

Cambridge International AS & A Level

COMPUTER SCIENCE

9618/12

Paper 1 Theory Fundamentals

May/June 2025

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- 2 (a) Convert the denary integer 558 into 12-bit binary and hexadecimal.

Binary

Hexadecimal

- (b) (i) Convert the two's complement binary integer 11100010 into denary.

.....

- (ii) Write the smallest and the largest two's complement binary integers that can be represented in 8 bits.

Smallest

Largest

(c) Give **one** application where Binary Coded Decimal (BCD) is used and justify its use.

Application

Justification

Solution:

(a)

Step 1: Convert 558 to Binary

Divide 558 by 2 repeatedly:

Division	Quotient	Remainder
$558 \div 2$	279	0
$279 \div 2$	139	1
$139 \div 2$	69	1
$69 \div 2$	34	1
$34 \div 2$	17	0
$17 \div 2$	8	1
$8 \div 2$	4	0
$4 \div 2$	2	0
$2 \div 2$	1	0
$1 \div 2$	0	1

Reading the remainders from bottom to top gives:

$$558_{10} = 1000101110_2$$

Since a 12-bit binary number is required, add leading zeros:

$$558_{10} = 001000101110_2$$

Step 2: Convert Binary to Hexadecimal

Group the binary number into groups of 4 bits:

0010 0010 1110

Convert each group:

Binary	Hex
0010	2
0010	2
1110	E

Therefore:

$$558_{10} = 22E_{16}$$

(b)(i)

Step 1: Check the Most Significant Bit (MSB)

The binary number is:

11100010

The leftmost bit is **1**, so the number is **negative**.

Step 2: Find the Magnitude

Invert all the bits

```
11100010
↓
00011101
```

Add 1

```
00011101
+      1
-----
00011110
```

Step 3: Convert to Decimal

00011110_2

$= 16 + 8 + 4 + 2$

$= 30$

Step 4: Apply the Negative Sign

The original number was negative, so:

Denary = -30

Final Answer

11100010_2 (two's complement) = -30_{10}

(ii)

For an 8-bit two's complement number:

- The **smallest (most negative)** value is **-128**, represented by:

10000000

- The **largest (most positive)** value is **+127**, represented by:

01111111

Final Answer

Smallest: 10000000

Largest: 01111111

(c)

Application:

Digital clock

Justification:

BCD stores each decimal digit separately, making it easy to display numbers directly on devices such as 7-segment displays without converting binary to decimal. This reduces errors and simplifies the display process.