T2

Data transmission

CHAPTER ASSIGNMENT · 77 MARKS

Name _____ Class _____ No. _____ Date _____

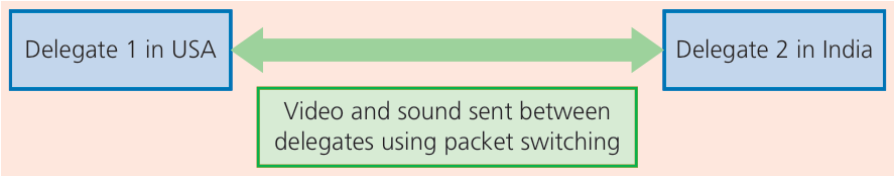
Answer every question in the space given. Show your working. You may use the chapter page to help you.

Questions from *Cambridge IGCSE and O Level Computer Science*, 2nd edition, David Watson and Helen Williams (Hodder Education), for classroom use.

Activities from the chapter

2.1

(1) Suppose a video conference is taking place between delegates in two different countries. Packet switching is being used to send video and sound data between the delegates:



▲ **Figure 2.7**

Describe:

(i) any potential problems with sound and video quality

(ii) how these problems could be caused.

(2) Explain how packet switching could be used to download a large web page from a website.

(3) (a) The trailer in a packet will use one form of error checking. Explain what is meant by a cyclic redundancy check.

(b) The payload contains the following data:

`11110000 10000011 00110011 00111111 11111110 11100011`

Use this data to show how the receiving computer can verify that the received payload was error-free.

(4) (a) Explain how it is possible for packets to be lost during their transmission across a network.

(b) Describe how it is possible for a system to deal with lost packets and prevent them from slowing down the transmission process.

(c) Explain why you think packet switching might improve data security.

2.2

(1) Explain what is meant by:

(i) serial, half-duplex data transmission

(ii) parallel, full-duplex data transmission

(iii) serial, simplex data transmission.

(2) Which types of data transmission are being described:

(i) data is sent one bit at a time in one direction only

(ii) data is being sent 8 bits at a time in one direction only

(iii) data is being sent 16 bits at a time in both directions simultaneously

(iv) data is sent one bit at a time in both directions simultaneously

(v) data is sent 16 bits at a time in one direction only?

2.3 Ten statements are shown on the left in the table. Each of these statements is either True or False. For each statement, tick (✓) the appropriate column to indicate which statements are true and which are false.

Statement	True	False
Packets have a header which contains the IP address of the sender and the receiver		
Packets don't require any form of error checking		
USBs use a protocol that allows for error-free data transmission between device and computer		
Serial data transmission suffers from data skewing		
The longest cable length supported by USB is 5 metres or less		
Simplex data transmission occurs when data is transmitted one bit at a time		
Full-duplex data transmission involves sending 8 bits of data at a time		
USB uses serial data transfer		
Packet switching prevents loss of any data packets		
USB connections can transfer data using half-duplex or full-duplex		

2.4 Find the parity bits for each of the following bytes:

	1	1	0	1	1	0	1	even parity being used
	0	0	0	1	1	1	1	even parity being used
	0	1	1	1	0	0	0	even parity being used
	1	1	1	0	1	0	0	odd parity being used
	1	0	1	1	0	1	1	odd parity being used
	1	1	1	1	1	1	0	even parity being used
	1	1	1	1	1	1	0	odd parity being used
	1	1	0	1	0	0	0	odd parity being used
	0	0	0	0	1	1	1	even parity being used
	1	1	1	1	1	1	1	odd parity being used

2.5

(1) Which of the following received bytes indicate an error has occurred following data transmission?

1	1	1	0	1	1	0	1	even parity being used
0	1	0	0	1	1	1	1	even parity being used
0	0	1	1	1	0	0	0	even parity being used
1	1	1	1	0	1	0	0	odd parity being used
1	1	0	1	1	0	1	1	odd parity being used
1	1	1	1	1	1	1	1	odd parity being used
0	0	0	0	0	0	0	0	even parity being used
1	1	1	0	0	0	0	0	odd parity being used
0	1	0	1	0	1	0	1	even parity being used
1	1	1	0	0	0	1	1	odd parity being used

(2) In each case, in **question 1**, where an error occurred, can you work out which bit in the byte was changed during data transmission?

2.6

(1) The following block of data was received after transmission from a remote computer; **odd parity** was being used by both sender and receiver. One of the bits has been changed during the transmission stage. Locate where this error is and suggest a corrected byte value:

	Parity bit	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7	Bit 8
Byte 1	0	1	1	0	0	0	1	0
Byte 2	1	0	1	1	1	1	1	1
Byte 3	1	0	0	1	1	0	0	0
Byte 4	0	1	1	0	1	0	1	0
Byte 5	1	1	1	0	0	1	1	0
Byte 6	1	0	0	0	0	1	0	1
Byte 7	0	1	1	1	0	0	0	0
Byte 8	0	0	0	0	0	0	0	1
Byte 9	0	1	1	1	1	0	1	0
Parity byte	1	0	1	1	1	1	0	0

(2) The following block of data was received after transmission from a remote computer. Even parity was being used by both sender and receiver. One of the bytes has been changed during the transmission stage. Locate where this error is and suggest a corrected byte value.

	Parity bit	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7	Bit 8
Byte 1	1	1	0	0	0	0	0	0
Byte 2	0	0	1	1	1	1	0	0
Byte 3	0	1	0	0	0	1	1	1
Byte 4	1	0	1	0	1	1	1	1
Byte 5	0	0	0	1	0	0	0	1
Byte 6	0	0	1	1	1	1	1	1
Byte 7	1	0	1	1	0	1	0	0
Byte 8	0	1	0	1	0	0	0	1
Byte 9	1	1	1	0	0	1	0	0
Parity byte	0	0	1	1	1	0	0	1

2.7

(1) Using the algorithm for ISBN-13 calculate the check digit for:

`978151045759`

(2) Find the check digits for the following numbers using **both** modulo-11 and ISBN 13 methods:

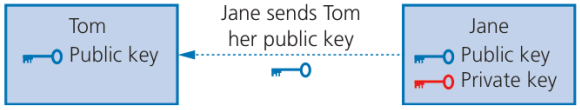
(i) 2 1 3 1 1 1 0 0 0 4 2 8

(ii) 9 0 9 8 1 2 1 2 3 5 4 4

2.8

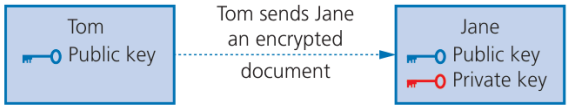
We will use an example to explain how this works; suppose Tom and Jane work for the same company and Tom wishes to send a confidential document to Jane:

1 Jane uses an algorithm to generate a **matching pair of keys** (private and public) that they must keep stored on their computers; the matching pairs of keys are mathematically linked but can't be derived from each other.
2 Jane now sends her public key to Tom.



▲ **Figure 2.20** Jane sends Tom her public key

3 Tom now uses Jane's public key (🔑) to encrypt the document he wishes to send to her. He then sends his encrypted document (ciphertext) back to Jane.



▲ **Figure 2.21** Encrypted document sent from Tom to Jane

4 Jane uses her **matching** private key (🔑) to unlock Tom's document and decrypt it; this works because the public key used to encrypt the document and the private key used to decrypt it are a matching pair generated on Jane's computer. (Jane can't use the public key to decrypt the message.)

(1) At the moment Jane can only receive encrypted documents from Tom. Describe what would need to happen for Jane to be able to **send** encrypted documents back to Tom.

(2) Explain why this method is much more secure than symmetric encryption.

2.9 For each of the following ten questions, choose which of the five options corresponds to the correct response.

(a) What is meant by the term **ciphertext** when used in encryption?

A an encryption or decryption algorithm

B an encrypted message

C a type of session key

D another name for plaintext

E text following an encryption algorithm

(b) When carrying out asymmetric encryption, which of the following users would keep the private key?

A the sender

B the receiver

C both sender and receiver

D all recipients of the message

E none of the above

(c) In encryption, which of the following is the term used to describe the message before it is encrypted?

A simpletext

B plaintext

C notext

D ciphertext

E firsttext

(d) Which of the following is the biggest disadvantage of using symmetric encryption?

A it is very complex and time consuming

B it is rarely used anymore

C the value of the key reads the same in both directions

D it only works on computers with older operating systems

E there is a security problem when transmitting the encryption key

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(e) Which of the following is the correct name for a form of encryption in which both the sender and the recipient use the same key to encrypt and decrypt?

A symmetric key encryption

B asymmetric key encryption

C public key encryption

D same key encryption

E block cipher encryption

(f) What of the following is the final number in a code, which is calculated from all the numbers in the code; its purpose is to find errors in data entry?

A parity check

B checksum

C cyclic redundancy check

D parity bit

E check digit

(g) Which of the following is a form of error detection that makes use of a system of acknowledgements and timeouts?

A automatic repeat request

B echo check

C check digit

D parity bit

E cyclic redundancy check

(h) Which of the following methods uses an extra bit added to a byte to ensure it contains an even number of 1s or odd number of 1s?

A cyclic redundancy check

B parity check

C checksum

D check digit

E echo check

(i) Which of the following uses a calculated value which is sent after a block of data; the receiving computer also calculates the value from the block of data and compares the values?

A parity check

B check digit

C packet switching

D checksum

E automatic repeat request

(j) Which of the following describes the check where the receiving computer sends back a copy of the data to the sending computer to allow it to compare the data?

A echo check

B automatic repeat request

C checksum

D parity check

E check digit

Exam-style questions

1 A company owns a number of vending machines. Data is sent from each of these machines at the end of the day. The data contains amount of money taken, products sold and any error conditions/reports.

(a) The company uses both echo checking and automatic repeat requests (ARQs).

(i) Describe how echo checks work. Explain whether this is a suitable error checking method in this application. [2]

(ii) Describe how automatic repeat request (ARQ) works. [3]

(b) **Checksum** and **check digit** are two terms often confused by students. Describe **three** differences of the two techniques. [3]

2 Explain each of the following computer terms:

(i) packet switching

(ii) cyclic redundancy check

(iii) data skewing

(iv) universal serial bus

(v) parity bit. [10]

3 Eight descriptions are given in the following table. The table columns are labelled checksum, parity check and ARQ. Tick (✓) the appropriate column which correctly matches each description to the error-checking technique. For each description, it is possible to match 1, 2, 3 or none of the error-checking methods. [8]

Description	Checksum ✓	Parity check ✓	ARQ ✓
extra bit sent with each byte of data			
makes use of timeout and acknowledgement			
if an error is found, a request is made to re-send the data			
check on whether a data packet has been changed following transmission			
re-calculation made on any additional data values sent to the recipient			
data is transmitted in blocks or packets			
a method that can determine which bit in a data stream has been changed			
additional value sent at the end of a block of data to be used to check if any data transmission errors occurred			

4

(a) Four statements about automatic repeat requests (ARQs) are given below, but they are not in the correct order. Put the statements into their correct sequence.

(i) the sending computer waits for a period of time to see if the receiving computer acknowledges receipt of the data

(ii) after a set time period, a timeout occurs which automatically triggers the re-sending of the data

(iii) the sending computer transmits a block of data to the receiving computer

(iv) this continues until the receiving computer sends an acknowledgement that the data has been received [3]

(b) Five statements about checksum error checking are given below, but they are not in the correct order. Put the statements into their correct sequence.

(i) if the two checksum values don't match, the receiving computer requests the data to be re-transmitted

(ii) the sending computer sends a block of data together with the checksum value

(iii) the receiving computer uses the block of data it receives to re-calculate the checksum using the same method as the sending computer

(iv) the two checksum values are compared by the receiving computer

(v) the sending computer uses the block of data to calculate the checksum using an agreed method [4]

(c) Five statements about parity checking are given below, but they are not in the correct order. Put the statements into their correct sequence.

(i) the sending computer sends the binary data including the parity bits

(ii) the sending and receiving computers agree the parity protocol (odd or even)

(iii) the sending computer adds a parity bit to each byte to make the byte odd or even parity

(iv) the receiving computer checks the parity of each byte received and checks it against the agreed protocol

(v) if the parity of the byte is incorrect, the receiving computer requests the data to be re-sent [4]

(d) Six statements about check digits are given below, but they are not in the correct order. Put the statements into their correct sequence.

(i) a human operator will be asked by the computer to re-enter the numerical code

(ii) the computer calculates the check digit based on the numerical code entered into the computer by a human operator

(iii) if the two check digits don't match, the human operator has made an error when entering the numerical code

(iv) the computer compares the calculated check digit with the check digit typed in by the human operator

(v) a human operator types in the numerical code into the computer

(vi) the check digit is calculated and added to the numerical code [5]

5

(a) Describe what is meant by **symmetric encryption**. [2]

(b) Describe what is meant by **asymmetric encryption**. [3]

(c) Explain why encryption is used when transmitting data over a network. [2]

6 Six descriptions are shown on the left and ten computer terms on the right. By drawing lines, connect each description to the correct computer term (not all of the computer terms will be used). [6]

a method of error detection; a value is calculated from a block of data and is sent with the block of data during data transmission	skewed data
a method of error detection; it is based on counting the number of 1-bits; uses an additional bit which is the most significant bit in the byte	half-duplex
a data transmission method where data can be sent in both directions at the same time (simultaneously)	checksum
a data transmission method where data is sent one bit at a time over a single channel/wire	ARQ
a data error occurring when data arrives at the destination out of synchronisation	full-duplex
a form of serial data transmission which allows devices to communicate with a computer; it has become the industrial standard	check digit
	universal serial bus
	encryption
	serial
	parity check

7 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. [2]

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

(ii) Explain why your answer to **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. [6]

Cambridge O Level Computer Science 2210, Paper 12 Q4, Oct/Nov 2017

8 Maisey purchases a new router and attaches it to her computer. The connection she sets up uses duplex data transmission.

(a) **Five** statements are given about duplex data transmission. **Tick** (✓) to show if the statement is **True** or **False**. [5]

Statement	True ✓	False ✓
Duplex data transmission can be either serial or parallel		
Duplex data transmission is when data is transmitted both ways, but only one way at a time		
Duplex transmission is always used to connect a device to a computer		
Duplex data transmission is when data is transmitted both ways at the same time		
Duplex data transmission automatically detects any errors in data		

(b) Maisey's computer uses an integrated circuit (IC) for data transmission that sends multiple bits at the same time. State whether the IC uses **serial** or **parallel** data transmission. [1]

(c) Maisey purchases a new printer and connects it to her computer using the USB port. Explain **two** benefits of using a USB connection. [4]

Cambridge O Level Computer Science 2210, Paper 12 Q9, Oct/Nov 2019