1. A variety of goods stored in a warehouse. All goods are bar coded. The number of each item in the warehouse is stored as a binary number.

(a) Change 125 into a binary number stored in an 8 bit byte. Show your working.

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Your Answer: ( )$_2$ **[2]**

(b) Convert your answer in question **1. (a),** into hexadecimal number. Show your working.

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Your Answer: ( )$_{16}$ **[2]**

(c) Convert your answer in question **1. (b)** into denary (decimal) number. Show your working.

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Your Answer: ( )$_{10}$ **[2]**

2.

2. A vending machine has the choices shown below

10	tea	11	with milk	12	with sugar	13	with milk and sugar
20	coffee	21	with milk	22	with sugar	23	with milk and sugar
30	hot chocolate	31	extra milk	32	extra sugar	33	with extra milk and extra sugar
40	cold water	41	hot water	42	fizzy water		
50	coke	51	orange	52	lemon		
60	chicken soup	61	tomato soup				

A customer uses a keypad to make their choice. Each number entered is represented in a 6-bit binary register.

For example, key press 33 (hot chocolate with extra milk and extra sugar) is represented by:

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

(a) (i) If a customer chooses coffee with milk and sugar what is the key press?

[1]

(ii) How is it represented in the 6-bit register?

32	16	8	4	2	1

[1]

(b) If the 6-bit register shows

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

What drink has the customer chosen?

..... **[1]**

(c) A customer using the vending machine gets an error message after keying in their selection.

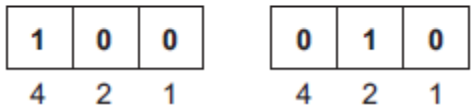
What could have caused this error message?

.....

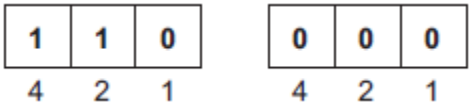
..... **[1]**

(d) It was decided to split the register so that each digit was represented by its own 3-bit register:

For example, 4 2 would now be represented as:



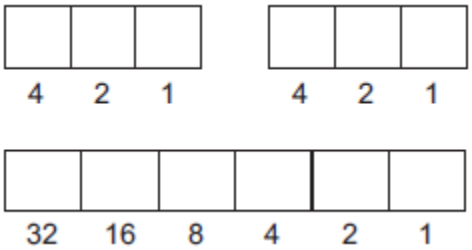
(i) What drink has been chosen if the 3-bit registers contain:



.....

..... **[1]**

(ii) How would the lemon option be shown on both types of register?



[2]

(iii) What is the advantage of using two 3-bit registers rather than one 6-bit register?

.....

..... **[1]**

3. 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:

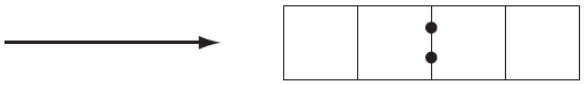
(clock display)

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]

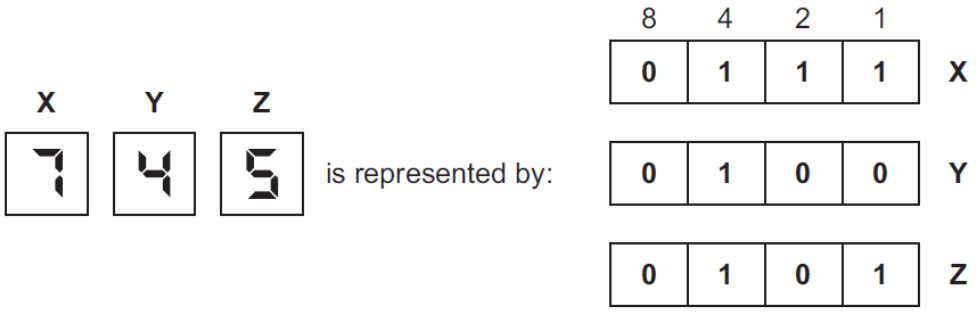
(b) What would be stored in the 4-digit binary codes if the clock display time was:

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

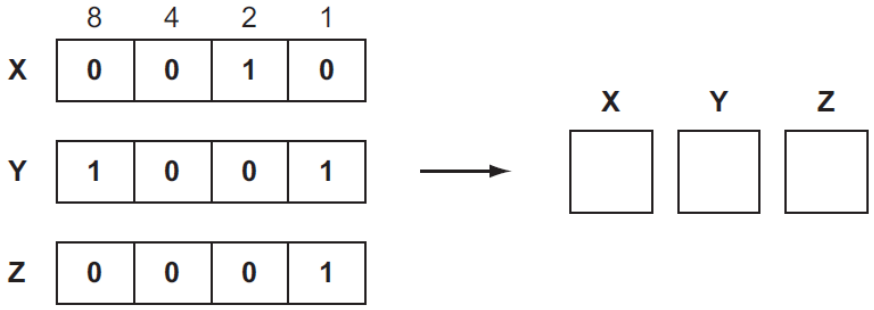
[4]

4. A digital light meter has a 3-digit LCD. The value of each digit on the instrument display is stored as a 4-bit binary number in a register.

For example:

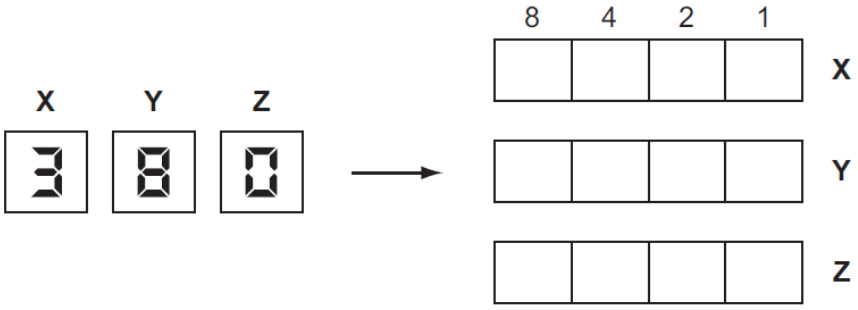


(a) What value is shown on the display if the 4-bit binary registers contain:



[3]

(b) What would be stored in the 4-bit binary registers if the display shows:



[3]

(c) If any of the 4-bit binary registers X, Y or Z contain the value **1 1 1 1** this indicates an error.

(i) How could this error be shown on the instrument display?

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[1]

(ii) What could cause an error to occur?

.....

.....

[1]

5. Some decorative lights are made up from a cluster of *red*, *blue*, *green*, *yellow* and *white* LEDs.

Each colour is represented by a binary code:

32	16	8	4	2	1	
1	0	0	0	0	0	red
0	1	0	0	0	0	blue
0	0	1	0	0	0	green
0	0	0	1	0	0	yellow
0	0	0	0	1	0	white
0	0	0	0	0	1	black (all lights off)

A 6-bit register, R1, stores the 1-values to represent a sequence of colours.
Thus, if R1 contains:

0	1	0	1	0	1

this means the ***blue***, ***yellow*** and ***black*** colour sequence is stored and displayed in that order.

The length of time each light is on is set by a binary value in another register, R2:

Thus

0	1	0

means each colour is on for 2 seconds.

(a) The two registers contain the following values.

What is the sequence of coloured lights **and** the timing for each colour?

R1

0	1	1	0	1	0

R2

1	1	1

sequence of colours .....

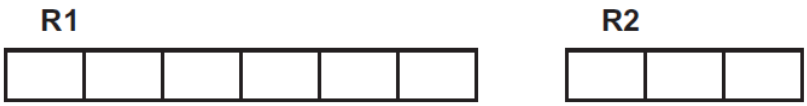
.....

.....

timing .....

..... [2]

(b) What will the two registers contain if the coloured light sequence is ***red***, ***green*** and ***black*** and the timing is 5 seconds?



[2]

(c) What is the problem with trying to display ***green***, ***blue***, ***red*** in that order?

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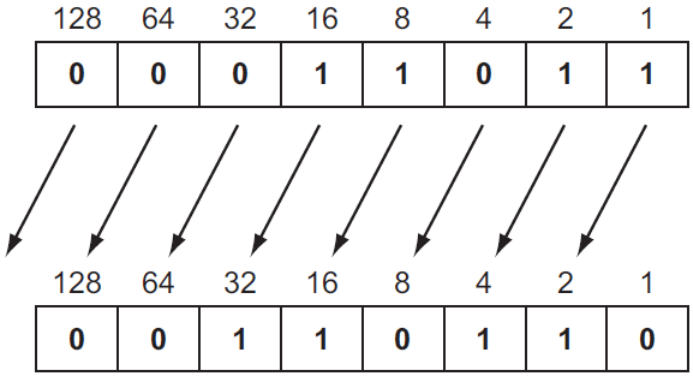
..... [2]

6. A denary number can be represented as an 8-bit binary number. For example:

27 would be represented as:



All the bits in the binary number have now been shifted (moved) one place to the left.

(a) What denary number does this now represent?

..... [1]

(b) What effect did the shift have on the original denary number?

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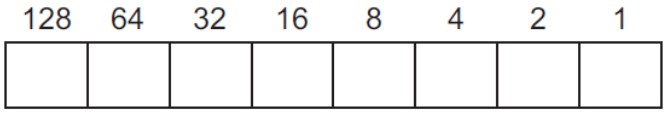
..... [1]

(c) If the above binary number was shifted another one place to the left, what denary number would it be equivalent to?

..... [1]

(d) **(i)** Represent the denary number 46 as an 8-bit binary number.



[1]

(ii) Shift this 8-bit binary number 2 places to the left.
What is the denary equivalent?

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[1]

(iii) What problem would arise if you tried to shift this 8-bit binary number 3 places to the left?

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[1]

(e) If any 8-bit binary number was shifted one place to the **right**, what would this be equivalent to?

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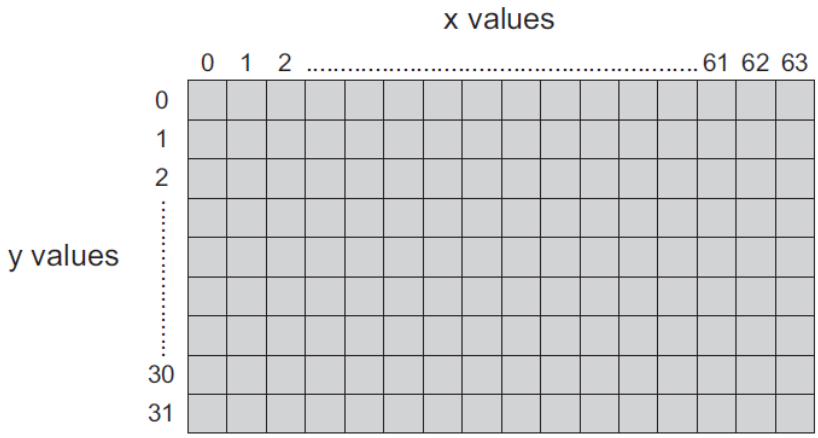
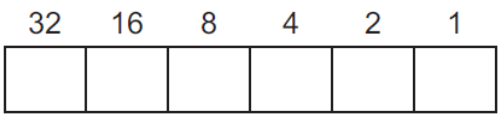
[1]

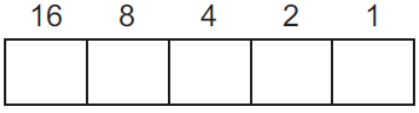
7. A touch screen is divided up into a number of locations:



Each x-position is shown in a 6-bit register:



and each y-position is shown in a 5-bit register:



Thus,

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

16	8	4	2	1
1	**0**	**1**	**0**	**1**

refers to screen position: **(30, 21)**

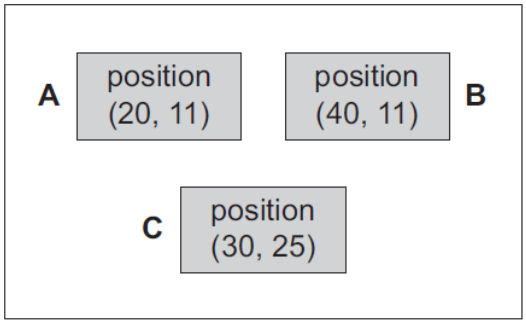
(a) Give the screen position referred to if the two registers contain:

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

16	8	4	2	1
0	**1**	**1**	**1**	**0**

(..... , ...) [2]

(b) Three options (A, B, C) are shown on the touch screen below:



If the two registers contain:

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

16	8	4	2	1
0	**1**	**0**	**1**	**1**

what option (A, B or C) has been chosen?

..... [1]

(c) Each box A, B, C is made up of 128 x 64 ***pixels***.

(i) What is meant by the term *pixel*?

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.....

..... [1]

(ii) The value of each pixel is stored in 1 byte of memory.

How much memory is needed to store one of these boxes?

Give your answer in kilobytes.

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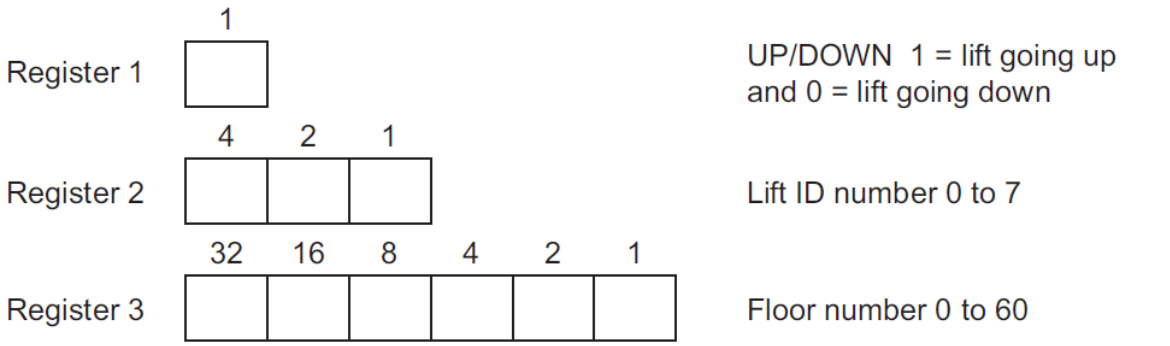
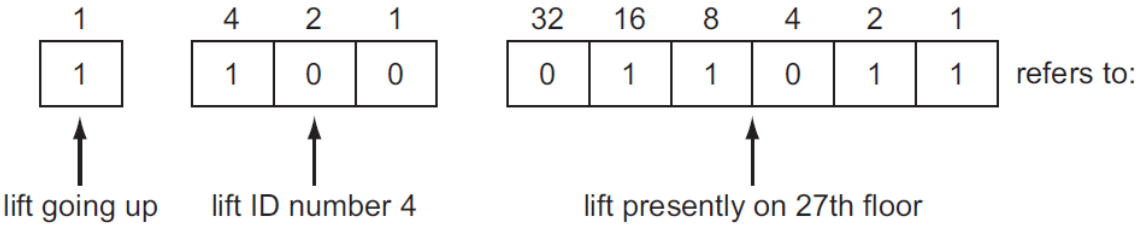
..... [2]

8. A large hotel uses eight lifts (elevators) to carry passengers between its sixty floors.

A computer is used to control and monitor the lifts. Each lift has three registers to represent its state.



Thus



(a) If the three registers contain the following data:

1	4	2	1	32	16	8	4	2	1
0	1	1	1	1	1	1	0	0	0

what information about the lift is shown?

.....

.....

..... [2]

(b) How would the following information be shown in the three registers:

lift 6 presently on the 45th floor and going down

1	4	2	1	32	16	8	4	2	1

[2]

(c) **(i)** A customer is on the 14th floor and wants to go to the 50th floor. She presses the button to call the lift.

What **two** pieces of information would the computer check to identify which of the eight lifts should be made available?

1 .....

.....

2 .....

..... [2]

(ii) Using your answers to part **(i)**, which of the following lifts would be made available to the customer?

1	0	0	0	1	0	0	1	0	0	**A**
0	0	0	1	0	0	1	1	1	1	**B**
1	0	1	0	1	1	0	0	1	0	**C**
1	0	1	1	0	0	1	0	1	0	**D**

[1]

(d) An engineer wishes to test that this computer system detects incorrect data.

Describe what input the engineer might use to check that the computer can correctly identify a fault condition.

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..... [2]