



Name:

Index:

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Class:

Date:

2.1 Types and methods of data transmission

Candidates should be able to:

Notes and guidance

1 (a) Understand that data is broken down into packets to be transmitted

(b) Describe the structure of a packet

- A packet of data contains a:

- packet header
- payload
- trailer

- The packet header includes the:

- destination address
- packet number
- originator's address

(c) Describe the process of packet switching

- Data is broken down into packets

- Each packet could take a different route

- A router controls the route a packet takes

- Packets may arrive out of order

- Once the last packet has arrived, packets are reordered

2 (a) Describe how data is transmitted from one device to another using different methods of data transmission

- Including:

- serial
- parallel
- simplex
- half-duplex
- full-duplex

(b) Explain the suitability of each method of data transmission, for a given scenario

- Including the advantages and disadvantages of each method

3 Understand the universal serial bus (USB) interface and explain how it is used to transmit data

- Including the benefits and drawbacks of the interface

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]

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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]

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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]

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- 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]

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5 A website allows users to purchase items.

Computer A sends a request for the homepage to the website's server.

(a) The request is sent using packet switching.

The structure of a packet of data has three elements. One element is the packet header.

(i) Identify **two** items of data contained in a packet header.

1

2 [2]

(ii) Identify the **two** other elements of a packet.

1

2 [2]

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(ii) Explain how the file is transmitted using packet switching.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... [5]

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- 5 Complete and annotate the diagram to demonstrate how packet switching is used to transmit data across a network, including the use of routers, from Device A to Device B.



[4]

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- 4 A restaurant has an electronic ordering system. The system allows customers to select the food they want to order. The data for the order is transmitted across their network to a computer in the restaurant kitchen.

(a) The data is sent using serial full-duplex data transmission.

- (i) Give **two** reasons why serial full-duplex is a suitable data transmission method for the data.

1

.....

2

.....

[2]

- (ii) Give **one** improvement that would be made to the data transmission if parallel transmission is used instead of serial transmission.

.....

..... [1]

(c) A customer can also order food from home using the internet. The data for their order is broken down into packets and transmitted across the internet to the computer in the restaurant kitchen.

(i) Tick (✓) **one** box to show which item would **not** be included in a packet's header.

- | | | |
|----------|----------------------|--------------------------|
| A | destination address | ☐ |
| B | originator's address | ☐ |
| C | packet number | ☐ |
| D | payload | ☐ |

[1]

(ii) The packets of data may need to be reordered when they arrive at the computer in the restaurant kitchen.

Explain why the packets of data may need to be reordered.

.....

.....

.....

..... [2]

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7 A theatre has a microphone on stage that is connected by cables to several speakers around the theatre. A person speaks into the microphone and their voice is output from the speakers.

Identify the most appropriate data transmission method for this purpose. Explain your choice.

Data transmission method

Explanation

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

[5]

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(c) The programmer wants to print a list of all her books on paper.

- (ii) The programmer needs to connect the printer to her computer. The printer is on the same desk as her computer.

Give a suitable method of data transmission that could be used to connect the computer to the printer.

Explain your choice.

Data transmission method

Explanation

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

[6]

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(c) The mouse is connected using a universal serial bus (USB) connection.

- (i) Explain how data is sent using the USB connection.

.....

.....

.....

..... [2]

- (ii) Give **two** benefits of using a USB connection for this purpose.

1

.....

2

.....

[2]



(iii) Give **one** drawback of using a USB connection for this purpose.

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

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2.2 Methods of error detection

Candidates should be able to:

- 1 Understand the need to check for errors after data transmission and how these errors can occur
- 2 Describe the processes involved in each of the following error detection methods for detecting errors in data after transmission: parity check (odd and even), checksum and echo check
- 3 Describe how a check digit is used to detect errors in data entry and identify examples of when a check digit is used, including international standard book numbers (ISBN) and bar codes
- 4 Describe how an automatic repeat query (ARQ) can be used to establish that data is received without error

Notes and guidance

- Errors can occur during data transmission due to interference, e.g. data loss, data gain and data change
- Including parity byte and parity block check
- Including the use of:
 - positive/negative acknowledgements
 - timeout

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]

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

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

.....

[1]

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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]

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5 Errors can occur when data is transmitted.

(a) Give **one** reason an error may occur when data is transmitted.

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

(b) Some error detection methods use a calculated value to check for errors.

Tick (✓) **one** box to show which error detection method does **not** use a calculated value to check for errors.

- | | | |
|---|--------------|--------------------------|
| A | Check digit | ☐ |
| B | Checksum | ☐ |
| C | Echo check | ☐ |
| D | Parity check | ☐ |

[1]

(c) An automatic repeat request (ARQ) can be used to make sure that data is received free of errors. It can use a positive or negative acknowledgement method to do this.

Explain how an ARQ operates using a positive acknowledgement method.

.....
.....
.....
.....
.....
.....
.....
.....
.....
..... [5]

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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
Parallel, half-duplex data transmission	Several bits of data sent down several wires, in both directions, at the same time
Parity check	An even or odd number of bits set to 1 in a byte, used to check if the byte has been transmitted correctly
Automatic repeat request (ARQ)	One bit sent at a time, over a single wire in one direction only
Checksum	An additional digit placed at the end of a number to check if the number has been entered correctly
	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
	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]

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- 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.

[4]

[4]

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(b) A checksum is used to check the data for errors after transmission.

(i) Describe the process of the checksum error detection method.

[5]

(ii) Identify **one** other error detection method that could be used to check for errors in the data.

..... [1]

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(iii) An even parity check is used to detect errors in the data after it has been transmitted to the printer.

Describe how an even parity check detects an error.

[4]

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(d) An echo check is used to check for errors after the image has been transmitted.

Draw and annotate a diagram to show how the echo check would detect any errors.

[3]

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2.3 Encryption

Candidates should be able to:

- 1 Understand the need for and purpose of encryption when transmitting data
- 2 Understand how data is encrypted using symmetric and asymmetric encryption

Notes and guidance

- Asymmetric encryption includes the use of public and private keys



10 Choose **five** correct terms from the following list to complete the spaces in the sentences below:

- cypher text
- encryption algorithm
- encryption key
- firewall
- plain text
- proxy server
- symmetric encryption

..... is a security system.

It uses the same to encrypt and decrypt a message.

Before encryption, the message is called

The processes the original message.

The output is known as [5]

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(b) Rebekah decides to encrypt the data that she transmits whilst using the Internet. She does this to keep the data safe.

(i) State why encryption helps keep the data safe.

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

(ii) The data is encrypted using symmetric encryption.

Describe how the data is encrypted using symmetric encryption.

.....
.....
.....
.....
.....
.....
.....
..... [4]

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- (b) The finance company is also worried about the security of the data stored on its servers.

The company has decided to encrypt the data to improve the security.

Describe how the data are encrypted.

.....

.....

.....

.....

.....

.....

.....

..... [4]

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- (b) The data stored by the library is archived at the end of each day. The archive is held on a server in the library office.

The data is encrypted with an 8-bit key. As some of the data is confidential, the library wants to make the encryption more secure.

- (i) State how the library could make the encryption more secure.

.....

..... [1]

- (ii) The term used to describe data before it is encrypted is plain text.

State the term used to describe encrypted data.

..... [1]

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6 Data can be encrypted using asymmetric encryption.

(a) Complete the paragraph about asymmetric encryption.

Use the terms from the list.

Some of the terms in the list will **not** be used. You may use a term more than once.

algorithm	binary	cipher text	compression	error
hardware	hexadecimal	meaningless	plain text	private
public	readable	transmission	unreadable	

Data is encrypted using an encryption key. This is a type of
that scrambles the and turns it into
..... This makes the data
A key is used to encrypt the data. This key cannot be used
to decrypt the data. A key is used to decrypt the data. Any
device is able to request the key, but only your device
knows the key.

[8]

(b) Data can also be encrypted using symmetric encryption.

Give **one** reason why a person would use asymmetric encryption instead of symmetric encryption.

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

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