4 Nine bytes of data are transmitted from one computer to another. Even parity is used. An additional parity byte is also sent.

The ten bytes arrive at the destination computer as follows:

	parity bit	bit 2	bit 3	bit 4	bit 5	bit 6	bit 7	bit 8
byte 1	1	1	1	0	1	1	1	0
byte 2	0	0	0	0	0	1	0	1
byte 3	0	1	1	1	1	0	0	0
byte 4	1	1	0	0	0	0	0	0
byte 5	1	0	1	1	1	1	1	0
byte 6	0	1	0	1	1	0	0	1
byte 7	0	1	1	1	0	0	1	1
byte 8	0	0	1	1	0	1	1	0
byte 9	1	1	0	0	0	0	1	1
parity byte	0	0	1	0	0	0	1	0

One of the bits was corrupted during the data transmission.

(a) **Circle** the corrupt bit in the corrupt byte in the table above. [1]

(b) Explain how the corrupted bit was found.

.....

.....

.....

.....

.....

.....[2]

3 A company has a number of offices on one site. Data are transmitted, using a wired network, from one office and stored at another office.

(a) State, with reasons, which data transmission, serial or parallel, should be used.

Type .....

Reasons .....

.....

.....

[3]

(b) The two registers' contents shown include parity bits.

Parity bit								
1	0	0	1	0	1	1	1	Register 1
1	0	0	0	0	1	1	1	Register 2

State which type of parity each register is using.

Register 1 .....

Register 2 .....

[2]

(c) Give one method, other than parity checking, that could be used for checking for errors in the transmission of data.

Method .....

.....[1]

1 **(a)** State what is meant by the terms:

Parallel data transmission .....

.....

.....

Serial data transmission .....

.....

.....

[2]

(b) Give **one** benefit of each type of data transmission.

Parallel data transmission

Benefit .....

.....

Serial data transmission

Benefit .....

.....

[2]

(c) Give **one** application of each type of data transmission. Each application must be different.

Parallel data transmission

Application .....

.....

Serial data transmission

Application .....

.....

[2]

2 **(a)** State what is meant by the term USB.

.....

.....

[1]

(b) Describe **two** benefits of using USB connections between a computer and a device.

1 .....

.....

.....

2 .....

.....

.....

[2]

5 Parity checks are often used to check for errors that may occur during data transmission.

(a) A system uses **even parity**.

Tick (✓) to show whether the following three bytes have been transmitted correctly or incorrectly.

Received byte	Byte transmitted correctly	Byte transmitted incorrectly
1 1 0 0 1 0 0 0		
0 1 1 1 1 1 0 0		
0 1 1 0 1 0 0 1		

[3]

(b) A parity byte is used to identify which bit has been transmitted incorrectly in a block of data.

The word "F L O W C H A R T" was transmitted using nine bytes of data (one byte per character). A tenth byte, the parity byte, was also transmitted.

The following block of data shows all ten bytes received after transmission. The system uses **even parity** and column 1 is the parity bit.

	letter	column 1	column 2	column 3	column 4	column 5	column 6	column 7	column 8
byte 1	F	1	0	1	0	0	1	1	0
byte 2	L	1	0	1	0	1	1	0	0
byte 3	O	1	0	1	0	1	1	1	1
byte 4	W	1	0	1	1	0	1	1	1
byte 5	C	1	0	1	0	0	0	1	1
byte 6	H	0	0	1	0	1	0	0	0
byte 7	A	0	0	1	0	0	1	0	1
byte 8	R	1	0	1	1	0	0	1	0
byte 9	T	1	0	1	1	0	1	0	0
parity byte		1	0	1	1	1	1	1	0

(i) **One** of the bits has been transmitted incorrectly.

Write the byte number and column number of this bit:

Byte number .....

Column number .....

[2]

(ii) Explain how you arrived at your answer for **part (b)(i)**.

.....

.....

.....

.....[2]

(c) Give the denary (base 10) value of the byte: **1 0 1 1 1 1 1 0**

.....

.....[1]

(d) A parity check may not identify that a bit has been transmitted incorrectly.

Describe **one** situation in which this could occur.

.....

.....

.....[1]

9 Check digits are used to ensure the accuracy of entered data.

A 7-digit number has an extra digit on the right, called the check digit.

digit position:	1	2	3	4	5	6	7	8
digit:	–	–	–	–	–	–	–	–

↑ check digit

The check digit is calculated as follows:

- each digit in the number is multiplied by its digit position
- the seven results are then added together
- this total is divided by 11
- the remainder gives the check digit (if the remainder = 10, the check digit is X)

(a) Calculate the check digit for the following number. Show all your working.

4 2 4 1 5 0 8 …

.....

.....

.....

Check digit .....

[2]

(b) An operator has just keyed in the following number:

3 2 4 0 0 4 5 X

Circle below **correct** if the check digit is correct **OR incorrect** if the check digit is incorrect.

correct **incorrect**

Explain your answer.

.....

.....

.....

.....

[3]

6 **(a)** **Three** descriptions of data transmission are given below.

Tick (✓) the appropriate box in each table to show the:

- type of transmission
- method of transmission

Description 1:

Data is transmitted several bits at a time down several wires in both directions simultaneously.

Type	Tick (✓)
simplex	
half-duplex	
full-duplex	

Method	Tick (✓)
serial	
parallel	

Description 2:

Data is transmitted in one direction only, one bit at a time, down a single wire.

Type	Tick (✓)
simplex	
half-duplex	
full-duplex	

Method	Tick (✓)
serial	
parallel	

Description 3:

Data is transmitted one bit at a time down a single wire; the data is transmitted in both directions but not at the same time.

Type	Tick (✓)
simplex	
half-duplex	
full-duplex	

Method	Tick (✓)
serial	
parallel	

[6]

(b) Give **two** reasons why serial transmission, rather than parallel transmission, is used to connect devices to a computer.

1 .....

.....

2 .....

.....

[2]

4 Five statements about **serial half-duplex** data transmission are shown in the table below.

Tick (✓) to show whether each statement is **true** or **false**.

Statement	true (✓)	false (✓)
Data is transmitted in one direction only, one bit at a time.		
Data is transmitted in both directions, multiple bits at a time.		
Data is transmitted in one direction only, multiple bits at a time.		
Data is transmitted in both directions, but only one direction at a time. Data is transmitted one bit at a time.		
Data is transmitted in both directions, but only one direction at a time. Data is transmitted multiple bits at a time.		

[5]

5 **(a)** Parity checks are often used to detect errors that may occur during data transmission.

The received bytes in the table below were transmitted using **odd parity**.

Tick (✓) to show whether each byte has been **corrupted during transmission** or **not corrupted during transmission**.

Received byte	corrupted during transmission (✓)	not corrupted during transmission (✓)
10110100		
01101101		
10000001		

[3]

(b) Another method of error detection is Automatic Repeat reQuest (ARQ).

Explain how ARQ is used in error detection.

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.....

..... [4]

4 There are various methods used to detect errors that can occur during data transmission and storage.

Describe each of the following error detection methods.

Parity check .....

.....

.....

.....

Check digit .....

.....

.....

.....

Checksum .....

.....

.....

.....

Automatic Repeat request (ARQ) .....

.....

.....

.....

[8]

7 Computer A is communicating with computer B.

(a) Draw an arrow or arrows to show simplex, duplex and half-duplex data transmission. The **direction** of the data transmission must be fully **labelled**.

Simplex data transmission

Computer **A**

Computer **B**

Duplex data transmission

Computer **A**

Computer **B**

Half-duplex data transmission

Computer **A**

Computer **B**

[6]

(b) State a use for the following data transmission methods. The use must be different for each data transmission method.

Simplex .....

.....

Duplex .....

.....

[2]

(c) A computer includes an Integrated Circuit (IC) and a Universal Serial Bus (USB) for data transmission.

Describe how the computer uses these for data transmission, including the type of data transmission used.

IC .....

.....

.....

.....

USB .....

.....

.....

.....

[4]

4 A file server is used as a central data store for a network of computers.

Rory sends data from his computer to a file server that is approximately 100 metres away.

It is important that the data is transmitted accurately. Rory needs to be able to read data from and write data to the file server at the same time.

(a) (i) Use ticks (✓) to identify the most suitable data transmission methods for this application.

Method 1	Tick (✓)	**Method 2**	Tick (✓)
Serial		Simplex	
Parallel		Half-duplex	
		Duplex	

[2]

(ii) Explain why your answer to **part (a)(i)** is the most suitable data transmission.

.....

.....

.....

.....

.....

.....

.....

.....[4]

(b) Identify and describe **two** methods of error checking that can be used to make sure that the data stored after transmission is accurate.

Method 1 .....

.....

.....

.....

.....

.....

.....

.....

Method 2 .....

.....

.....

.....

.....

.....

.....

.....

[6]

12 Parity checks are used to check for errors during data transmission. A system uses **odd** parity.

(a) Complete the following two bytes of data so that they both have **odd** parity:

	1	1	1	1	0	0	0

	0	0	0	0	1	1	1

[2]

(b) Name and describe another method which can be used to check whether data has been correctly transmitted.

Name of method .....

Description .....

.....

.....

[2]

7 **(a)** Check digits are used to ensure the accuracy of input data.

A 7-digit code number has an extra digit on the right, called the check digit.

Digit position	1	2	3	4	5	6	7	8
Digit	–	–	–	–	–	–	–	–

The check digit is calculated as follows:

- each digit in the number is multiplied by its digit position
- the seven results are then added together
- this total is divided by 11
- the remainder gives the check digit (if the remainder = 10, the check digit is X)

(i) Calculate the check digit for the following code number. Show all your working.

4 2 4 1 5 0 8 …

.....

.....

.....

Check digit .....

[2]

(ii) An operator has just keyed in the following code number:

3 2 4 0 0 4 5 X

Has the operator correctly keyed in the code number?

.....

Give a reason for your answer.

.....

.....

.....

.....

[3]

(b) When data are transmitted from one device to another, a parity check is often carried out on each byte of data. The parity bit is often the leftmost bit in the byte.

(i) If a system uses even parity, give the parity bit for each of the following bytes:

parity bit							
	1	**1**	**0**	**0**	**1**	**1**	**0**

parity bit							
	0	**0**	**0**	**0**	**0**	**0**	**1**

[2]

(ii) A parity check can often detect corruption of a byte.

Describe a situation in which it **cannot** detect corruption of a byte.

.....

.....

.....[1]

3 **Five** computer terms and **seven** descriptions are shown below.

Draw a line to connect each computer term to its correct description.

Computer term	Description
Serial, simplex data transmission	Several bits of data sent down several wires, in both directions, but not at the same time
	Several bits of data sent down several wires, in both directions, at the same time
Parallel, half-duplex data transmission	An even or odd number of bits set to 1 in a byte, used to check if the byte has been transmitted correctly
Parity check	One bit sent at a time, over a single wire in one direction only
	An additional digit placed at the end of a number to check if the number has been entered correctly
Automatic repeat request (ARQ)	A value transmitted at the end of a block of data; it is calculated using the other elements in the data stream and is used to check for transmission errors
Checksum	An error detection method that uses response and time out when transmitting data; if a response is not sent back to the sender in an agreed amount of time, then the data is re-sent

[5]

3 **(a)** Explain what is meant by:

(i) Serial data transmission

.....

.....

.....

.....[2]

(ii) Parallel data transmission

.....

.....

.....

.....[2]

(b) A computer in a factory is connected to a printer. The printer is located in an office 1 km away from the factory.

Identify which data transmission method would be most suitable for this connection.

.....

Give **two** reasons for your choice.

1 .....

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.....

2 .....

.....

.....

[3]