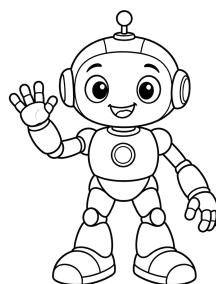


TEACHER GUIDE

ANSWERS AND MARKS

GRADE 8 · INFORMATION AND COMMUNICATION TECHNOLOGY

UNIT 1 Number Systems



! FOR THE TEACHER ONLY

This booklet has the answers to every exercise in the Unit 1 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 1.1 - 1.5, textbook links, an oral quiz
- **Answers** - chapters 1 to 5, in the same order as the workbook
- **Unit 1 Test** - the marking scheme and the common mistakes
- **Extra** - homework ideas, an optional skills test, board practice

★ BEFORE THE FIRST LESSON

- ☐ Every computer opens the Calculator, and its Programmer mode works.
- ☐ Five small cards (16, 8, 4, 2 and 1 dots) for each pair, for Practical 4.
- ☐ Buttons, seeds or bottle caps to use as beads in Practical 2.

"When students turn the cards and light the bulbs, binary stops being a mystery."

- THE KING OF ICT

TEACHER GUIDE

Marks and Pacing

You decide how much class time each part needs

Chapter	Exercise	Marks
Chapter 1	A Check the symbols	6
	B Fill in the blanks	6
	C Complete the table	8
	D Which number system?	8
	E True or false	6
	F Answer these	4
Chapter 2	A Lowest to highest	6
	B Counting frames	4
	C Value of the underlined digit	6
	D Write in expanded form	8
	E Fill in the blanks	6
	F True or false	6
	G Answer these	4
Chapter 3	A Put the steps in order	7
	B Complete the table	6
	C Convert to binary	12
	D Complete the division ladders	6
	E Answer these	6

Chapter	Exercise	Marks
Chapter 4	A Powers of 2	6
	B Use the place value chart	8
	C Write in expanded form	6
	D Which is bigger?	6
	E Read the binary cards	8
	F Answer these	4
Chapter 5	A Read the light bulbs	8
	B Switch on the bulbs	4
	C Input, processing or output?	6
	D Label the diagram	6
	E True or false	6
	F Crossword	10
	G Answer these	4
End	Unit 1 Test	40
TOTAL		237

! 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.

★ TEACHING TIPS

- Before Practical 1, open the Calculator on one computer and check that Programmer mode is there.
- Make a set of binary cards for every pair before Practical 4. Old greeting cards are strong and free.
- Say "the base tells the family" every time you write a subscript. Soon the class says it with you.



TEACHER GUIDE

Class Marks Record

Copy this page for each class

No	Student name	Ch 1 (38)	Ch 2 (40)	Ch 3 (37)	Ch 4 (38)	Ch 5 (44)	Test (40)	Total (237)
1								
2								
3								
4								
5								
6								
7								
8								
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10								
11								
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26								
27								
28								
29								



TEACHER GUIDE

Practicals at a Glance

Workbook activities 1.1 to 1.5

Activity	Students do	Check that ...
1.1	Number systems on the Calculator	they opened Menu - Programmer and filled the table: HEX 0 to 9 and A to F (base 16); DEC 0 to 9 (base 10); OCT 0 to 7 (base 8); BIN 0 and 1 (base 2).
1.2	A counting frame	they showed 231, 123, 312 and 321 with beads; 321 has the highest value; the expanded form is right.
1.3	Convert and check	each division ladder is right and matches the BIN line of the Calculator; $100 = 1100100$.
1.4	Binary cards	the cards are in the order 16, 8, 4, 2, 1; $10111 = 23$, $10010 = 18$, $11111 = 31$.
1.5	Human light bulbs	hands up = 1 and hands down = 0; $01001 = 9$; $13 = 01101$; $A = 1000001$.

Textbook links

Workbook	Textbook (Grade 8, Unit 1)	Activity
Chapter 1 - Number systems and their bases	pages 1 - 3 (1.1 - 1.3)	1.1
Chapter 2 - Decimal and binary numbers	pages 3 - 4 (1.4, 1.5)	1.2
Chapter 3 - Converting decimal to binary	pages 4 - 6 (1.6, 1.6.1)	1.3
Chapter 4 - Converting binary to decimal	pages 6 - 7 (1.6.2)	1.4
Chapter 5 - How the computer uses binary	pages 8 - 10 (1.7)	1.5
Unit 1 in One Page	page 10 (Summary)	-

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

Ask the class ...	Answer
1. How many symbols does the binary number system have?	Two (0 and 1)
2. What is the base of the octal number system?	8
3. Which number system uses the symbols A to F?	Hexadecimal
4. Where do we write the base of a number?	Right end, subscript
5. What is a bit?	A binary digit
6. What is 2^3 ?	8
7. What is 1010_2 in decimal?	10
8. What is 6 in binary?	110
9. Is ON shown by 1 or by 0?	1
10. Where is data saved permanently?	Hard disk

★ TEACHING TIP

- Buttons, seeds or bottle caps on a drawn frame work as well as a real counting frame.



ANSWERS

Chapter 1

Number systems and their bases

A Check the symbols

6 marks

1. 1101_2 YES (1 and 0 are binary symbols)	2. 1201_2 NO (2 is not a binary symbol)
3. 75_8 YES (7 and 5 are octal symbols)	4. 78_8 NO (8 is not an octal symbol)
5. $9A_{10}$ NO (A is not a decimal symbol)	6. $9A_{16}$ YES (both are hexadecimal symbols)

B Fill in the blanks

6 marks

1. languages	2. numbers	3. method
4. symbols	5. base	6. subscript

C Complete the table

8 marks

Number system	Symbols	Base
Binary	0, 1	2
Octal	0, 1, 2, 3, 4, 5, 6, 7	8
Decimal	0, 1, 2, 3, 4, 5, 6, 7, 8, 9	10
Hexadecimal	0 to 9 and A, B, C, D, E, F	16

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

D Which number system?

8 marks

The number	Binary	Octal	Decimal	Hexadecimal
1011_2	☒	☐	☐	☐
365_{10}	☐	☐	☒	☐
$9C_{16}$	☐	☐	☐	☒
640_8	☐	☒	☐	☐
100_{10}	☐	☐	☒	☐
$A5_{16}$	☐	☐	☐	☒
17_8	☐	☒	☐	☐
100_2	☒	☐	☐	☐

E True or false

6 marks

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



F Answer these

4 marks

1. What is a number system? (2 marks)

A number system is a method that can be used to represent numbers. Each number system has a fixed number of different symbols. 2 marks for this idea.

2. What does the base of a number show? Give one example. (2 marks)

The base shows to which number system the number belongs. Example: 101_2 is a binary number, 47_{10} is a decimal number. 1 mark for the idea, 1 mark for a correct example.

ANSWERS

Chapter 2

Decimal and binary numbers

A Lowest to highest

6 marks

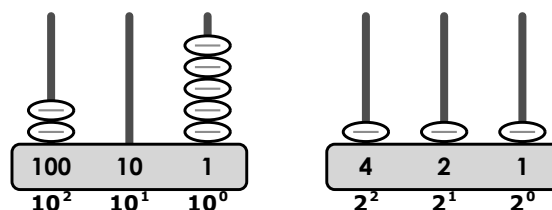
258 < 285 < 528 < 582 < 825 < 852

1 mark for each number in the right place.

B Counting frames

4 marks

- 312_{10}
- 110_2
- 205_{10} : 2, 0 and 5 beads
- 111_2 : 1 bead on each rod



Frames 1 and 2 need the base as well. 1 mark each.

C Value of the underlined digit

6 marks

1. $4\underline{7}2_{10}$: $7 \times 10 = \mathbf{70}$	2. $\underline{3}18_{10}$: $3 \times 100 = \mathbf{300}$	3. $90\underline{6}_{10}$: $6 \times 1 = \mathbf{6}$
4. $\underline{1}01_2$: $1 \times 4 = \mathbf{4}$	5. $1\underline{1}1_2$: $1 \times 2 = \mathbf{2}$	6. 100_2 : $0 \times 1 = \mathbf{0}$

1 mark each. The value alone (70, 300 ...) is enough.

D Write in expanded form

8 marks

- $352_{10} = 3 \times 10^2 + 5 \times 10^1 + 2 \times 10^0 = 300 + 50 + 2$
- $608_{10} = 6 \times 10^2 + 0 \times 10^1 + 8 \times 10^0 = 600 + 0 + 8$
- $110_2 = 1 \times 2^2 + 1 \times 2^1 + 0 \times 2^0 = 4 + 2 + 0 = 6_{10}$
- $100_2 = 1 \times 2^2 + 0 \times 2^1 + 0 \times 2^0 = 4 + 0 + 0 = 4_{10}$

2 marks each: 1 mark for the first line, 1 mark for the values.



E Fill in the blanks

6 marks

1. decimal	2. arithmetic	3. place value
4. two	5. bits	6. digit

F True or false

6 marks

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

G Answer these

4 marks

1. What is a bit? (2 marks)

A bit is a binary symbol: 0 or 1. Bit = binary digit. 2 marks.

2. What do 10^0 , 10^1 and 10^2 show in a decimal number? (2 marks)

They show the place values of the decimal symbols: $10^0 = 1$ (ones), $10^1 = 10$ (tens), $10^2 = 100$ (hundreds). 2 marks.

ANSWERS

Chapter 3

Converting decimal to binary

A Put the steps in order

7 marks

The numbers the student writes, from the top of each list down:

A: 3, 1, 2 B: 4, 1, 3, 2

So the right order is: A - press 9, the processor reads 00001001, the monitor shows 9. B - divide by 2, write the remainder, divide the quotient again, write the remainders from the bottom to the top.

B Complete the table

6 marks

Division	Quotient	Remainder
$26 \div 2$	13	0
$13 \div 2$	6	1
$6 \div 2$	3	0
$3 \div 2$	1	1
$1 \div 2$	0	1

$$26_{10} = 11010_2$$

1 mark for each row, 1 mark for the binary answer.



TIP: A torch switched on and off is a quick way to show ON = 1 and OFF = 0.



C Convert to binary

12 marks

1. $6_{10} = 110_2$	2. $10_{10} = 1010_2$	3. $19_{10} = 10011_2$
4. $25_{10} = 11001_2$	5. $40_{10} = 101000_2$	6. $57_{10} = 111001_2$

2 marks each: 1 mark for a correct division ladder, 1 mark for the answer.

D Complete the division ladders

6 marks

1. 22_{10} : the empty boxes are 5 and 1; $22_{10} = 10110_2$
2. 37_{10} : the empty boxes are 0 and 4; $37_{10} = 100101_2$

1 mark for each empty box, 1 mark for each binary number.

E Answer these

6 marks

1. Why is converting from one number system to another important? (2 marks)

All input fed into the computer is kept in binary form. For example, a decimal number typed on the keyboard is kept as binary inside the computer ($9 = 00001001$) and shown again as a decimal number on the screen. 2 marks for this idea.

2. Amali is 14 years old. Write her age as a binary number. Show your working. (2 marks)

$14 \div 2 = 7 \text{ r } 0$; $7 \div 2 = 3 \text{ r } 1$; $3 \div 2 = 1 \text{ r } 1$; $1 \div 2 = 0 \text{ r } 1$. Read from the bottom:
 $14_{10} = 1110_2$. 1 mark for the working, 1 mark for the answer.

3. Kasun converted 11_{10} to binary. His remainders from the top to the bottom were 1, 1, 0 and 1, so he wrote $11_{10} = 1101_2$. What was his mistake? Write the correct answer. (2 marks)

He read the remainders from the top to the bottom. They must be read from the bottom to the top: $11_{10} = 1011_2$. 1 mark for the mistake, 1 mark for the answer.

★ **TIP:** After every conversion, ask students to check it the other way round: binary back to decimal.

ANSWERS

Chapter 4

Converting binary to decimal

A Powers of 2

6 marks

1. $2^2 = 4$	2. $2^3 = 8$	3. $2^5 = 32$
4. $2^6 = 64$	5. $2^7 = 128$	6. $2^{10} = 1024$



B Use the place value chart

8 marks

Binary number	128	64	32	16	8	4	2	1	Decimal value
1001 ₂					1	0	0	1	9
101010 ₂			1	0	1	0	1	0	42
1100100 ₂		1	1	0	0	1	0	0	100
11111111 ₂	1	1	1	1	1	1	1	1	255

1 mark for the bits in the right places, 1 mark for the decimal value.

C Write in expanded form

6 marks

- $1011_2 = 1 \times 2^3 + 0 \times 2^2 + 1 \times 2^1 + 1 \times 2^0 = 8 + 0 + 2 + 1 = 11_{10}$
- $10101_2 = 1 \times 2^4 + 0 \times 2^3 + 1 \times 2^2 + 0 \times 2^1 + 1 \times 2^0 = 16 + 0 + 4 + 0 + 1 = 21_{10}$
- $11010_2 = 1 \times 2^4 + 1 \times 2^3 + 0 \times 2^2 + 1 \times 2^1 + 0 \times 2^0 = 16 + 8 + 0 + 2 + 0 = 26_{10}$

2 marks each: 1 mark for the working, 1 mark for the answer.

D Which is bigger?

6 marks

1. $1010_2 (10) < 12_{10}$	2. $111_2 (7) = 7_{10}$	3. $10000_2 (16) > 15_{10}$
4. $1100_2 (12) > 1010_2 (10)$	5. $11001_2 (25) = 25_{10}$	6. $1111_2 (15) < 10001_2 (17)$

1 mark for each correct sign. The decimal values are in brackets.

E Read the binary cards

8 marks

1. $10001_2 = 16 + 1 = 17_{10}$	2. $11100_2 = 16 + 8 + 4 = 28_{10}$
3. $01101_2 = 8 + 4 + 1 = 13_{10}$	4. $10110_2 = 16 + 4 + 2 = 22_{10}$

1 mark for the binary number (01101 or 1101 are both right), 1 mark for the decimal value.

F Answer these

4 marks

1. Write the place values of the first five places of a binary number, from the right. (2 marks)

1, 2, 4, 8, 16 ($2^0, 2^1, 2^2, 2^3, 2^4$). 2 marks; 1 mark if one value is wrong.

2. Nimal says that 100_2 is one hundred. Is he correct? Explain. (2 marks)

No. The base 2 shows it is a binary number: $100_2 = 1 \times 4 + 0 \times 2 + 0 \times 1 = 4_{10}$. 1 mark for "No", 1 mark for the reason or the working.

★ TEACHING TIP

- Write the powers of 2 on the board at the start of every lesson in Chapter 4.



ANSWERS

Chapter 5

How the computer uses binary

A Read the light bulbs

8 marks

1. $10011_2 = 16 + 2 + 1 = 19_{10}$	2. $01110_2 = 8 + 4 + 2 = 14_{10}$
3. $11000_2 = 16 + 8 = 24_{10}$	4. $00101_2 = 4 + 1 = 5_{10}$

1 mark for the binary number, 1 mark for the decimal value.

B Switch on the bulbs

4 marks

1. $3 = 00011$  2. $12 = 01100$ 

3. $21 = 10101$  4. $30 = 11110$ 

1 mark for each number when exactly the right bulbs are ON.

C Input, processing or output?

6 marks

What happens?	Input	Processing	Output
Feeding text, images and sounds into a computer	☒	☐	☐
Processing data in binary form	☐	☒	☐
Changing binary data back into text, images and sounds	☐	☐	☒
Typing your name on the keyboard	☒	☐	☐
The monitor showing a photo	☐	☐	☒
The microprocessor working on the binary data	☐	☒	☐

D Label the diagram

6 marks

1. system unit	2. digital camera	3. microprocessor
4. monitor	5. keyboard	6. main memory

E True or false

6 marks

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

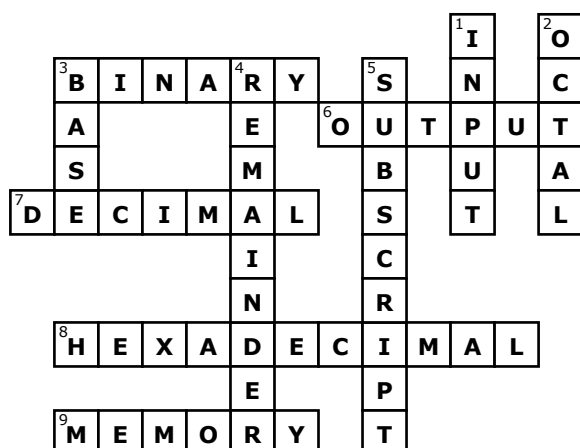
★ TEACHING TIP

- Remind students that the remainder is always 0 or 1 when we divide by 2.



F Crossword

10 marks



Across: 3 BINARY, 6 OUTPUT, 7 DECIMAL, 8 HEXADECIMAL, 9 MEMORY

Down: 1 INPUT, 2 OCTAL, 3 BASE, 4 REMAINDER, 5 SUBSCRIPT

G Answer these

4 marks

1. How does a computer use ON and OFF states? (2 marks)

The computer uses ON (1) and OFF (0) states to represent data and instructions as a bit pattern of 1s and 0s. 2 marks.

2. Write TWO activities in a computer that are carried out using 0s and 1s. (2 marks)

Any two, 1 mark each: input of data from input devices (camera, keyboard); saving data temporarily in the main memory; saving data permanently on the hard disk; processing data; sending information to the output devices.

MARKING SCHEME

Unit 1 Test

Total 40 marks

1 Choose the correct answer

8 marks (1 each)

1. (a) number system	2. (a) 2
3. (c) 10	4. (d) $7B_{16}$
5. (a) binary digit	6. (c) 13
7. (a) 10100	8. (b) 0

2 Fill in the blanks

8 marks (1 each)

1. base	2. subscript	3. octal	4. decimal
5. place	6. 2 (two)	7. 1	8. memory



3 Complete the chart

8 marks (1 each)

1. $5_{10} = 101_2$	2. $12_{10} = 1100_2$	3. $111_2 = 7_{10}$	4. $1001_2 = 9_{10}$
5. $18_{10} = 10010_2$	6. $10101_2 = 21_{10}$	7. $30_{10} = 11110_2$	8. $100000_2 = 32_{10}$

4 Answer these

16 marks

1. What is a number system? (2 marks)

A method that can be used to represent numbers (each number system has a fixed number of different symbols). 2 marks.

2. Write the symbols and the base of the binary and the decimal number systems. (4 marks)

Binary: symbols 0 and 1 (1), base 2 (1). Decimal: symbols 0 to 9 (1), base 10 (1).

3. Convert 45_{10} to a binary number. Show your working. (3 marks)

$45 \div 2 = 22 \text{ r } 1$; $22 \div 2 = 11 \text{ r } 0$; $11 \div 2 = 5 \text{ r } 1$; $5 \div 2 = 2 \text{ r } 1$; $2 \div 2 = 1 \text{ r } 0$; $1 \div 2 = 0 \text{ r } 1$. $45_{10} = 101101_2$. 2 marks for the working, 1 mark for the answer.

4. Convert 110110_2 to a decimal number. Show your working. (3 marks)

$1 \times 32 + 1 \times 16 + 0 \times 8 + 1 \times 4 + 1 \times 2 + 0 \times 1 = 32 + 16 + 4 + 2 = 54_{10}$. 2 marks for the working, 1 mark for the answer.

5. A user presses 9 on the keyboard. Write what happens in input, processing and output. Use the words binary and decimal. (4 marks)

Input: the user presses 9 (a decimal digit) on the keyboard (1). Processing: the processor keeps and processes it in binary form, as the bit pattern 00001001 (1). Output: the binary is converted back and the monitor shows the decimal number 9 (1). 1 mark for using binary and decimal correctly.

i WHAT STUDENTS USUALLY GET WRONG

- They read the remainders from the top. Read them from the **bottom to the top**.
- They stop dividing too early. Keep dividing until the **quotient is 0**.
- They start the place values on the left. Binary place values start on the **right**: 1, 2, 4, 8 ...
- They think 2^0 is 0. It is **1**.
- They add the place values of the 0s too. Add only where the bit is **1**.
- They forget the base, or write it big. Write it **small**, at the **right end**: 101_2 .
- They read 10_2 as ten. It is **two**.



TIP: Students who finish early can colour the pictures, or make binary numbers for a friend to read.



★ HOMEWORK AND EXTRA PRACTICE

- Write your age, your house number and the day of your birthday in binary.
- Make a set of binary cards at home and teach a family member to read them.
- Find five things at home that are ON or OFF. Which one is a 1 and which one is a 0?
- Fast learners: write the numbers 1 to 16 in binary. What pattern do you see in the last bit?

> SKILLS TEST - 20 MINUTES, 20 MARKS (OPTIONAL)

After the unit, with binary cards and a computer. The answers are in brackets.

Step	The student must ...	Marks
1	Show 19 with the binary cards and write the binary number (10011).	2
2	The teacher shows 11010 with the cards. Say the decimal value (26).	2
3	Convert 27 to binary with a division ladder (11011).	3
4	Check it on the Calculator: Programmer, DEC , type 27, read BIN .	2
5	Convert 101100₂ to decimal with place values (44).	3
6	Check it on the Calculator: click BIN , type 101100, read DEC .	2
7	Draw five bulbs and switch on the bulbs that show 6 (00110).	2
8	On the Calculator, find 47 in HEX, OCT and BIN (2F, 57, 101111).	3
9	Say what happens in input, processing and output.	1
	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; check with the Calculator.

Decimal to binary	Answer	Binary to decimal	Answer
15 ₁₀	1111₂	1010 ₂	10₁₀
24 ₁₀	11000₂	10111 ₂	23₁₀
33 ₁₀	100001₂	101011 ₂	43₁₀
50 ₁₀	110010₂	111111 ₂	63₁₀
64 ₁₀	1000000₂	1000001 ₂	65₁₀
99 ₁₀	1100011₂	10000000 ₂	128₁₀

★ TEACHING TIPS

- Ask students to find their age and their house number in binary. They love to share them.
- Show a counting frame with a rod that has no beads. A 0 still keeps its place.

