10}$ (1 mark). $3 = 0011$, $7 = 0111$, so the BCD number is **0011 0111** (1 mark).

G True or false

7 marks

1. T	2. F	3. T	4. F	5. T	6. F	7. T
------	------	------	------	------	------	------



TIP: For clusters, let students draw the cluster lines in pencil first, always from the right.



MARKING SCHEME

Unit 3 Test

Total 40 marks

1 Choose the correct answer

8 marks (1 each)

1. (d) 16	2. (b) 108_8
3. (c) 5 and 2	4. (c) 13
5. (a) $2F_{16}$	6. (b) 3 bits
7. (b) 4 bits	8. (c) Unicode

2 Fill in the blanks

8 marks (1 each)

1. radix	2. weighting	3. LSB	4. 8
5. 4	6. megabyte	7. Register	8. ANSI

3 Complete the conversions

8 marks (1 each)

1. $29_{10} = 11101_2$	2. $100_{10} = 144_8$
3. $250_{10} = FA_{16}$	4. $101101_2 = 45_{10}$
5. $157_8 = 111_{10}$	6. $2C_{16} = 44_{10}$
7. $110101110_2 = 656_8$	8. $10111101_2 = BD_{16}$

4 Answer these

16 marks

1. Convert 75_{10} to a binary number. Show your working. (3 marks)

$75 \div 2 = 37 \text{ r } 1$; $37 \div 2 = 18 \text{ r } 1$; $18 \div 2 = 9 \text{ r } 0$; $9 \div 2 = 4 \text{ r } 1$; $4 \div 2 = 2 \text{ r } 0$; $2 \div 2 = 1 \text{ r } 0$; $1 \div 2 = 0 \text{ r } 1$. Read from the bottom: $75_{10} = 1001011_2$. 2 marks for the working, 1 mark for the answer.

2. Convert $3B6_{16}$ to an octal number through binary. Show your working. (3 marks)

$3 = 0011$, $B = 1011$, $6 = 0110$, so $3B6_{16} = 1110110110_2$ (1 mark). Clusters of 3: 001110110110 (1 mark) = 1666_8 (1 mark).

3. (a) How many bytes are in 2 KB? (b) Write from the fastest to the slowest: hard disk, cache memory, magnetic tape, RAM. (3 marks)

(a) $2 \times 1024 = 2048 \text{ bytes}$ (1 mark). (b) Cache memory, RAM, hard disk, magnetic tape (2 marks; 1 mark if one is in the wrong place).



4. (a) Write 2026 in BCD. (b) In ASCII, G is 71 and O is 79. Write GO in 7-bit ASCII. (4 marks)

(a) **0010 0000 0010 0110** (2 marks; 1 mark if one digit is wrong). (b) G = **1000111**, O = **1001111** (1 mark each).

5. Why was the Unicode system designed? Write one place where it is used. (3 marks)

BCD has only 10 characters and ASCII only 128, so they cannot show languages like Sinhala, Tamil, Japanese and Chinese (1 mark). Unicode uses 16 bits for 65 536 different symbols and gives every character of every language a unique code (1 mark). Used for websites and newspapers (1 mark).

i WHAT STUDENTS USUALLY GET WRONG

- They read the remainders from the top. Read them from the **bottom to the top**.
- They write a remainder of 10 to 15 as two digits. Write **A to F**: $47 = 2F_{16}$, not 215.
- They make clusters from the left. Start from the **right** and add 0s on the left.
- They write numbers like 386_g . Every digit must be **smaller than the base**.
- They think the LSD of 3290 is 9. In a whole number it is the **last digit**: 0.
- They mix up BCD and binary: 37 is **0011 0111** in BCD but 100101 in binary.
- They use 1000 instead of **1024** when they change storage units, or write Gb for GB.

★ HOMEWORK AND EXTRA PRACTICE

- Write your birthday (day, month and year) in binary, octal and hexadecimal.
- Find the capacity of three storage devices at home (phone, pen drive, memory card) and order them.
- Write your name in ASCII binary. Ask a family member to decode it with the table.
- Find five colour codes on the Internet (#.....) and write their R, G and B values in decimal.
- Fast learners: convert the numbers 0 to 24 into all four number systems without looking at Table 3.7.

★ TEACHING TIPS

- Keep a poster of Table 3.12 (0 to F with their 4-bit codes) on the classroom wall.
- Ask students to find the colour code of their school colours with Practical 1.
- Bring a pen drive and a DVD to class. Let students read the capacity printed on them.
- Play "faster or slower": you name two storage devices, the class points to the faster one.
- Ask: why is a 32 GB pen drive shown as less than 32 GB? Accept answers about 1000 and 1024.



PRACTICAL TEST - 20 MINUTES, 20 MARKS (OPTIONAL)

Use it after the unit, in the computer room. The answers are in brackets.

Step	The student must ...	Marks
1	Show DEC 200 on the Calculator and read HEX and OCT (C8, 310).	2
2	Convert 109₁₀ to binary with a ladder (1101101); check it on the Calculator.	3
3	Convert 11010110₂ to octal and hexadecimal with clusters (326, D6).	3
4	Convert 7B₁₆ to decimal (123) and check it (HEX, then read DEC).	3
5	Find the capacity and the free space of drive C: in File Explorer.	2
6	Type OK in Notepad with Alt codes (79, 75) and write it in ASCII (1001111, 1001011).	4
7	Type a Sinhala letter in MS Word with Alt + X (0D85).	1
8	Close every window neatly and remove the pen drive safely.	2
	Total	20

QUICK BOARD PRACTICE - WITH ANSWERS

Write a few of these on the board at the start of a lesson. Students answer on paper and check with the Calculator.

Decimal	Binary	Octal	Hex	Number	Decimal
53	110101	65	35	101110 ₂	46
99	1100011	143	63	11011001 ₂	217
156	10011100	234	9C	57 ₈	47
200	11001000	310	C8	1A3 ₁₆	419
255	11111111	377	FF	FF ₁₆	255
500	111110100	764	1F4	777 ₈	511

TEACHING TIPS

- Write a short word in ASCII binary on the board as a secret message. The first to decode it wins.
- Show a digital clock or a calculator and ask: which coding system shows these digits? (BCD)
- In Practical 5, help students who have a laptop without a number pad: use Alt + X in MS Word instead.
- Ask students to type their name in Sinhala or Tamil in MS Word. Unicode makes this possible.
- Before the test, give each student three numbers to convert in all four number systems.
- Ask the class to explain 23_y to a partner: which bases are possible, and why?

