Chapter 1:

Binary systems and hexadecimal

Question 1 (Practice Question ☺)

Convert the following

#	Binary to Denary	Denary to binary	Binary to hex	Hex to binary	Denary to hex	Hex to Denary
1	11001011	213	11001100	45	233	5A
2	00110101	9	11110001	FA	21	CC
3	10000011	67	00110001	5D	9	97
4	10001111	99	11000010	99	75	40
5	11100011	23	10100100	03	188	07
6	00000100	143	10100111	6B	56	3D
7	00010010	6	11101100	DD	4	F1
8	00111111	1	11111100	FE	121	FB
9	10101010	197	00111111	22	94	82
10	01010101	252	00000011	18	201	E4

Answers:

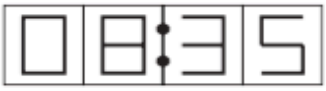
#	Binary to Denary	Denary to binary	Binary to hex	Hex to binary	Denary to hex	Hex to Denary
1	203	11010101	CC	01000101	E9	90
2	53	00001001	F1	11111010	5	204
3	131	01000011	31	01011101	09	151
4	143	01100011	C2	10011001	4B	64
5	227	00010111	A4	00000011	BC	7
6	4	10001111	A7	01101011	38	61
7	18	00000110	EC	11011101	04	241
8	63	00000001	FC	11111110	79	251
9	170	11000101	3F	00100010	5E	130
10	85	11111100	03	00011000	C9	228

Question 2 (Spec 2016)

4 A digital alarm clock is controlled by a microprocessor. It uses the 24-hour clock system (i.e. 6 pm is 18:00).

Each digit in a typical display is represented by a 4-digit binary code.

For example:



(clock display)

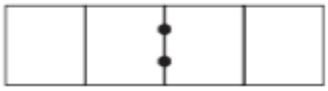
is represented by:

0	0	0	0	1st digit (0)
1	0	0	0	2nd digit (8)
0	0	1	1	3rd digit (3)
0	1	0	1	4th digit (5)

(a) What time is shown on the clock display if the 4-digit binary codes are:

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

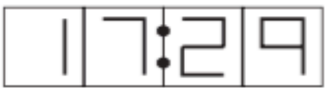
→



(clock display)

[2]

(b) What would be stored in the 4-digit binary codes if the clock display time was:



→

				1st digit
				2nd digit
				3rd digit
				4th digit

[4]

Question 3 (Spec 2016)

13 When a key is pressed on the keyboard, the computer stores the ASCII representation of the character typed into main memory.

The ASCII representation for A is 65 (denary), for B is 66 (denary), etc.

There are two letters stored in the following memory locations:

Location 1	A
Location 2	C

(a) **(i)** Show the contents of Location 1 and Location 2 as binary.

Location 1 ....

Location 2 .... [2]

(ii) Show the contents of Location 1 and Location 2 as hexadecimal.

Location 1 ....

Location 2 .... [2]

(b) The following machine code instruction is stored in a location of main memory:

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

Convert this binary pattern into hexadecimal.

.... [4]

(c) Explain why a programmer would prefer to see the contents of the locations displayed as hexadecimal rather than binary, when debugging his program that reads the key presses.

....

....

....

.... [2]

Question 4 (June 2015 12)

9 Draw a line to connect each question to the correct answer.

Question	Answer
What is the denary (base 10) equivalent to the hexadecimal digit **E**?	**8**
If 1 GB = 2^X then what is the value of X?	**12**
How many bits are there in one byte?	**14**
If the broadband data download rate is 40 megabits per second, how many seconds will it take to download a 60 MB file?	**19**
What is the denary (base 10) value of the binary number 0 0 1 0 0 1 0 0 ?	**30**
What hexadecimal value is obtained when the two hexadecimal digits **C** and **D** are added together?	**36**

[5]

Question 5 (June 2015 12)

10 Letters from the alphabet are represented in a computer by the following denary (base 10) values:

A = 97
G = 103
I = 105
L = 108
N = 110

The word "**A L I G N**" is stored as: 97 108 105 103 110

(a) Convert each of the five values to binary. The first one has been done for you.

Letter	**Denary value**							
A (97):	**0**	**1**	**1**	**0**	**0**	**0**	**0**	**1**
L (108):								
I (105):								
G (103):								
N (110):								

[2]

(b) An encryption system works by shifting the binary value for a letter one place to the left. "A" then becomes:

1	**1**	**0**	**0**	**0**	**0**	**1**	**0**

This binary value is then converted to hexadecimal; the hexadecimal value for "A" will be:

C 2

For the two letters "L" and "G", shift the binary values one place to the left and convert these values into hexadecimal:

									hexadecimal
L:									....
G:									....

[4]

Question 6 (Nov 2015 11 Q2)

(a) Convert the hexadecimal number **B5** into binary:

....

Convert the binary number **1 1 1 1 0 1 1 0** into hexadecimal:

.... [2]

(b) Give **two** examples where hexadecimal numbers are used in computer science.

1 ....

....

2 ....

.... [2]

(c) State **two** benefits of using hexadecimal numbers in computer science.

1 ....

....

2 ....

.... [2]

Question 7 (Nov 2015 11)

10 Characters can be represented in a computer by a numerical code.

The following list shows 16 characters with their numerical codes in denary:

a = 97	e = 101	k = 107	t = 116
b = 98	g = 103	m = 109	u = 117
c = 99	h = 104	o = 111	w = 119
d = 100	i = 105	r = 114	

. = 46 (code for the full stop)

Web addresses can be written using hexadecimal rather than denary. Hexadecimal codes are preceded by a % sign. For example, the word "**c a g e**" is written as:

either	99	97	103	101	(in denary)
or	%63	%61	%67	%65	(in hexadecimal)

(a) Complete the conversion of the following web address into hexadecimal:

w	w	w	.	c	i	e	.	o	r	g	.	u	k
%77	%77	%77											

[3]

(b) Complete the web address from the given hexadecimal codes:

%77	%77	%77	%2E	%72	%6F	%63	%6B	%69	%63	%74	%2E	%63	%6F	%6D
w	w	w												

[3]

Question 8 (Nov 2015 12)

4 (a) (i) Convert the following **two** hexadecimal numbers into binary:

F A 7
D 3 E

F A 7												
D 3 E												

[4]

(ii) Now perform the AND (logic) operation on each corresponding pair of binary bits in the two numbers from **part (i)**.

[2]

(iii) Convert your answer in **part (ii)** into hexadecimal.

....

....
[2]

(b) (i) The following code shows HTML 'tag' pairs on either side of the text stating the colour that each creates.

```
<font color " # F F 0 0 0 0 " > RED </font>
<font color " # 0 0 F F 0 0 " > GREEN </font>
<font color " # 0 0 0 0 F F " > BLUE </font>

<font color " #       X       " > YELLOW </font>
<font color " #       Y       " > MAGENTA </font>
<font color " #       Z       " > CYAN </font>
```

Yellow is a combination of red and green, magenta a combination of red and blue and cyan a combination of green and blue.

State what 6-digit hexadecimal values should replace X, Y and Z in the above code.

X ....

Y ....

Z ....
[3]

(ii) Describe how other colours, such as a darker shade of blue, are created.

....

....

....
[2]

(c) 1A – 16 – C5 – 22 – FF – FF is an example of a MAC address.

(i) Identify what the first six and last six hexadecimal digits represent.

First six digits ....

....

....

Last six digits ....

....

....
[2]

(ii) State why MAC addresses are used.

....

....
[1]

Question 9 (Nov 2015 13)

2 Sensors and a microprocessor monitor a car exhaust for high temperature and high carbon monoxide (CO) levels.

(a) Describe how the sensors and microprocessor are used to monitor the temperature and CO levels and warn the driver if either is out of range.

....

....

....

....

....

....

....

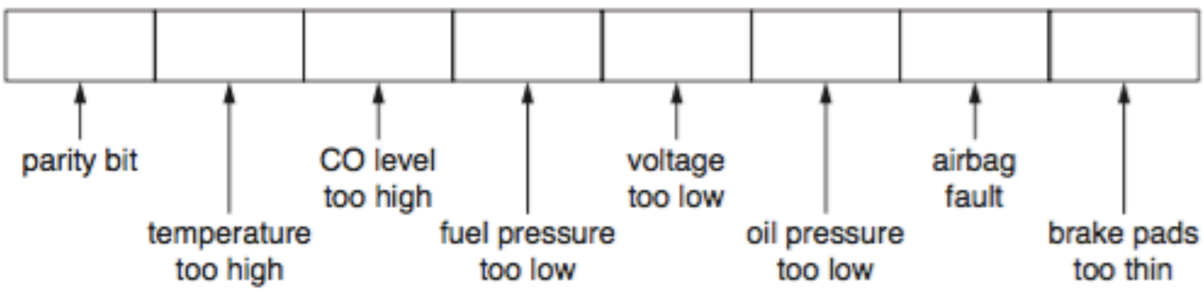
....

....

....

....[5]

(b) The information from seven sensors is sent to an engine management system in the car. The status of each sensor is stored in an 8-bit register; a value of 1 indicates a fault condition:



For example, a register showing **0 1 0 1 1 0 0 0** indicates:

- temperature too high
- fuel pressure too low
- voltage too low

(i) Identify the fault condition(s) that the following register indicates:

0	0	1	0	0	1	0	1

....

....

....[2]

(ii) The system uses **odd** parity.

Write the correct parity bit in each register.

	1	1	1	0	0	1	0

	0	0	0	1	1	1	0

[2]

(iii) A car has a faulty airbag and the CO level is too high.

Write what should be contained in the 8-bit register.

[2]

(iv) Give the hexadecimal value of the binary number shown in **part (iii)**.

....

....[1]

Question 10 (June 2016 11)

2 Hexadecimal codes are used in MAC addresses.

(a) State what is meant by the term MAC.

....[1]

(b) Explain what the hexadecimal code in a MAC address represents.

....

....

....

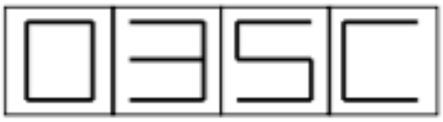
....

....

....[3]

Question 11 (June 2016 11)

7 Each seat on a flight is uniquely identified on an LCD above the seat. For example, seat 035C is shown as:



The first three characters are digits that represent the row.
The fourth character is the seat position in that row. This is a single letter, A to F, that is stored as a hexadecimal value.

Each of the four display characters can be stored in a 4-bit register. For example, 0 and C would be represented as:

	8	4	2	1
0:	**0**	**0**	**0**	**0**
C:	**1**	**1**	**0**	**0**

(a) Show how the 4-bit registers would store the remaining two characters, 3 and 5.

3				

5				

[2]

(b) Identify which seat is stored in the following 4-bit registers.

0	**0**	**0**	**1**	→	....
1	**0**	**0**	**1**	→	....
0	**1**	**0**	**0**	→	....
1	**1**	**1**	**0**	→	....

[2]

Question 12 (June 2016 12)

3 **(a)** Convert the following hexadecimal number into 12-bit binary:

4 A F

[3]

(b) The 2016 Olympic Games will be held in Rio de Janeiro. A timer that counts down to the opening of the Games is shown on a microprocessor-controlled display.

The number of hours, minutes and seconds until the Games open are held in three 8-bit registers.

The present register values are:

0	1	1	0	1	0	0	1	105 hours
0	0	1	0	0	0	0	0	32 minutes
0	0	0	1	0	1	0	0	20 seconds

The timer will count **down** in seconds.

(i) Show the values in each 8-bit register **30 seconds** after the time shown above:

								hours
								minutes
								seconds

[3]

(ii) Write the hexadecimal value of the **minutes** register from **part (b)(i)**.

....[1]

Question 13 (Nov 2016 12)

5 A computer uses an 8-bit register.

The 8-bit register contains binary integers.

(a) Write the denary (base 10) value represented by:

128	64	32	16	8	4	2	1
0	**1**	**1**	**1**	**0**	**0**	**0**	**0**

....[1]

(b) All the bits in the register are shifted **one** place to the **right** as shown below.

0	**1**	**1**	**1**	**0**	**0**	**0**	**0**

0	**0**	**1**	**1**	**1**	**0**	**0**	**0**

Write the denary number that is represented after this shift.

....[1]

(c) State the effect the shift to the right had on the original denary number from **part (a)**.

....[1]

(d) The original number in **part (a)** is shifted **three** places to the **right**.

(i) Show the new binary number:

[1]

(ii) Write the equivalent denary number.

....[1]