Question	Answer	Marks
3(a)	1 mark for: serial Any **two** from: serial data transmission more reliable over distance less likely for the data to be skewed/out of synchronisation less interference as only a single wire it is a cheaper connection as only single wire needed // cheaper to set up	**3**
3(b)	Register 1 – odd Register 2 – even	**2**
3(c)	Any **one** from: checksum ARQ (Automatic Repeat request)	**1**

1 (a) parallel

any **one** from:

– 8 bits/1 byte/multiple bits sent at a time
– using many/multiple/8 wires/lines (1 mark)

serial

any **one** from:

– one bit sent at a time
– over a single wire (1 mark) [2]

(b) parallel

– faster rate of data transmission (1 mark)

serial

any **one** from:

– more accurate/fewer errors <u>over a longer distance</u>
– less expensive wiring
– less chance of data being skewed/out of synchronisation/order (1 mark) [2]

(c) parallel

any **one** from:

– sending data from a computer to a printer
– internal data transfer (buses) (1 mark)

serial

– connect computer to a modem (1 mark) [2]

2 **(a)** – universal serial bus
– description of USB [1]

(b) Any **two** from:

– devices are automatically detected and configured when initially attached
– impossible to connect device incorrectly/connector only fits one way
– has become the industry standard
– supports multiple data transmission speeds
– lots of support base for USB software developers
– supported by many operating systems
– backward compatible
– faster transmission compared to wireless [2]

5 **(a)** 1 mark per correctly placed tick

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) **(i)** byte number: **7**

column number: **6**

[2]

(ii) Any **two** from:

- letter "A"(byte 7) transmitted as odd parity (three 1s)
- column 6 has odd parity (seven 1s)
- intersection of byte 7 and column 6 indicates incorrect bit value

[2]

(c) 190

[1]

(d) Any **one** from:

- 2 bits interchanged (e.g. 1 → 0 and 0 → 1) that won't change parity value
- even number of bits/digits are transposed
- If there are multiple errors in the same byte/column, that still produce the same parity bit, the error will not be detected

[1]

9 (a) **1** mark for correct check digit and **1** mark for showing the calculation

$(4 \times 1) + (2 \times 2) + (4 \times 3) + (1 \times 4) + (5 \times 5) + (0 \times 6) + (8 \times 7)$

$= 4 + 4 + 12 + 4 + 25 + 0 + 56 = 105$

$105/11 = 9$ remainder 6

1 mark for any correct line of working

check digit is: **6** [2]

(b) **incorrect** check digit [1]

- check digit should be 1
- (3*1) + (2*2) + (4*3) + (0*4) + (0*5) + (4*6) + (5*7) // 3 + 4 + 12 + 0 + 0 + 24 + 35 // Total = 78
- 78/11 gives 7 remainder 1 [2]

6 (a)

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

Method	Tick (✓)
serial	
parallel	✓

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

Method	Tick (✓)
serial	✓
parallel	

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

Method	Tick (✓)
serial	✓
parallel	

[6]

(b) Any **two** from:
- single wire means there is less chance of interference/data corruption
- single wire reduces costs
- more reliable over greater distances
- bits will still be synchronised after transmission [2]

Question	Answer	Marks
4	1 mark per correct tick	5

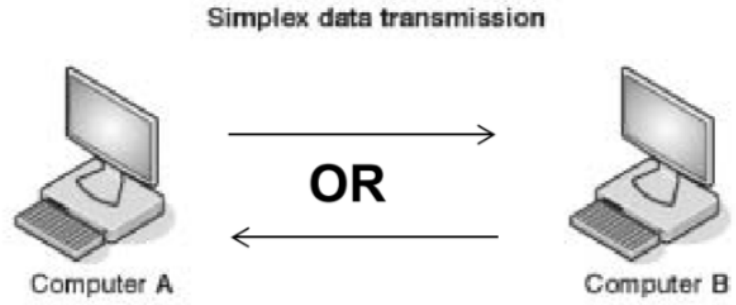
Statement	True	False
Data is transmitted in one direction only, one bit at a time.		✓
Data is transmitted in both directions, multiple bits at a time.		✓
Data is transmitted in one direction only, multiple bits at a time.		✓
Data is transmitted in both directions, but only one direction at a time. Data 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.		✓

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>5(a)</td><td>1 mark per correct tick

<table><tr><th>Received byte</th><th>corrupted during transmission (✓)</th><th>not corrupted during transmission (✓)</th></tr><tr><td>10110100</td><td>✓</td><td></td></tr><tr><td>01101101</td><td></td><td>✓</td></tr><tr><td>10000001</td><td>✓</td><td></td></tr></table></td><td>3</td></tr>
<tr><td>5(b)</td><td>Four from:
Uses acknowledgement and time out
Check performed on received data // error is detected by e.g. parity check, check sum
If error detected, request sent to resend data // negative acknowledgment is used
If no acknowledgement is sent that data is received // positive acknowledgement is used
Data is resent / Resend request repeated, till data is resent correctly …
… or request times out // limit is reached</td><td>4</td></tr>
</table>

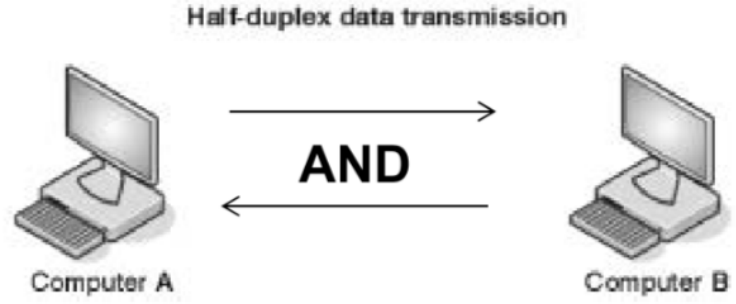
Question	Answer	Marks
4	**Two** marks for each correct description **Parity Check** Checks a byte of data Check is performed when data is received A parity bit is added (to the parity byte) Counts / checks number of 1's // counts / checks to see if 1's are even // counts / checks to see if 1's are odd Can be <u>even</u> or <u>odd</u> If parity is incorrect, error is detected **Check digit** A digit that is calculated from the data // uses modulo to calculate digit // valid description of modulo It is appended / added to the data Digit is recalculated when data is entered Digits are compared to check for error **Checksum** A value is calculated from the data // Valid description of calculation It is transmitted with the data Value is recalculated after transmission Values are compared after transmission to check for error **Automatic Repeat reQuest** Uses acknowledgement / request and time-out Error control protocol Check performed on receiving data // error is detected by e.g. parity check, check sum If error detected, request is sent to resend data // negative acknowledgement is used Resend request is repeated till data is sent correctly / requests time out / limit is reached Send acknowledgement that data is received // positive acknowledgement is used If acknowledgement not received in set time data is resent	**8**

Question	Answer	Marks
7(a)	1 mark for correct arrow(s), one mark for correct description	6



(Direction of data is) one way only // unidirectional

(Direction of data is both ways) at same time / simultaneously / concurrently



(Direction of data is both ways) but at different times / not at the same time / not simultaneously / not concurrently

Question	Answer	Marks
7(b)	1 mark each use, must be different. **Simplex** e.g.: Microphone to computer Sensor to computer Computer to printer Computer to speaker Computer to monitor Webcam to computer Sending data to a device // sending data from a device **Duplex** e.g.: Telephone call Voice over IP Computer to printer (only award once) Instant messaging Broadband connections Video conferencing Sending data to and from devices e.g wireless technology Computer to modem	**2**
7(c)	2 marks for IC, 2 marks for USB **IC** parallel transmission // description of parallel for sending data internally **USB** serial transmission // description of serial for sending data externally (to and from peripherals / between devices)	**4**

Question	Answer	Marks
4(a)(i)	<table><tr><th>Method 1</th><th>Tick (✓)</th><th>Method 2</th><th>Tick (✓)</th></tr><tr><td>Serial</td><td>✓</td><td>Simplex</td><td></td></tr><tr><td>Parallel</td><td></td><td>Half-duplex</td><td></td></tr><tr><td></td><td></td><td>Duplex</td><td>✓</td></tr></table>	**2**
4(a)(ii)	Any **four** from (**Max 3** for serial): Serial has <u>less/lower</u> interference Serial is (more) reliable/accurate <u>over distances</u> In serial the bits won't be skewed In serial it is easier to collate the bits together again after transmission Duplex transmits data in both directions <u>at the same time</u> simplex/half-duplex/remaining methods won't allow read and write at same time	**4**

Question	Answer	Marks
4(b)	1 mark for error checking method, 2 marks for description: Checksum A value is calculated from the data // Description of calculation Value is transmitted with data Value is recalculated after transmission If the values match the data is (more likely to be) accurate Parity check A parity bit is transmitted with each byte of data Odd or even (parity can be used) Counts / checks number of 1's // counts / checks to see if 1's are even // counts / checks to see if 1's are odd (Each byte is) checked after transmission to see if it matches the odd/even parity used Automatic Repeat Request (ARQ) Uses acknowledgement and timeout When a device detects an error in data transmission it asks for the packet to be resent / no error detected, positive acknowledgment sent The sending device resends the packet after the request to resend/ timeout received This process is continuous until the packet received is correct/until the ARQ limit is reached Echo (check) Copy of data is sent back to sender Data is compared to see if it matches If it does not match error detected	**6**

12 (a)

1	1	1	1	1	0	0	0
0	0	0	0	0	1	1	1

[2]

(b) 1 mark for error detection method and 1 mark for description

- Check sum
- … sum of bits is transmitted and checked against the sum of the received bits

- Check digit
- … a digit that is calculated (e.g. using modulo-11) and transmitted with the data

- ARQ
- … when an error is detected in a packet of data a request is automatically sent for the data to be resent

[2]

7 (a) (i) 1 mark for correct check digit and 1 mark for showing the calculation

(4 × 1) + (2 × 2) + (4 × 3) + (1 × 4) + (5 × 5) + (0 × 6) + (8 × 7)

= 4 + 4 + 12 + 4 + 25 + 0 + 56 = 105

105/11 = 9 remainder 6

check digit is: **6** [2]

(ii) 1 mark
- No/incorrect check digit

2 marks
- Total is 78
- 78/11 …
- … gives 7 remainder 1
- check digit should be 1 [3]

(b) (i) 1 mark for each correct parity bit

parity bit

0	1	1	0	0	1	1	0

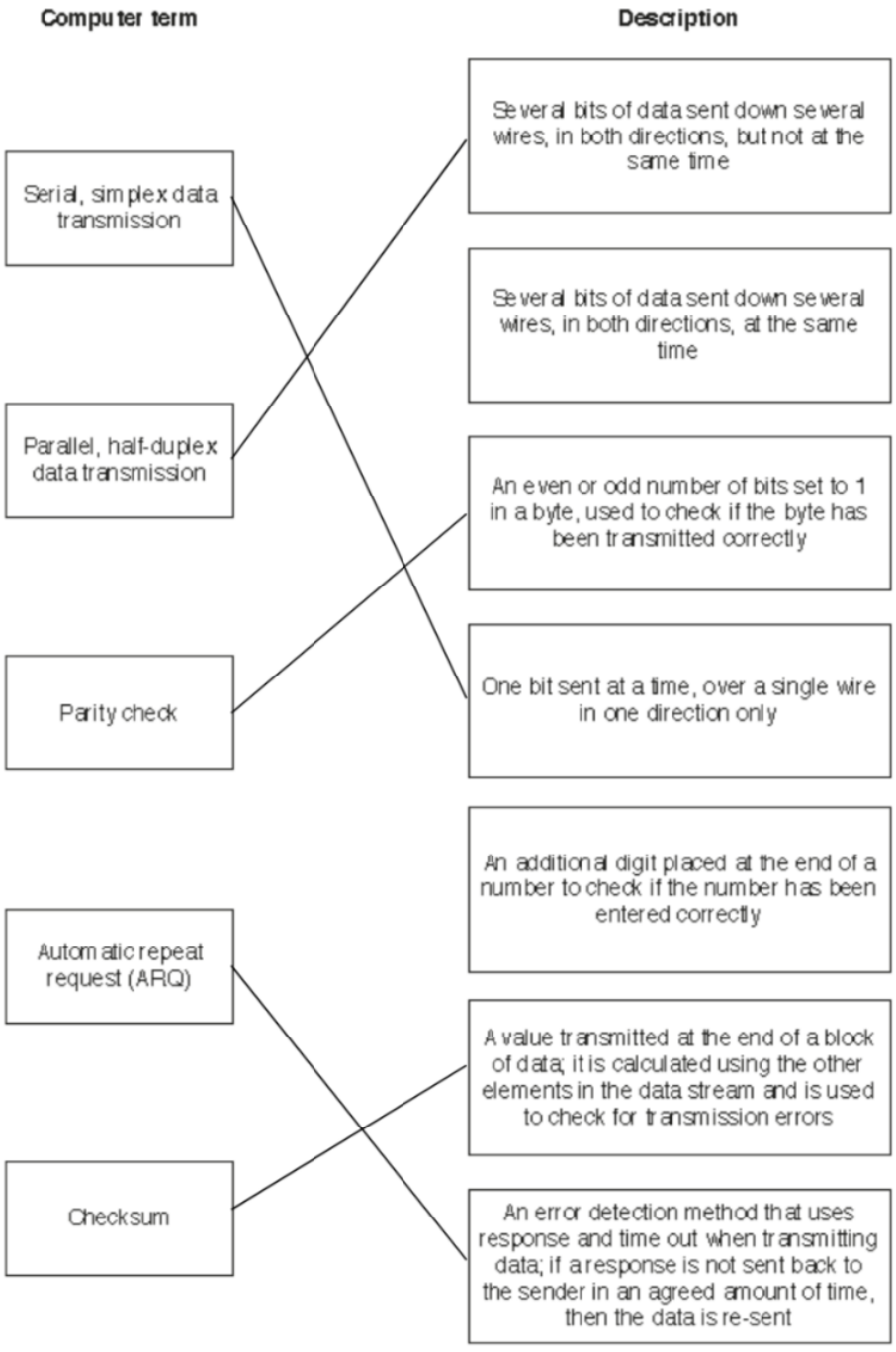
parity bit

1	0	0	0	0	0	0	1

[2]

(ii) Any **one** from:
- an even number of digits are changed
- a transposition error(s) has occurred [1]

3


Computer term
Description
Serial, simplex data transmission
Parallel, half-duplex data transmission
Parity check
Automatic repeat request (ARQ)
Checksum
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
An even or odd number of bits set to 1 in a byte, used to check if the byte has been transmitted correctly
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
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]

3 **(a)** **(i)** Any **two** from:

serial

- one bit sent at a time // bits sent sequentially
- over a single wire
- synchronous or asynchronous

[2]

(ii) Any **two** from:

parallel

- several bits / a byte sent at a time
- using many / multiple wires
- synchronous

[2]

(b) – serial

Any **two** from:

- serial data transmission more reliable over long distances
- less likely for the data to be skewed/out of synchronisation
- less interference as only a single wire
- it is a cheaper connection as only single wire needed // cheaper to set up
- a fast connection is not required as a printer is limited by its printing speed

[3]

4 **(a)** Intersection of Row 7 and column 4 circled [1]

(b) – Row (byte number) 7 has an odd number of 1s (five 1s)
– Column (bit number) 4 has an odd number of 1s (five 1s)

[2]