Grade 12 A/L ICT · Lesson 3

Lesson 3 A/L Exam Practice: Questions and Answers

These questions follow the style of the G.C.E. A/L ICT exam. **Paper I** has 30 multiple choice questions with five options (1)–(5) shown here as A–E. **Paper II Part A** has structured questions and **Part B** has essay questions. Every question has a model answer and marking points. They cover all of Competency 3 (3.1–3.3): number systems and conversions, signed numbers, character codes (BCD, EBCDIC, ASCII, Unicode), binary arithmetic and bitwise logic.

Paper I – Multiple choice questions (30)

1. Which decimal number equals 11100101_2?

A. 235
B. 229
C. 217
D. 101
E. 227

2. What is 300_{10} in binary?

A. 10010110
B. 100011100
C. 100101100
D. 110010100
E. 100101101

3. What is 500_{10} in hexadecimal?

A. F41
B. 1F5
C. 764
D. 1F4
E. 1E4

4. What is 101110011_2 in octal?

A. 173
B. 563
C. 571
D. 536
E. B73

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5. What is $A7_{16}$ in octal?

A. 107
B. 724
C. 167
D. 1007
E. 247

6. Which of these values is the largest?

A. 250_{10}
B. FF_{16}
C. 376_{8}
D. FA_{16}
E. 11111110_{2}

7. How many different values can be stored in 10 bits?

A. 1,000
B. 100
C. 1,023
D. 1,024
E. 512

8. What is −100 in 8-bit 2’s complement?

A. 10011101
B. 01100100
C. 10011011
D. 11100100
E. 10011100

9. The 8-bit 1’s complement number 11111010 equals:

A. −6
B. −5
C. −122
D. −4
E. 250

10. The 8-bit sign-magnitude number 10011001 equals:

A. −103
B. −26
C. 25
D. −25
E. 153

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11. What is the range of a 16-bit 2’s complement integer?

A. −32,767 to +32,767

B. 0 to 65,535

C. −32,768 to +32,767

D. −65,536 to +65,535

E. −32,768 to +32,768

12. Which statement about 2’s complement is TRUE?

A. It needs a separate subtract circuit

B. Its MSB is 0 for negative numbers

C. It has +0 and −0

D. It cannot store −128 in 8 bits

E. It has only one zero

13. What is 407 in BCD?

A. 110010111

B. 0001 1001 0111

C. 0111 0000 0100

D. 0100 0000 0111

E. 0100 0111 0000

14. How many bits are needed to store 2026 in BCD?

A. 16

B. 8

C. 12

D. 11

E. 32

15. The ASCII code of “M” is 77. What is the code of “m”?

A. 97

B. 45

C. 109

D. 119

E. 78

16. The ASCII code of the character “5” is:

A. 65

B. 5

C. 48

D. 101

E. 53

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17. How many bytes are needed to store “Sri Lanka” in ASCII?

A. 9
B. 4
C. 18
D. 8
E. 72

18. Which coding scheme was designed by IBM and has non-continuous letters?

A. Unicode
B. UTF-8
C. ASCII
D. BCD
E. EBCDIC

19. Which is the main reason Unicode was introduced?

A. To represent the characters of all languages
B. To store numbers in BCD
C. To speed up the CPU clock
D. To replace binary
E. To make English text smaller

20. How many bytes does the word “ලංකා” (4 code points) take in UTF-8?

A. 12
B. 8
C. 6
D. 4
E. 16

21. Unicode 18.0, released in September 2026, contains about:

A. 128 characters
B. 172,808 characters
C. 1,114,112 characters
D. 256 characters
E. 65,536 characters

22. What is 1101 + 1011 + 0110?

A. 10110
B. 100100
C. 11100
D. 11110
E. 11010

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23. What is 101000 − 011011?

A. 110011
B. 001100
C. 010011
D. 001110
E. 001101

24. In 8-bit 2's complement, 00110000 + 11110110 (ignoring the final carry) gives:

A. 00100110
B. 100100110
C. 00100111
D. 11000110
E. 00111010

25. Which 8-bit 2's complement addition causes overflow?

A. −60 + (−60)
B. 90 + 60
C. 90 + (−60)
D. 100 + 27
E. −100 + 50

26. 11110000 AND 10101010 = ?

A. 01011010
B. 01010000
C. 10100000
D. 11111010
E. 00001111

27. 11110000 XOR 10101010 = ?

A. 01011010
B. 10101111
C. 10100000
D. 00001010
E. 11111010

28. Which operation gives 1 when the two input bits are different?

A. OR
B. NAND
C. NOT
D. XOR
E. AND

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29. To set bit 0 of a byte to 1 without changing the others, use:

A. NOT
B. AND with 11111110
C. OR with 00000001
D. AND with 00000001
E. XOR with 11111111

30. x XOR x always equals:

A. All 1s
B. NOT x
C. All 0s
D. 2x
E. x

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Paper II Part A – Structured questions

1. Number systems. *(8 marks)*

(i) Explain why computers use the binary number system. *(2 marks)*
(ii) Convert 156_{10} to binary, showing your working. *(2 marks)*
(iii) Convert 11010110_2 to hexadecimal and to octal. *(2 marks)*
(iv) Convert $2AF_{16}$ to decimal. *(2 marks)*

2. Signed numbers. *(8 marks)*

(i) Represent −45 in 8-bit sign-magnitude, 1’s complement and 2’s complement. *(3 marks)*
(ii) Find the decimal value of the 8-bit 2’s complement number 11101100. *(2 marks)*
(iii) State the range of 8-bit 2’s complement integers. *(1 marks)*
(iv) Give two reasons why CPUs use 2’s complement. *(2 marks)*

3. Character representation. *(9 marks)*

(i) Write 59 in BCD and in pure binary. *(2 marks)*
(ii) Write “ICT” in 8-bit ASCII binary. *(3 marks)*
(iii) Give the Unicode code point and the UTF-8 bytes of “ද්”. *(2 marks)*
(iv) Give one disadvantage of ASCII and of BCD. *(2 marks)*

4. Binary arithmetic and logic. *(9 marks)*

(i) Add 1011 + 1101 + 0111 showing the carries. *(2 marks)*
(ii) Subtract 11010 − 01011 using borrowing. *(2 marks)*
(iii) Calculate 45 − 20 using 8-bit 2’s complement. *(3 marks)*
(iv) For A = 11001010 and B = 10101100 find A AND B and A XOR B. *(2 marks)*

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Paper II Part B – Essay questions

1. Essay 1 – Number systems in computing. *(11 marks)*

(i) Explain the terms base and place value using decimal, binary, octal and hexadecimal. *(4 marks)*
(ii) Convert 2026_{10} to binary, octal and hexadecimal and explain the grouping method. *(4 marks)*
(iii) Give three real uses of hexadecimal in ICT. *(3 marks)*

2. Essay 2 – Signed numbers and arithmetic. *(10 marks)*

(i) Compare sign-magnitude, 1’s complement and 2’s complement using −20 in 8 bits. *(4 marks)*
(ii) Show how a CPU calculates 45 − 20 with an adder only. *(3 marks)*
(iii) Explain overflow with the example 100 + 50 in 8 bits. *(3 marks)*

3. Essay 3 – Character codes and bitwise logic. *(11 marks)*

(i) Compare BCD, EBCDIC, ASCII and Unicode by bits used, number of characters and one use each. *(4 marks)*
(ii) Explain why Unicode is important for Sinhala and Tamil users. *(3 marks)*
(iii) Describe AND, OR, XOR and NOT with a truth table and one use of a mask. *(4 marks)*

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Exam tips

- Decimal → base n: divide by n, read remainders bottom to top.
- Base n → decimal: digit × place value, then add.
- Octal = 3 bits per digit; hex = 4 bits per digit; group from the right.
- Octal ↔ hex: always go through binary.
- MSB is the sign bit: 0 positive, 1 negative.
- 2’s complement = flip all bits + 1; 8-bit range −128 to +127.
- BCD: each digit in 4 bits; 1010–1111 not used.
- ASCII: A = 65, a = 97, 0 = 48, space = 32; small = capital + 32.
- EBCDIC: IBM, 8 bits, A = C1 hex.
- Unicode: U+ code points; UTF-8 1–4 bytes; Sinhala U+0D80–U+0DFF.
- 1 + 1 = 0 carry 1; 0 − 1 = 1 borrow 1; A − B = A + 2’s complement of B.
- Overflow: two positives give a negative or two negatives give a positive.

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Answers and explanations

Paper I

1. **B** – 128+64+32+4+1 = 229.
2. **C** – 256 + 32 + 8 + 4 = 300.
3. **D** – 500 = 1×256 + 15×16 + 4.
4. **B** – 101 110 011 = 5 6 3.
5. **E** – 1010 0111 → 010 100 111 = 247.
6. **B** – FF = 255; the others are 254, 254, 250, 250.
7. **D** – 2^{10} = 1,024.
8. **E** – +100 = 01100100, flip = 10011011, +1 = 10011100.
9. **B** – Flip: 00000101 = 5, so −5.
10. **D** – Sign 1, size 0011001 = 25.
11. **C** – -2^{15} to $2^{15} - 1$.
12. **E** – One zero; −128 to +127.
13. **D** – 4 = 0100, 0 = 0000, 7 = 0111.
14. **A** – 4 digits × 4 bits.
15. **C** – 77 + 32 = 109.
16. **E** – “0” = 48, so “5” = 53.
17. **A** – 9 characters including the space.
18. **E** – A–I, J–R, S–Z are separate runs.
19. **A** – ASCII could not hold other scripts.
20. **A** – Each Sinhala code point = 3 bytes.
21. **B** – 1,114,112 is the code space, not the characters assigned.
22. **D** – 13 + 11 + 6 = 30 = 11110.
23. **E** – 40 − 27 = 13 = 001101.
24. **A** – 48 + (−10) = 38 = 00100110.
25. **B** – 150 > 127; −120 and 127 fit.
26. **C** – Keep the left 4 bits of B.
27. **A** – 1 where bits differ.
28. **D** – XOR = exclusive OR.
29. **C** – OR sets bits.
30. **C** – Equal bits give 0.

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Paper II Part A – model answers and marking points

1. *(8 marks)*

(i) (2 marks)
Circuits have two stable states, on/off (1); two states are reliable and easy to detect (1).

(ii) (2 marks)
Repeated division by 2 (1); 10011100_2 (1).

(iii) (2 marks)
$D6_{16}$ (1); 326_8 (1).

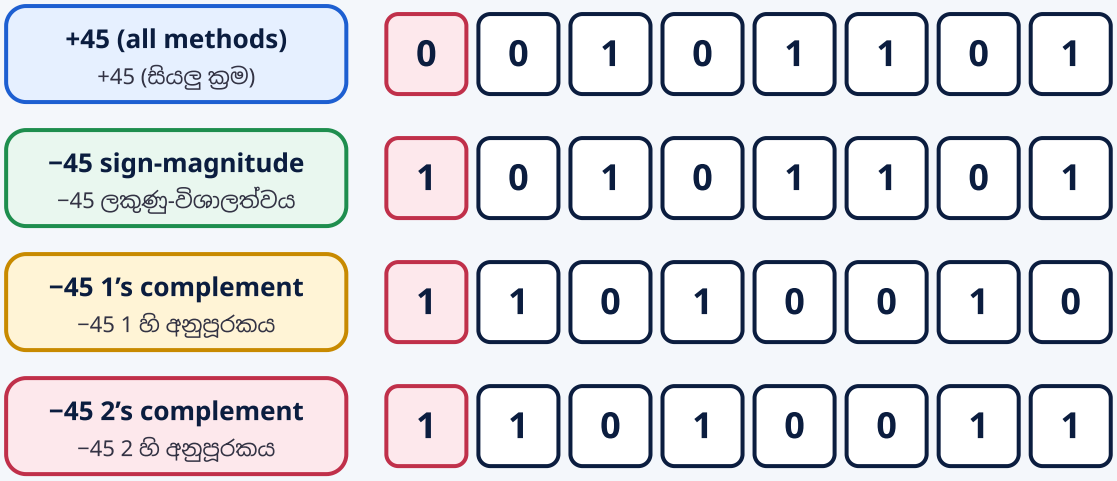
(iv) (2 marks)
2×256 + 10×16 + 15 (1); = 687 (1).

🎯 Examiner tip: always show the division or the place values – the working earns marks.

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2. *(8 marks)*

(i) (3 marks)
10101101 (1); 11010010 (1); 11010011 (1).



Three ways to store −45 in 8 bits.

(ii) (2 marks)
MSB 1, negative; flip and add 1 = 20 (1); −20 (1).

(iii) (1 marks)
−128 to +127 (1).

(iv) (2 marks)
Only one zero (1); the same adder does subtraction (1).

🎯 Examiner tip: write all 8 bits – dropping leading zeros loses the sign bit.

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3. *(9 marks)*

(i) (2 marks)
BCD 0101 1001 (1); binary 111011 (1).

(ii) (3 marks)
I = 01001001 (1); C = 01000011 (1); T = 01010100 (1).

(iii) (2 marks)
U+0D85 (1); E0 B6 85 (1).



From a Sinhala letter to stored bits.

(iv) (2 marks)
ASCII – only 128 characters, no Sinhala (1); BCD – wastes codes 1010–1111 (1).

🎯 Examiner tip: in BCD keep each digit as a separate group of 4 bits.

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4. *(9 marks)*

(i) (2 marks)
Carries shown (1); 11111 (1).

(ii) (2 marks)
Borrows shown (1); 01111 (1).

(iii) (3 marks)
−20 = 11101100 (1); add to 00101101 (1); drop carry = 00011001 (1).

(iv) (2 marks)
10001000 (1); 01100110 (1).

A A	1	1	0	0	1	0	1	0
B B	1	0	1	0	1	1	0	0
A AND B A AND B	1	0	0	0	1	0	0	0
A OR B A OR B	1	1	1	0	1	1	1	0
A XOR B A XOR B	0	1	1	0	0	1	1	0
NOT A NOT A	0	0	1	1	0	1	0	1

MSB = sign
Each bit is worked out on its own, column by column

Bitwise operations on A and B.

🎯 Examiner tip: check every arithmetic answer by converting to decimal.

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Paper II Part B – model answers and marking points

1. *(11 marks)*

> **(i)** (4 marks)
> Base = number of digits (1); bases 10, 2, 8, 16 (1); place value = power of the base (1); example such as $345_8 = 3\times64 + 4\times8 + 5$ (1).

> **(ii)** (4 marks)
> 11111101010_2 (1); 3752_8 (1); $7EA_{16}$ (1); 3 bits per octal digit, 4 per hex digit, from the right (1).

> **(iii)** (3 marks)
> Web colour codes such as #1D5FD1 (1); memory addresses (1); MAC or IPv6 addresses (1).

🎯 Examiner tip: an essay with worked numbers gets more marks than words only.

2. *(10 marks)*

> **(i)** (4 marks)
> SM 10010100 (1); 1's 11101011 (1); 2's 11101100 (1); two zeros in SM and 1's, one in 2's (1).

> **(ii)** (3 marks)
> 2's complement of 20 (1); add 00101101 + 11101100 = 100011001 (1); drop 9th bit = 00011001 = 25 (1).

> **(iii)** (3 marks)
> Range −128 to +127 (1); 10010110 read as −106 (1); two positives gave a negative (1).

🎯 Examiner tip: always state the number of bits before you show a signed number.

3. *(11 marks)*

> **(i)** (4 marks)
> BCD 4 bits, digits 0–9, calculators (1); EBCDIC 8 bits, 256, IBM mainframes (1); ASCII 7 bits, 128, English text (1); Unicode up to 32 bits, over 172,808 characters, all languages (1).

> **(ii)** (3 marks)
> Own code points for each script (1); text works the same on every device (1); searchable and shareable on the web (1).

> **(iii)** (4 marks)
> Truth table for AND and OR (1); XOR and NOT (1); bitwise works bit by bit with no carry (1); mask use such as subnet mask AND or OR 00100000 for lower case (1).

🎯 Examiner tip: comparison essays score best as a neat table.

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