

Unit 6: Data Types (A Level Only Content)

Marks: /36

Answer **all** the questions.

1(a). Convert the denary number -8 to:

(i) An 8-bit sign and magnitude binary number.

----- [1]

(ii) An 8-bit two's complement binary number.

----- [1]

- (b). A computer represents floating point binary numbers using a 6-bit mantissa and 4-bit exponent, both using two's complement.

Add the following three numbers together and give the answer in the format described. You must show your working.

010100 0010

011000 0001

100010 0010

[6]

- 2(a). State which bitwise manipulation on 00010101 would have achieved the same result as the calculation on part (a).

[1]

- (b). Two equal (unsigned) integers, shown below, are added together. Calculate the result, showing your working.

$$\begin{array}{r} 00010101 \\ 00010101 \end{array} +$$

[2]

- 3(a). An AND operation with the mask 10101010 is applied to the binary number 01010101. Show the result.

01010101

10101010 AND

[1]

- (b). An OR operation with the mask 10101010 is applied to the binary number 01010101. Show the result.

01010101

10101010 OR

[1]

4. Two floating point numbers are shown below. Calculate the answer of the second number subtracted from the first. You must show your working and ensure your answer is normalised.

01001100 0011 - 01001010 0010

[5]

5(a). The XOR operator can be used to encrypt data.

Show the effect of applying XOR on Text and Key, by completing the last row of the table below.

Text	O								C								R							
Value	0	1	0	0	1	1	1	1	0	1	0	0	0	0	1	1	0	1	0	1	0	0	1	0
Key	A								B								C							
Value	0	1	0	0	0	0	0	1	0	1	0	0	0	0	1	0	0	1	0	0	0	0	1	1
XOR																								

[2]

(b). Show the effect of applying XOR on your answer to part (a) and Key, by completing the first and last rows of the table below.

(a)																								
Key	A								B								C							
Value	0	1	0	0	0	0	0	1	0	1	0	0	0	0	1	0	0	1	0	0	0	0	1	1
XOR																								

[2]

(c). Explain whether the type of encryption described above is symmetric or asymmetric.

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[2]

(d). Explain why asymmetric encryption is more suited to transactions over the internet than symmetric encryption.

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[4]

6(a). Show a representation of denary -119 in 8-bits using:

(i) Sign and Magnitude

----- [1]

(ii) Two's Complement

----- [1]

(b). A floating point number is represented with a mantissa of 8-bits followed by an exponent of 4-bits, both in two's complement.

00011010 0010

(i) Identify whether or not the number is normalised.

----- [1]

(ii) State how you arrived at your answer to part (i).

----- [1]

7. Explain how, using bit shift, the unsigned binary number 00101100 can be divided by 4.

----- [2]

8. 00001100 is shifted two places to the left.

- (i) Show the result.

----- [1]

- (ii) Identify what arithmetic operation this shift is equivalent to.

----- [1]

END OF QUESTION PAPER

Question			Answer/Indicative content	Marks	Guidance
	c		Symmetric (1) as the same key is used to decrypt it as encrypt it (1)	2	Allow FT for asymmetric if (b) indicates asymmetric encryption used
	d		Any four from: Symmetric encryption would require both parties to have copy of the key (1) this couldn't be transmitted over the internet or an eavesdropper monitoring the message may see it (1) Asymmetric gets round this requirement as there are two different keys (1) One key encrypts the data (1) which can be publically distributed (1) and a different key to decrypt it (1) which is kept private (1)	4	
			Total	10	
6	a	i	11110111	1	
		ii	10001001	1	
	b	i	Not Normalised	1	
		ii	(Mantissa) Starts with 00 (normalised numbers start 01 or 10)	1	
			Total	4	
7			Shift Right (1) Two Places (1)	2 (AO1.2)	Allow one mark for correct number of places but wrong direction. Examiner's Comments Generally most candidates stated that two bit shifts were required but some went on to state the incorrect direction i.e. left.
			Total	2	

Question			Answer/Indicative content	Marks	Guidance
8		i	00110000	1	
		ii	Multiplying by 4	1	
			Total	2	