Computers manipulate binary patterns. Patterns can represent signed or unsigned integers.

(i) Convert the denary number 57 to 8-bit binary.

(2)

 (ii) Convert the binary number 0010 1101 to hexadecimal.

(2)

(iii)
In arithmetic, subtraction can be done by adding a negative number.

Calculate 18 − 8, using 8-bit binary and two's complement.

Convert the result back to denary.

Show all your working.

(4)

(iv)
Complete the table to show the result of the 8-bit binary addition.

0	1	0	0	0	0	0	1
0	1	1	0	0	1	1	0

(2)

(v).
Construct an expression to calculate the file size, in mebibytes, of a CD quality (44.1 KHz, bit depth of 16), two-channel stereo soundtrack that is 4 minutes long.

You do **not** need to carry out the calculation.

(4)

 (vi) Explain why hexadecimal notation is used.

(2)

(vii)Convert the denary number −33 to 8-bit binary using two's complement.

(2)

(viii) Identify the result of a single logical shift left on the 8-bit binary pattern 0101 0101.   (1)
   A   Addition **B**   Division **C**   Multiplication **D** Subtraction

ANSWERS

1. Convert the denary number 57 to 8-bit binary.

128 64 32 16 8 4 2 1

0   0   1   1   0 0 0 1   32 + 16 + 8 + 1 = 57

2. Convert the binary number 0010 1101 to hexadecimal

Split into nibbles 0010   1101

Convert to denary

8 4 2 1   8 4 2 1

0010 = 2   1 1 0 1 = 8+4+1 = 13

Hex = 0-9, A=10, B=11, C=12, D=13,E=14,F=15

The answer is 2D

3. Calculate 18 - 8, using 8-bit binary and two's complement.

18 = 00010010 (16 + 2)

-8 = start with +8 00001000

Copy down all the bits up to and including the first 1, starting on the right (the LSB). Then flip the rest.

11111000 = -8

Add the 2

00010010
11111000 +

00001010   Check the answer…..this is 10. 18-8 is 10 so it is correct.

4. Binary rules: 0+0=0, 0+1=1, 1+1=0 carry 1, 1+1+1 = 1 carry 1
   Answer is 10100111

5. Sound file size in bits = sample rate (in Hertz) * time (in seconds) * bit depth

   44100 (Hz) * 240 (seconds) * 16 (bit depth) = size in bits.
   Now convert to MiB
   44100 (Hz) * 240 (seconds) * 16 (bit depth)
           1024 * 1024 * 8

6. Hexadecimal is used to make it easier for humans to handle large binary numbers since 8 bits in binary (base 2) is represented in only 2 characters in hex (base 16).

7. Start with +33 and convert to binary. Then copy down the bits from the right hand side up to and including the first 1, then flip the rest. Check your answer! **11011111**