5.4 Binary number system part 2

Name: _____

Class: _____

Date: _____

Time: **145 minutes**

Marks: **99 marks**

Comments:

Q1.

Bit patterns can be interpreted in a number of different ways. A computer word contains the bit pattern 0011 0100.

(a)   What is its decimal value if it represents:
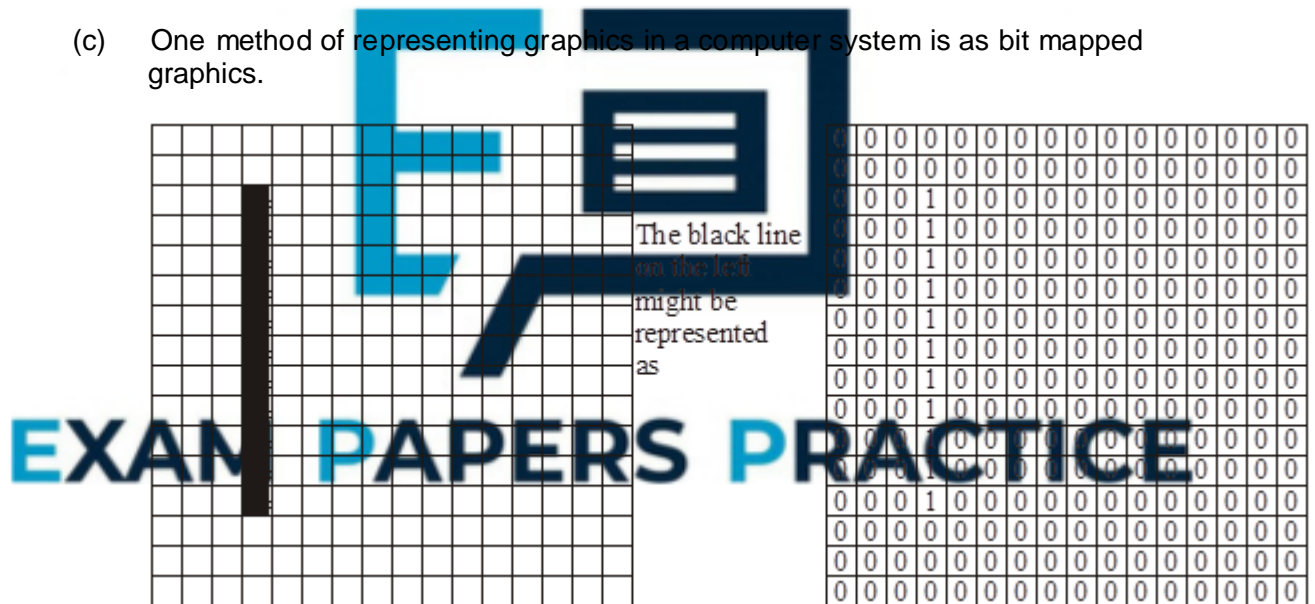
a pure binary integer; _____

(1)

(b)   (i)   The ASCII value for the character '0' (zero) is 48. What character is represented by 0011 0100?

_____

(1)

(ii)   Name one other standard coding system for coding information expressed in character or text-based form.

_____

(1)

(c)   One method of representing graphics in a computer system is as bit mapped graphics.

The black line on the left might be represented as

(i)   Describe how a coloured line might be represented.

_____

_____

_____

(2)

(ii)   Describe how a line would be stored using vector graphics.

_____

_____

_____

_____

(3)

(Total 8 marks)

Q2.

The binary pattern 1011 1110 0100 could be interpreted in a number of different ways.

(a)   State its hexadecimal representation.

_____

(1)

(b)   State its value in denary if it represents an unsigned fixed point number with four bits after the binary point. Use the space below to show your working.

_____

(3)

(c)   State its value in denary if it represents a two's complement integer.

_____

(2)

(d)   The system stores floating point numbers in *normalised form* using 2's complement, with an 8-bit mantissa and a 4-bit exponent as follows.

Mantissa   Exponent

(i)   State the value of 1011 1110 0100 in denary if it represents a two's complement floating point number. Use the space below to show your working.

_____

(3)

(ii) This floating point number is said to be normalised.

How does the bit pattern indicate that this number is normalised?

_____

_____

(1)

(Total 10 marks)

Q3.

(a) A system stores integers in **16 bits**. Using binary representation, show the steps of subtracting 6 from 18, using two's complement.

_____

_____

_____

_____

_____

_____

_____

(4)

(b) The system stores floating point numbers in *normalised form* using 2's complement with a 12-bit mantissa and a 4-bit exponent as follows.

(i) A floating point number is stored in main memory at symbolic address Num1. Complete the table below, showing the contents of the memory location using binary notation and the value in decimal.

Symbolic Address	Hexadecimal Representation	Binary Representation	Decimal Value
Num1	A802		

(4)

(ii) Why should floating point numbers be stored in normalised form?

_____

_____

(1)

(Total 9 marks)

Q4.

(a) What is the binary representation of 63?

_____

(1)

(b) How many different bit patterns can be represented by an 8 bit word?

_____

(1)

(c) What is the largest pure binary number that can be stored in an 8 bit byte?
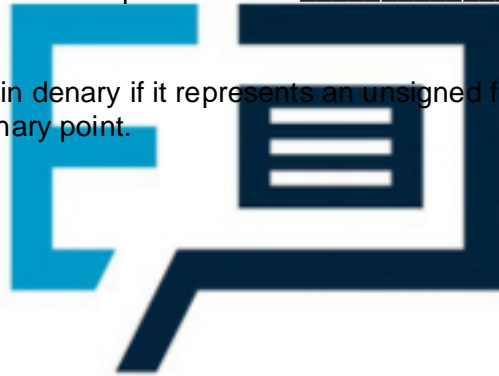
_____

(1)

(Total 3 marks)

Q5.

The binary pattern 1011 0111 0110 can be interpreted in a number of different ways.

(a) State its hexadecimal representation: _____

(1)

(b) State its value in denary if it represents an unsigned fixed point number with four bits after the binary point.

_____

(2)

(c) (i) State its value in denary if it represents a two's complement floating point number with an eight bit mantissa followed by a four bit exponent.

_____

_____

_____

(3)

(ii) This floating point number is said to be *normalised*.
How does the bit pattern indicate that this number is normalised?

_____

_____

(1)

(iii) Why should floating point numbers be stored in normalised form?

_____

_____
(1)
(Total 8 marks)

Q6.

(a)   How many bytes are 1 Kilobyte? _____
(1)

(b)   A computer system uses 2 bytes to store a number.

(i)   What is the largest pure binary integer it can store? _____
(1)

What is the bit pattern if the number 37 is to be stored as

(ii)   a pure binary integer?

(1)

(c)   The ASCII coding system uses seven bits to code a character.
The character digits 0 to 9 are assigned the decimal number codes 48 to 57.
An extra bit is used as a parity bit.
A computer system uses the most significant bit (MSB) as a parity bit for each byte
and works with **even** parity.

(i)   What is the bit pattern if the digits 37 are to be stored as characters?

(3)

(ii)   Explain how the parity bit is used by this computer system.

_____

_____

_____
(2)
(Total 8 marks)

Q7.

(a)   The number 0111 0010 1011 1101 is stored in twos complement notation in 16 bits
with the most significant 10 bits representing the mantissa and the least significant 6
bits representing the exponent.

(i)   Is this number positive or negative?_____

(ii)   Estimate the magnitude of this number. Circle the correct answer below.

$>2^{32}$	Between 2^{16} and 2^{32}	Between 2^2 and 2^{-2}	$<2^{-2}$

(2)

(b)   The number 0110 0001 0100 1000 is stored in the **same format**. Convert this number into denary.

Answer _____

(3)

(c)   (i)   Give **one** advantage of fixed point over floating point representation.

_____

(ii)   Under what circumstances would fixed point representation be used rather than floating point?

_____

(2)
(Total 7 marks)

Q8.

A computer design company has produced a design for an elementary computer. It is to be used to teach students about machine architecture, machine operations and the design of an *instruction set*.

The current instruction register has a length of 16 bits.
The accumulator has a length of 16 bits.
The size of each memory location is 16 bits.
The current instruction register is designed to hold one instruction at a time.
A machine instruction is 16 bits in length.
The most significant eight bits of a machine instruction denote the machine operation.
The least significant bits denote an operand or the address of an operand.
Main memory stores both instructions and data.

The structure of a machine instruction is as follows.
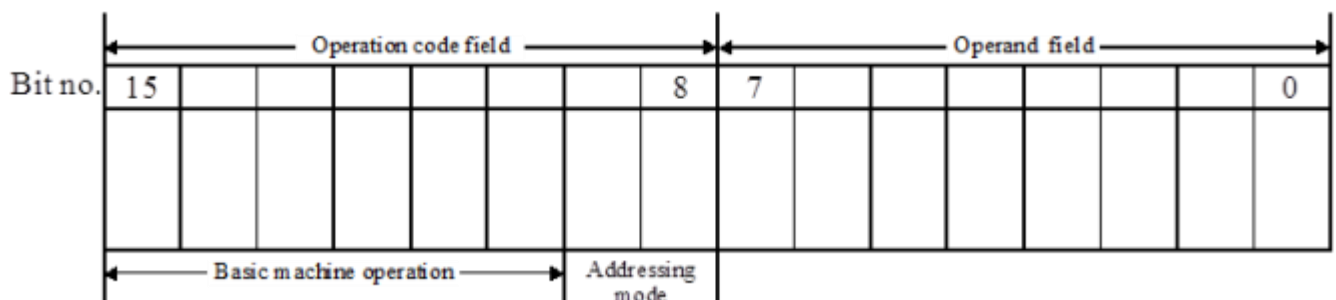
(a)   Define the term instruction set.

_____

_____

(1)

(b) With 6 bits of the operation code reserved to denote basic machine operations, how many basic machine operations may be coded?

_____

(1)

(Total 2 marks)

Q9.

Bit patterns can be interpreted in a number of different ways.

(a) A computer word contains the bit pattern 0001 0111.

What is its decimal value if it represents a pure binary integer

_____

(1)

(b) A computer system uses **odd** parity. The most significant bit (MSB) is used as a parity bit. The ASCII value for the character '!'is decimal number 33.

(i) What would be the 8-bit binary pattern to represent the character '!'?

MSB

(2)

(ii) Asynchronous data transmission is used if one character is sent at a time. One start bit marks the beginning of a character and one stop bit marks the end of a character.

What would be the bit pattern if the character '!' above is sent using asynchronous data transmission?

(1)

(Total 4 marks)

Q10.

(a) (i) Convert the hexadecimal number BD93 to binary.

_____

(1)

(ii) The contents of register A is 1011 1010 0000 0011.
These bits are a representation of a number in twos complement, with the leftmost 10 bits as the mantissa and the rightmost 6 bits as the exponent.

Convert this number into decimal. Show your working.

_____

(3)

(b) Give **two** reasons why floating point numbers are normalised.

1. _____

_____

2. _____

_____

(2)
(Total 6 marks)

Q11.

Bit patterns can be interpreted in a number of different ways. A computer word contains the bit pattern 0011 0110.

(a) What is its decimal value if it represents a pure binary integer

_____

(1)

(b) (i)   The ASCII value for the character '2' is 50.   What is the character stored in the computer word 0011 0100?

_____

(2)

(ii) Name **one** other standard coding system for coding information expressed in character or text-based form.

_____

(1)

(c) One method of storing graphics in a computer system is as vector graphics.

(i) Name **one** other method.

_____

(1)

(ii) Describe how a black-and-white image would be stored using your method.

_____

_____

_____

_____

(2)
(Total 7 marks)

Q12.

(a) A binary pattern might represent a decimal *integer* or a decimal *real number.* In a computing context, give an example of

  (i) a decimal integer _____

  (ii) a decimal real number _____

  (iii) The binary data 00110111 represents an unsigned real number in fixed point form, with the binary point between bits 1 and 2, e.g. 1101.11. Convert this number into decimal, showing all your working.

(4)

(b) Convert the binary data 10110111 00111110 into hexadecimal.

(1)

(c) Give **one** example of where hexadecimal numbers are used, and explain why they are used here rather than binary numbers.

_____

_____

_____

_____

(2)
(Total 7 marks)

Q13.

(a) Data can be stored inside a computer system in several different representations. The number 25 is to be stored in a 16-bit word.

What is the bit pattern if the number 25 is to be stored as a pure binary integer

(1)

(b) The ASCII code for the character '3' is the decimal number 51.

    (i) What is the ASCII code for the character '5'? _____

(1)

    (ii) If eight bits are used to store one character, what is the bit pattern when the string '25' is stored in a 16-bit word?

(2)
(Total 4 marks)

Q14.

A two byte register holds numbers in floating point form with a 10 bit mantissa and a 6 bit exponent.

(a) Explain the terms:

    (i) mantissa; _____

_____

(1)

    (ii) exponent. _____

_____

(1)

(b) Each of these holds data in two's complement form. At one moment, this register holds the following bits.

0110101100000011

    (i) Label the mantissa in this data.

(1)

    (ii) How can you tell if the number is positive or negative?

_____

_____

(1)

(c) Explain, or show, how you would subtract 3 from 5 using two's complement.

_____

_____

_____

_____

_____

(2)

(d)   Give **one** advantage of floating point notation over fixed point notation for storing real numbers.

_____

_____

(1)

(Total 8 marks)

Q15.

(a)   Bit patterns can be interpreted in a number of different ways. A computer word contains the bit pattern 0101 1001. What is its decimal value if it represents:

a pure binary integer; _____

(1)

(b)   A binary pattern in a 16 bit word can represent different forms of information, such as pure binary or BCD, as above, or two ASCII characters. Name three different forms of information, excluding those given above.

1. _____

2. _____

3. _____

(3)

(Total 4 marks)

Q16.

What would be the result of performing **each** of the following logical operations?

(a)   NOT 01001111

_____

(1)

(b)   00110000 OR 00000010

_____

(1)

(c)   11000001 AND 00010011

_____

(1)

(d)   00000101 XOR 10001110

_____