CAMBRIDGE IGCSE (0478)

Module D: Data transmission

Workbooklet mark scheme · 6 parts · 122 marks

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	Total	**122**

MODULE D DATA TRANSMISSION · D1

Packets and packet switching: mark scheme

20 marks · Cambridge 0478 syllabus 2.1.1

How to use. One mark per creditworthy point up to the maximum shown. **/** separates alternative words; **//** separates alternative answers. Words in (brackets) are not needed for the mark. "..." means the point builds on the one before. Nothing incorrect is rewarded.

QUESTION	ANSWER	MARKS	GUIDANCE
1(a) 0478 2.1.1(b)	One mark for each: (packet) header payload trailer	**3**	Any order. Do not accept "data" alone for payload.
1(b) 0478 2.1.1(b)	Payload	**1**	More than one tick = 0.
2(a) 0478 2.1.1(b)	One mark for each: destination address // address of the receiving device packet number originator's address // address of the sending device // source address	**3**	Any order. "Address" alone = 0 (must say which address). Do not credit payload.
3(a) 0478 2.1.1(b)(c)	Any two from: packets may take different routes // packets may arrive out of order the number shows the packet's place in the order (of the original data) ... so the packets can be reordered / put back in order (once the last packet has arrived)	**2**	max 2.
3(b) 0478 2.1.1(b)(c)	Any two from: it shows where the packet is going // identifies the receiving device a router reads the destination address ... so the router can control the route the packet takes // decide where to send it next so the packet reaches the correct device / the contractor's computer	**2**	max 2.
4(a) 0478 2.1.1(a)(c)	Any six from: the file / data is broken down into packets each packet has a header containing the destination address // packet number each packet could take a different route a router controls the route a packet takes ... ... using the destination address packets may arrive out of order once the last packet has arrived, the packets are reordered ... ... using the packet numbers	**6**	max 6. Do not credit server for router. Do not credit "the packets are reordered as they arrive".

QUESTION	ANSWER	MARKS	GUIDANCE
5(a) 0478 2.1.1(c)	Same route: False Router controls the route: True Reordered when first arrives: False	**3**	1 mark per correct row. More than one tick in a row = 0 for that row. Row 1: each packet could take a different route. Row 3: packets are reordered once the last packet has arrived.

Total: 20 marks

MODULE D DATA TRANSMISSION · D2

Serial, parallel and duplex: mark scheme

20 marks · Cambridge 0478 syllabus 2.1.2

How to use. One mark per creditworthy point up to the maximum shown. **/** separates alternative words; **//** separates alternative answers. Words in (brackets) are not needed for the mark. "..." means the point builds on the one before. Vague answers such as "it is faster" or "it is better" with no reason are not credited. Never credit a reversed answer (for example, saying serial data is skewed).

QUESTION	ANSWER	MARKS	GUIDANCE
1(a) 0478 2.1.2(a)	(Data is sent) one bit at a time ... down a single wire / channel	**2**	One mark per bullet.
1(b) 0478 2.1.2(a)	Multiple / several bits are sent at the same time ... down multiple wires / channels	**2**	One mark per bullet.
2(a) 0478 2.1.2(a)	Sensor to monitoring computer: simplex Handheld radios: half-duplex Video call: full-duplex Both directions, one at a time: half-duplex	**4**	One mark per correct row. A row with more than one tick scores 0.
3(a) 0478 2.1.2(b)	Any three from: The data travels a long distance // 300 m is a long distance Bits arrive in order / in sequence // data will not be skewed Less interference // no crosstalk (between wires) More reliable / accurate over long distances Only one wire is needed, so the (long) cable is cheaper Sensor readings are a small amount of data, so the lower speed is not a problem	**3**	max 3. Answers must say why serial suits this link, not just describe serial.
3(b) 0478 2.1.2(b)	Any one from: Slower (than parallel) // takes longer to send data as only one bit is sent at a time	**1**	Do not accept "data can be skewed": skew is a parallel problem.
4(a) 0478 2.1.2(b)	Any two from: Short distance // the cable is only 30 cm ... so the bits are unlikely to be skewed // bits arrive together / in sync Multiple bits are sent at the same time, so it is faster Large amounts of data need to be sent quickly	**2**	max 2. "Faster" alone, with no reason, scores 0.
4(b) 0478 2.1.2(b)	Any two from: Data needs to travel in both directions ... at the same time Print data can be sent while status data comes back // no waiting for the direction to switch	**2**	max 2.

QUESTION	ANSWER	MARKS	GUIDANCE
4(c) 0478 2.1.2(b)	Any two from: Data can be skewed // bits may arrive out of order / at different times (over a long distance) More interference / crosstalk between the wires More wires are needed, so it is more expensive Only suitable for short distances // less reliable over long distances	**2**	max 2. Skew and "bits out of order" are the same point.
5(a) 0478 2.1.2(b)	Any one from: Cheaper // fewer wires / channels needed Simpler to set up	**1**	max 1.
5(b) 0478 2.1.2(b)	Any one from: Data can be sent in both directions at the same time No waiting for the other device to finish sending // no delay switching direction // faster overall	**1**	max 1. Do not accept "both directions" alone: half-duplex also does this.

Total: 20 marks

MODULE D DATA TRANSMISSION · D3

The USB interface: mark scheme

20 marks · Cambridge 0478 syllabus 2.1.3

How to use. One mark per creditworthy point up to the maximum shown. **/** separates alternative words; **//** separates alternative answers. Words in (brackets) are not needed for the mark. Benefit and drawback lists follow the points Cambridge credited in its 0478 Oct/Nov 2025 mark scheme; they are not exhaustive. Credit any other valid benefit or drawback. "Fast" or "faster" on its own is not enough; "fast transmission" // "adequate transmission speed" is credited. "Can be used over long distances" is not credited.

QUESTION	ANSWER	MARKS	GUIDANCE
1(a) 0478 2.1.3	Universal serial bus	**1**	All three words needed. Ignore capitals.
1(b) 0478 2.1.3	Serial	**1**	Both boxes ticked = 0.
2(a) 0478 2.1.3	Any two from: Data is sent one bit at a time // bit by bit Data is sent down a single wire / channel / line	**2**	"Serial" alone is not a mark; it must be explained. Do not accept "down a cable" alone (too vague). Do not credit "several bits at once" (that is parallel).
2(b) 0478 2.1.3	Any two from: The tablet is (automatically) detected (by the computer) The (device) driver is automatically downloaded / installed The tablet is ready to use without the user setting it up // plug and play	**2**	"Plug and play" alone = 1. Do not accept "the user installs the driver".
3(a) 0478 2.1.3	Any two from: The keyboard is (automatically) detected // driver automatically installed // plug and play The keyboard can be powered by the computer (through the connection) It is a universal connection / standard It is backward compatible The cable cannot be inserted incorrectly // cannot be plugged in the wrong way round Supports different data transmission speeds High / adequate transmission speed Less chance of errors / skewing // unlikely to have interference / crosstalk	**2**	"Fast" / "faster" alone = NE. Do not accept "can be used over long distances". Do not accept "it is cheap" or "it is wireless".
3(b) 0478 2.1.3	Any one from: The wire may get in the way // the wire may limit where the keyboard can be moved Slower transmission than a parallel connection Limited (maximum) cable length // cannot be used over long distances (without a repeater)	**1**	"Slow" / "slower" alone = NE; it must be compared with parallel. Credit any other valid drawback of USB.

QUESTION	ANSWER	MARKS	GUIDANCE
4(a) 0478 2.1.3	Several bits at the same time down several wires: False Can be powered through its USB connection: True Driver must always be installed by hand: False Backward compatible: True	**4**	1 mark per correct row. More than one tick in a row = 0 for that row. Row 1 describes parallel transmission; USB is serial. Row 3: the driver is installed automatically (plug and play).
5(a) 0478 2.1.3	Any two from: USB uses serial transmission // sends data one bit at a time (down a single wire) Parallel sends several bits at the same time (down several wires) So (over a short distance) USB is slower than a parallel connection	**2**	The answer must show the technician is wrong. Do not credit "USB is faster".
6(a) 0478 2.1.3	Any five from, max 4 from benefits and max 2 from drawbacks: **How it sends data** Data is sent one bit at a time down a single wire (serial) **Benefits** Each device is automatically detected // drivers installed automatically // plug and play, so staff can set up desks without installing software The mouse / webcam can be powered by the computer through the connection It is a universal connection, so the mouse, webcam and drive can all use the same type of port It is backward compatible (with older ports / devices) It cannot be plugged in the wrong way round Supports different data transmission speeds // adequate transmission speed for the devices Less chance of errors / skewing // interference **Drawbacks** Slower transmission than a parallel connection (e.g. when copying large files to the storage drive) The wires may get in the way // may limit movement of the mouse Limited (maximum) cable length // cannot be used over long distances (without a repeater) Credit any other valid drawback of USB	**5**	No drawback given: max 4. A bare list of one-word benefits ("universal, power, plug and play") = max 2. "Fast" alone = NE. Do not accept "can be used over long distances", "wireless" or "more secure" as benefits.

Total: 20 marks

MODULE D DATA TRANSMISSION · D4

Parity checks and checksums: mark scheme

21 marks · Cambridge 0478 syllabus 2.2.1, 2.2.2

How to use. One mark per creditworthy point up to the maximum shown. **/** separates alternative words; **//** separates alternative answers. Words in (brackets) are not needed for the mark. A correct answer with no working gets full marks. The 0478 syllabus does not set a particular checksum calculation, so Question 5 needs no calculation method; any valid description of the process is credited.

QUESTION	ANSWER	MARKS	GUIDANCE
1(a) 0478 2.2.1	Any two from: data loss // bits / data missing data gain // extra bits / data added data change // bits changed / flipped (0 to 1 or 1 to 0)	**2**	max 2. Two different ways needed. Do not accept "data is stolen / intercepted" (a security issue, not a transmission error).
1(b) 0478 2.2.1	Any two from: (interference means) the data received may not be the same as the data sent to make sure the data is accurate / correct / not corrupted incorrect readings could otherwise be stored / used / acted on so that data with errors can be identified (and sent again)	**2**	max 2.
2(a) 0478 2.2.2	Row 1: 0 Row 2: 1 Row 3: 0	**3**	1 mark per row. Working: 1010011 has four 1s, so 0 (01010011); 0111011 has five 1s, so 1 (10111011, six 1s); 0000000 has no 1s, so 0 (zero counts as even).
2(b) 0478 2.2.2	11010010: Error detected 01110110: No error detected 10000000: No error detected	**3**	1 mark per correct row. Working: four 1s (even, fails odd parity); five 1s (odd); one 1 (odd). More than one tick in a row = 0 for that row.
3(a) 0478 2.2.2	Any two from: if two / an even number of bits change ... ... the number of 1s is still odd / even (as agreed) // the parity is still correct so the error is not detected bits could be swapped / transposed and the number of 1s is unchanged	**2**	max 2. "It cannot tell which bit is wrong" alone is not creditworthy here (that is about locating an error, not missing one).
4(a) 0478 2.2.2	Byte 3 Column 6	**2**	1 mark each. Working: 1s in each row (bytes 1-4, parity byte) are 4, 6, **5**, 4, 6, so only byte 3 is odd; 1s in columns 1-8 are 2, 2, 4, 2, 4, **3**, 4, 4, so only column 6 is odd. The changed bit is where they cross.

QUESTION	ANSWER	MARKS	GUIDANCE
4(b) 0478 2.2.2	11000011	**1**	Received 11000111: the column 6 bit changes from 1 back to 0. The corrected byte has four 1s (even) and column 6 then has two 1s (even). Correct answer only.
4(c) 0478 2.2.2	Any two from: the 1s in each column (of the four bytes) are counted a (parity) bit is set for each column ... ... so that each column has an even number of 1s these bits together form the parity byte	**2**	max 2. Must refer to columns, not rows. Do not accept "odd number of 1s": this block uses even parity.
5(a) 0478 2.2.2	Any four from: a value / checksum is calculated from the data (using an algorithm) before it is sent the checksum is sent with the data the receiving computer recalculates the checksum from the data received (using the same algorithm) the two checksums are compared if they are different / do not match, an error is detected if they are the same / match, no error is detected // the data is accepted (if there is an error) a request is sent to resend the data	**4**	max 4. No particular calculation method is required. Do not credit a description of a parity bit / counting 1s as the checksum.

Total: 21 marks

MODULE D DATA TRANSMISSION · D5

Echo checks, check digits and ARQ: mark scheme

20 marks · Cambridge 0478 syllabus 2.2.2 (echo check), 2.2.3, 2.2.4

How to use. Any N from the points listed, up to the max shown. **/** separates alternative words; **//** separates alternative answers. Words in (brackets) are not needed for the mark. Every check-digit sum was checked by program. In Question 2 a correct final answer with no working earns 1 mark only, because the question says "Show your working" and the working is a mark point.

QUESTION	ANSWER	MARKS	GUIDANCE
1(a) 0478 2.2.2	The weather station / sender sends the data to the central computer / receiver The receiver sends a copy of the data (it received) back to the sender The sender compares the data sent back with the original data (it sent) If they match, no error is detected // the data is assumed correct If they do not match, an error is detected ... ... and the data is sent again	**4**	Any 4 from. The comparison must be made by the sender: "the receiver compares" does not earn the comparison mark.
1(b) 0478 2.2.2	The data is sent twice // doubles the amount of data transmitted / transmission time The error may have happened on the way back, so correct data may be resent // it cannot tell whether the error was on the way there or back The same error could (in theory) happen in both directions and not be noticed	**1**	Any 1 from.
2(a) 0478 2.2.3	Working: 3×5 + 7×4 + 1×3 + 9×2 = 15 + 28 + 3 + 18 = 64; 64 ÷ 11 = 5 remainder 9 (1) Check digit = 11 − 9 = **2** (1)	**2**	1 mark for a correct total of 64 or the remainder 9 shown; 1 mark for 2. The answer 9 (the remainder) scores the working mark only. Full code is 37192.
2(b) 0478 2.2.3	Working: 3×5 + 7×4 + 9×3 + 1×2 = 15 + 28 + 27 + 2 = 72; 72 ÷ 11 = 6 remainder 6, so check digit should be 11 − 6 = 5 (1) 5 does not match the typed check digit 2 // rejected (1)	**2**	1 mark for working giving 72 (or the expected check digit 5); 1 mark for "rejected" with that reason. "Rejected" with no working: 1 mark. Allow comparison with 37192 from (a) (digits 1 and 9 swapped) for the working mark. "Accepted": 0.
3(a) 0478 2.2.3	The check digit is calculated from the other digits (and added to the code) When the code is entered, the computer recalculates the check digit from the entered digits and compares it with the check digit entered If they are different, an error is detected // the code must be re-entered	**2**	Any 2 from. Do not credit a description of parity or a checksum.

QUESTION	ANSWER	MARKS	GUIDANCE
3(b) 0478 2.2.3	ISBN // international standard book number Bar code (on products) Product codes // ID / account / membership numbers // vehicle identification numbers	**2**	Any 2 from. Do not credit a brand name.
4(a) 0478 2.2.4	The receiver / print centre checks the data for errors (on arrival) If no error is found, it sends a positive acknowledgement (to the sender) If an error is found, it sends a negative acknowledgement ... ... and the sender sends the data again The sender starts a timer // a timeout when it sends the data If no acknowledgement is received before the timeout, the data is sent again This repeats until a positive acknowledgement is received // (a set number of times)	**4**	Any 4 from. "Acknowledgement" alone without positive/negative or the condition is too vague.
5(a) 0478 2.2.2, 2.2.3, 2.2.4	Row 1: Echo check Row 2: Check digit Row 3: ARQ	**3**	1 mark per correct row. A row with more than one tick scores 0.

Total: 20 marks

MODULE D DATA TRANSMISSION · D6

Encryption: mark scheme

21 marks · Cambridge 0478 syllabus 2.3.1, 2.3.2

How to use. One mark per creditworthy point up to the maximum shown. **/** separates alternative words; **//** separates alternative answers. Words in (brackets) are not needed for the mark. Marked positively: no deductions.

QUESTION	ANSWER	MARKS	GUIDANCE
1(a) 0478 2.3.1	Any one from: • so that if the data is intercepted it cannot be understood / is meaningless • to keep personal / confidential data private // so only the warehouse (with the key) can read it • to protect against data theft / misuse of the details	**1**	"To keep it safe / secure" alone = TV. Do not accept "to stop it being intercepted".
1(b) 0478 2.3.1, 2.3.2	cipher text // ciphertext	**1**	Do not accept "encrypted data" (repeats the question) or "scrambled".
1(c) 0478 2.3.1	Any two from: • encryption does not prevent the data being intercepted / copied (as it is transmitted) • the data is scrambled / is cipher text, so an interceptor cannot understand it • it cannot be decrypted without the (correct) key	**2**	max 2.
2(a) 0478 2.3.2	One mark for each correct word, in order: plain algorithm cipher same sent	**5**	Distractors: different, intercepted, private. Gap 5: accept "given / transmitted / shared" (correct meaning) though not in the list.
3(a) 0478 2.3.2	(The printing company's) public key	**1**	Do not accept "the design agency's public key" or any private key.
3(b) 0478 2.3.2	(The printing company's) private key	**1**	Must be the opposite of 3(a). Do not accept "the design agency's private key".
3(c) 0478 2.3.2	Any two from: • the public key can only be used to encrypt (the data) // cannot be used to decrypt the data • only the (matching) private key can decrypt the drawings • the private key is kept by the printing company / is never sent / shared	**2**	max 2. "The public key is meant to be public" alone = TV.
4(a) 0478 2.3.2	One mark for each correct row: Row 1: Asymmetric Row 2: Both Row 3: Symmetric Row 4: Asymmetric	**4**	More than one tick in a row = 0 for that row. Row 4: the private key stays with the receiver.

QUESTION	ANSWER	MARKS	GUIDANCE
5(a) 0478 2.3.2	Any four from: • two (different but matching) keys are used: a public key and a private key • the partner office (receiver) sends / shares its public key with the firm // the public key is available to anyone • the firm encrypts the records with the partner office's public key • (using an encryption algorithm) the plain text is turned into cipher text • the cipher text is transmitted to the partner office • the partner office decrypts the records with its (matching) private key • the private key is kept secret / is never transmitted	**4**	max 4. Do not credit a reversed answer (encrypt with private, decrypt with public), or keys belonging to the wrong organisation (e.g. "the firm's public key").

Total: 21 marks