CAMBRIDGE IGCSE (0478)

Module B: Memory and storage

Workbooklet mark scheme · 8 parts · 161 marks

Contents

Part	Topic	Marks
B1	Primary storage, RAM and ROM: mark scheme	20
B2	Virtual memory: mark scheme	20
B3	Why computers need secondary storage: mark scheme	20
B4	Magnetic, optical and solid-state storage: mark scheme	20
B5	Choosing storage: mark scheme	21
B6	Cloud storage: mark scheme	20
B7	Units of data storage: mark scheme	20
B8	Calculating file sizes: mark scheme	20
	Total	**161**

MODULE B MEMORY AND STORAGE · B1

Primary storage, RAM and ROM: mark scheme

~25 minutes · 20 marks · Cambridge 0478 syllabus 3.3.1

How to use. Mark positively. "Any N from" means award one mark per point up to N. **//** separates alternative answers for the same mark. Words in (brackets) are not needed for the mark. Credit any other valid answer that shows the same understanding.

QUESTION	ANSWER	MARKS	GUIDANCE
1(a) 0478 3.3.1	Storage / memory that is directly accessed by the CPU / processor	**1**	
1(b) 0478 3.3.1	Any two from: RAM // random access memory ROM // read only memory Cache	**2**	Registers are not credited. Secondary storage devices are not credited.
2 0478 3.3.1	ROM is volatile: False RAM stores the data currently in use: True ROM contents normally changed every time a program runs: False Both RAM and ROM directly accessed by the CPU: True	**4**	One mark per correct row. Two ticks in a row: no mark for that row.
3 0478 3.3.1	start-up instructions non-volatile volatile read and write	**4**	One mark per correct term, in order.
4 0478 3.3.1	Any three from: The data in RAM is lost (when the battery runs out) // e.g. the exhibit number typed in is lost ... because RAM is volatile The contents of ROM are kept // because ROM is non-volatile When switched on again, the start-up instructions in ROM are run / read by the CPU (Part of) the operating system / the guide's program is loaded into RAM again	**3**	max 3. Must refer to both RAM and ROM for full marks.

QUESTION	ANSWER	MARKS	GUIDANCE
5 0478 3.3.1	Any four from: ROM stores the start-up instructions // the BIOS / bootstrap ROM is non-volatile // ROM keeps its contents when power is off ... so the instructions are available every time the guide is switched on ROM is read only // contents cannot normally be changed, so the start-up instructions cannot be changed / deleted by accident RAM stores the data / instructions currently in use RAM is read and write // contents can be changed (as the guide is used) RAM is volatile, so it cannot keep the start-up instructions when the power is off	**4**	Maximum 3 marks if only RAM or only ROM is described.
6 0478 3.3.1	Any two from: RAM is volatile, ROM is non-volatile // RAM loses its contents when power is off, ROM does not RAM is read and write, ROM is read only // RAM contents can be changed, ROM contents normally cannot RAM stores data / programs currently in use, ROM stores the start-up instructions RAM normally has a larger capacity than ROM	**2**	Each difference must refer to both RAM and ROM.

Total: 20 marks

MODULE B MEMORY AND STORAGE · B2

Virtual memory: mark scheme

Mark scheme · ~25 minutes · 20 marks · Cambridge 0478 syllabus 3.3.4

How to use. Mark positively. "Any N from" means award one mark per point up to N. **//** separates alternative answers for the same mark. Words in (brackets) are not needed for the mark. Credit any other valid answer that shows the same understanding.

QUESTION	ANSWER	MARKS	GUIDANCE
1(a) 0478 3.3.4	Any **two** from: (Part of) secondary storage // HDD // SSD used as (if it were) (extra) RAM used when RAM is full (to) temporarily hold pages / data moved from RAM	**2**	max 2. Do not credit "extra RAM chips" or "part of the CPU".
1(b) 0478 3.3.4	Any **two** from: The operating system creates it by allocating / partitioning / setting aside an area of secondary storage // HDD // SSD when RAM is (nearly) full	**2**	max 2.
2 0478 3.3.4	full secondary storage pages needed RAM	**5**	1 mark per correct term, in order.
3 0478 3.3.4	Any **three** from: RAM has a limited size // 16 GiB may not be enough (several large) programs / data / films may fill RAM virtual memory gives extra space when RAM is full so more programs / data can be open at once // a new program can still be loaded prevents the computer crashing / failing to load a program when RAM is full	**3**	max 3. Do not credit "to store files" / "for backups".
4 0478 3.3.4	Created on a ROM chip: False CPU can only process data once it is in RAM: True Store files permanently: False Pages transferred from RAM to virtual memory: True	**4**	1 mark per correct row. Two ticks in a row: no mark for that row.

QUESTION	ANSWER	MARKS	GUIDANCE
5(a) 0478 3.3.4	Any **two** from: Secondary storage is slower to access than RAM Pages must be transferred back into RAM before the CPU can use them Many pages are transferred back and forth // disk thrashing, which takes time	**2**	max 2. "Virtual memory is slower" alone is not enough.
5(b) 0478 3.3.4	Install / add more RAM so more programs / data fit in RAM // RAM is full less often // fewer pages need to be transferred	**2**	1 mark for the action, 1 for a reason that follows it. Also credit: close programs / films not in use, so less RAM is used.

Total: 20 marks

MODULE B MEMORY AND STORAGE · B3

Why computers need secondary storage: mark scheme

20 marks · Cambridge 0478 syllabus 3.3.2

How to use. Mark positively. "Any N from" means award one mark per point up to N. **//** separates alternative answers for the same mark. Words in (brackets) are not needed for the mark. "..." means the point depends on the one before. Credit any other valid answer that shows the same understanding.

QUESTION	ANSWER	MARKS	GUIDANCE
1 0478 3.3.1, 3.3.2	HDD: Secondary RAM: Primary SSD: Secondary ROM: Primary	**4**	1 mark per correct row. More than one tick in a row: no mark for that row.
2 0478 3.3.2	directly RAM // primary storage // main memory non-volatile permanent // long-term	**4**	1 mark per correct word. Do not accept "ROM" or "cache" for the second blank. Do not accept "secure" / "backup" for the last blank.
3(a) 0478 3.3.2	Any **two** from: To store the software / loan log permanently // long-term It is non-volatile // RAM is volatile ... so the software / loan log is not lost when the kiosk is switched off (each night) RAM is too small to hold all the software and the loan log	**2**	max 2. Do not accept "for backups" alone: a backup may be a use, but it is not the purpose. Do not accept "used when RAM is full".
3(b) 0478 3.3.2	Any **three** from: The software is stored on secondary storage (e.g. HDD / SSD) while the kiosk is off The CPU cannot access secondary storage directly The software / instructions (and data) are copied / loaded into RAM The CPU fetches the instructions (and data) from RAM // executes them from RAM	**3**	max 3. Do not accept "the CPU runs the software straight from the hard disk". Do not accept "loaded into ROM".

QUESTION	ANSWER	MARKS	GUIDANCE
4 0478 3.3.2	Any **two** differences, 2 marks each (one for each side): Primary storage is directly accessed by the CPU // secondary storage is not directly accessed by the CPU RAM is volatile // secondary storage is non-volatile Primary storage is faster to access // secondary storage is slower to access Primary storage usually has a smaller capacity // secondary storage usually has a larger capacity Primary storage holds the data / instructions currently in use // secondary storage holds data / programs (more) permanently	**4**	max 4. 1 mark for one side of a difference, 1 for the matching other side. A single comparative sentence covering both sides earns 2 (e.g. "primary is faster to access than secondary"). Do not accept "primary storage is volatile" (ROM is non-volatile): accept "RAM is volatile".
5 0478 3.3.2	Any **three** from: The version saved an hour earlier will be available ... because it is stored on the SSD / secondary storage, which is non-volatile The latest (unsaved) edits are lost ... because they were only in RAM ... which is volatile // loses its data when power is lost	**3**	max 3. Do not accept "the recording is lost completely".

Total: 20 marks

MODULE B MEMORY AND STORAGE · B4

Magnetic, optical and solid-state storage: mark scheme

~25 minutes · 20 marks · Cambridge 0478 syllabus 3.3.3

How to use. Mark positively. "Any N from" means award one mark per point up to N. **//** separates alternative answers for the same mark. Words in (brackets) are not needed for the mark. Credit any other valid answer that shows the same understanding.

QUESTION	ANSWER	MARKS	GUIDANCE
1 0478 3.3.3	SSD: Solid-state DVD: Optical HDD: Magnetic USB flash drive: Solid-state	**4**	One mark per correct row. More than one tick in a row: no mark for that row.
2 0478 3.3.3	Any **four** from: Data is stored on (magnetic) platters // disks with a magnetic coating The platters spin Each platter is divided into (concentric) tracks ... ... and (each track into) sectors A read/write head (on an arm) moves across the platter The head uses an electromagnet ... ... to magnetise tiny areas / regions of the surface (to write data) Data is read by the head sensing / detecting the magnetised areas The pattern of magnetised areas represents the binary data / 1s and 0s	**4**	max 4. Do not accept "uses magnets" alone. Do not credit lasers, pits/lands or electrons/gates.
3 0478 3.3.3	laser pits lands reflect	**4**	One mark per correct word, in order. Accept "laser beam". Final blank: accept "reflect // scatter // reflect different amounts of".

QUESTION	ANSWER	MARKS	GUIDANCE
4 0478 3.3.3	Any **four** from: Uses flash memory // has no moving parts Uses NAND or NOR technology Data is stored (electronically) in cells made of transistors Each transistor has a control gate and a floating gate A voltage on the control gate moves / pulls electrons into the floating gate Electrons are trapped in the floating gate (by insulation) ... ... and stay there when the power is off // it is non-volatile Whether or not electrons are trapped represents a bit // trapped = 0, empty = 1	**4**	max 4. Accept either 0/1 mapping if used consistently. Do not credit magnets or lasers.
5(a) 0478 3.3.3	Any **two** from: SD card // memory card USB flash drive // USB memory stick // pen drive (Built-in) flash memory in a phone / tablet / camera	**2**	Do not accept "USB" alone (it is a port). Do not accept SSD, HDD, CD, DVD, Blu-ray, RAM or ROM. No marks for brand names.
5(b) 0478 3.3.3	Any **two** from: An SSD has no moving parts // reads data electronically An HDD must wait for the platter to spin to the right sector An HDD must move the read/write head to the right track An SSD can access any cell directly // has no waiting for mechanical movement	**2**	max 2. Do not accept "an SSD is faster" alone (repeats the question).

Total: 20 marks

MODULE B MEMORY AND STORAGE · B5

Choosing storage: mark scheme

~25 minutes · 21 marks · 0478 syllabus 3.3.3

How to use. "Any N from" means award 1 mark per valid point up to N. **//** separates alternative answers for the same mark. Words in (brackets) are not needed for the mark. Mark positively; credit any other valid answer.

QUESTION	ANSWER	MARKS	GUIDANCE
1(a) 0478 3.3.3	HDD: magnetic SD card: solid state Blu-ray disc: optical USB flash drive: solid state DVD: optical	**5**	1 mark per row. More than one tick in a row = 0 for that row.
2(a) 0478 3.3.3	Solid state // flash memory	**1**	Accept SSD / memory card. Do not accept a device that is not solid state.
2(b) 0478 3.3.3	Any three from: It has no moving parts It stores data using transistors // NAND/NOR flash // control gates and floating gates Data is stored electronically // as trapped charge (not by mechanical parts) So it is not damaged when the device is dropped / shaken in the van // it is durable/robust It is small/light, so it fits in a handheld device It is non-volatile, so delivery records are kept when the device is switched off	**3**	max 3. Award 2 at most if no reference to how solid state works (no moving parts / transistors / gates / flash).
3(a) 0478 3.3.3	Any three from: Data is stored on (spinning) platters Platters are divided into tracks and sectors A read/write head moves (on an arm) across the platter Electromagnets are used to read/write data By magnetising areas of the surface (to represent 1s and 0s)	**3**	max 3. Do not accept lasers or pits/lands (optical).

QUESTION	ANSWER	MARKS	GUIDANCE
3(b) 0478 3.3.3	Any two from: High/large capacity // can store a very large number of photographs Low cost per unit of storage // cheaper per gigabyte than solid state The drive is not moved, so its moving parts are unlikely to be damaged Non-volatile // keeps the archive when power is off Suitable for long-term storage // reliable	**2**	max 2. "Cheap" alone: accept as BOD only if linked to large amounts of data.
4(a) 0478 3.3.3	laser pits lands	**3**	Pits and lands in either order. Accept "laser beam".
4(b) 0478 3.3.3	Any two from: Discs are cheap to produce in large numbers // low cost for 200 copies Light/thin/small, so cheap and easy to post Enough capacity to hold a film // Blu-ray has a large capacity (for an optical disc) Read-only disc, so the film cannot be changed/deleted (accidentally) Reviewers can play it in a standard disc player/drive	**2**	max 2. Do not accept "durable" (optical discs scratch easily).
5(a) 0478 3.3.3	Any two from: Magnetic storage has moving parts // the platter must spin and the read/write head must move to the right place Which takes time // causes a delay before data can be read Solid state has no moving parts // data is accessed electronically (using transistors) So data can be read/written almost immediately	**2**	max 2. "Solid state is faster" alone = 0 (repeats the question).

Total: 21 marks

MODULE B MEMORY AND STORAGE · B6

Cloud storage: mark scheme

20 marks · Cambridge 0478 syllabus 3.3.5, 3.3.6

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. Credit any other valid answer that shows the same understanding.

QUESTION	ANSWER	MARKS	GUIDANCE
1(a) 0478 3.3.5	Any two from: Data is stored on (remote) servers // off-site (servers) owned / managed by a third party // provider Accessed (remotely) over the internet // a network Can be accessed from any device with an internet connection	**2**	max 2. Do not accept "stored online" alone for 2 marks.
1(b) 0478 3.3.5	Any one from: Cloud data is stored on physical servers // storage devices (in a data centre) The provider needs physical hardware / drives to store the data	**1**	
2(a) 0478 3.3.5, 3.3.6	Accessed remotely using the internet: True Local data needs internet: False Provider maintains its servers: True Only Wi-Fi: False	**4**	One mark per correct row. A row with both boxes ticked scores 0.
3(a) 0478 3.3.6	Any four from, max two per advantage: Can be accessed from anywhere / any device with an internet connection ... staff working from home can open the bookings Several staff can access / share the same data at once ... all eight staff see the same up-to-date bookings Provider (usually) backs up the data ... bookings are not lost if the office hard drive fails / office computer is damaged Storage capacity can be increased easily ... as the company takes more bookings, it can buy more space Provider maintains the hardware // the company does not need to buy / maintain its own storage ... saves the cost of IT staff / a new drive	**4**	One mark for each advantage, one for its expansion in context. Expansion only credited with its matching advantage.

QUESTION	ANSWER	MARKS	GUIDANCE
3(b) 0478 3.3.6	Any four from, max two per disadvantage: Needs an internet connection ... if the connection fails, staff cannot see bookings Security of the data is controlled by the provider // may be less secure ... customers' personal details could be stolen if the provider is hacked Ongoing cost // subscription fee ... the company must keep paying for the storage Less control over the data ... bookings may be unavailable if the provider has a fault / closes Access may be slow // depends on internet speed ... with a slow connection, staff wait to open bookings	**4**	One mark for each disadvantage, one for its expansion in context. Do not accept "needs Wi-Fi" (any internet connection works).
4(a) 0478 3.3.6	Locally (no mark for choice alone) Any three from: There is no internet connection at the camp ... so cloud storage could not be accessed // data could not be uploaded Local storage does not need an internet connection // can be accessed offline Data can be saved straight away each day Should keep a (second) local backup copy // e.g. external drive	**3**	max 3. If "cloud storage" is chosen, award 0 for the whole part.
4(b) 0478 3.3.6	Any two from: User has (full) control of the data // of its security No ongoing / subscription fee Access is not limited by internet speed // can be faster to access Data is not held by a third party // more privacy	**2**	max 2. Do not accept "works offline" (already given in (a)).

Total: 20 marks

MODULE B MEMORY AND STORAGE · B7

Units of data storage: mark scheme

20 marks · Cambridge 0478 syllabus 1.3.1

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. The 0478 syllabus (2026-2028) uses 1 KiB = 1024 bytes and each unit is 1024 of the one before: answers using 1000 are not credited, and answers must be in the units asked for.

QUESTION	ANSWER	MARKS	GUIDANCE
1(a) 0478 1.3.1	8	**1**	Correct answer only.
1(b) 0478 1.3.1	exbibyte // EiB	**1**	Do not accept exabyte / EB.
1(c) 0478 1.3.1	4 (bits) 2 (nibbles) 1024 (KiB) gibibytes // GiB	**4**	1 mark per row. Row 3: do not accept 1000. Row 4: do not accept gigabytes / GB.
2(a) 0478 1.3.1	0.5 GiB	**1**	0.5 GiB = 512 MiB; 2048 KiB = 2 MiB; 4 194 304 bytes = 4 × 1024 × 1024 = 4 MiB. More than one tick = 0.
2(b) 0478 1.3.1	nibble, byte, kibibyte, mebibyte, tebibyte, exbibyte	**2**	2 marks: all six in the correct order. 1 mark: one pair of neighbouring units swapped // one unit out of place with the rest in order. Order given largest to smallest: 0.
3(a) 0478 1.3.1	16 384 / 8 (= 2048 bytes) then / 1024 // 16 384 / 8192 2 (KiB)	**2**	1 mark for working, 1 mark for the answer. Correct answer with no working = 2. Working mark for / 8 even if the second step is wrong. Do not credit / 1000 (2.048 = 1 mark max, for / 8).
3(b) 0478 1.3.1	3072 (MiB)	**1**	3 × 1024. Do not accept 3000.

QUESTION	ANSWER	MARKS	GUIDANCE
3(c) 0478 1.3.1	5 × 1024 × 1024 // 5120 (KiB) × 1024 // 5 × 1 048 576 5 242 880 (bytes)	**2**	1 mark for working, 1 mark for the answer. Correct answer with no working = 2. 5 000 000 = 0.
3(d) 0478 1.3.1	2.5 (GiB)	**1**	2560 / 1024. Accept 2½. Do not accept 2.56.
4(a) 0478 1.3.1	Any two from: 1 KiB is 1024 bytes 1024 is a power of 2 // 1024 = 2^{10} (because) computers store data in binary // each binary place is a power of 2 1000 bytes is a kilobyte (KB), a different unit	**2**	max 2.
5(a) 0478 1.3.1	TiB larger than PiB: False 1 GiB = 1 048 576 KiB: True 8 nibbles in 4 bytes: True	**3**	1 mark per correct row. More than one tick in a row = 0 for that row. Row 2: 1024 MiB × 1024 KiB = 1 048 576 KiB. Row 3: 4 bytes = 32 bits = 8 × 4 bits.

Total: 20 marks

MODULE B MEMORY AND STORAGE · B8

Calculating file sizes: mark scheme

20 marks · Cambridge 0478 syllabus 1.3.2 (with 1.2.2, 1.2.3)

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. Calculations: one mark for each correct stage of working (max 2) and one mark for the correct answer; the unit is not needed when the question sets it. The syllabus requires 1024, not 1000: an answer using 1000 at any unit step scores 0 for the answer mark.

QUESTION	ANSWER	MARKS	GUIDANCE
1(a) 0478 1.2.3	The number of pixels in the image // width × height in pixels	**1**	Do not accept "the quality of the image" alone.
1(b) 0478 1.2.3	The number of bits used to represent each colour // bits per pixel	**1**	Do not accept "the number of colours" alone.
1(c) 0478 1.2.2	The number of bits per sample	**1**	Do not accept "the number of samples (per second)" (that is sample rate).
2(a) 0478 1.3.2	Any two working marks from: 512 × 256 × 8 // = 1 048 576 bits ÷ 8 // = 131 072 bytes ÷ 1024 Answer: 128 (KiB)	**3**	Full working: 512 × 256 = 131 072 pixels; × 8 = 1 048 576 bits; ÷ 8 = 131 072 bytes; ÷ 1024 = 128 KiB. max 2 for working. 131.072 (÷ 1000) scores 0 for the answer.
3(a) 0478 1.3.2	Any two working marks from: 1024 × 1024 × 24 // = 25 165 824 bits ÷ 8 // = 3 145 728 bytes ÷ 1024 // = 3072 KiB ÷ 1024 (again) Answer: 3 (MiB)	**3**	Full working: 1024 × 1024 = 1 048 576 pixels; × 24 = 25 165 824 bits; ÷ 8 = 3 145 728 bytes; ÷ 1024 = 3072 KiB; ÷ 1024 = 3 MiB. Shortcut accepted: 1024 × 1024 pixels × 3 bytes ÷ (1024 × 1024) = 3 MiB. max 2 for working. 3072 (left in KiB) does not score the answer mark.
4(a) 0478 1.3.2	Any two working marks from: 8192 × 8 × 128 // = 8 388 608 bits ÷ 8 // = 1 048 576 bytes ÷ 1024 // = 1024 KiB ÷ 1024 (again) Answer: 1 (MiB)	**3**	Full working: 8192 × 128 = 1 048 576 samples; × 8 = 8 388 608 bits; ÷ 8 = 1 048 576 bytes; ÷ 1024 = 1024 KiB; ÷ 1024 = 1 MiB. max 2 for working.

QUESTION	ANSWER	MARKS	GUIDANCE
4(b) 0478 1.3.2	2 (MiB)	**1**	8192 × 16 × 128 = 16 777 216 bits = 2 097 152 bytes = 2 MiB. FT: double their answer to 4(a).
5(a) 0478 1.3.2	Any two working marks from: 4096 × 16 × 30 // = 1 966 080 bits ÷ 8 // = 245 760 bytes ÷ 1024 Answer: 240 (KiB)	**3**	Full working: 4096 × 30 = 122 880 samples; × 16 = 1 966 080 bits; ÷ 8 = 245 760 bytes; ÷ 1024 = 240 KiB. Hand tip: each second is 4096 × 16 ÷ 8 = 8192 bytes = 8 KiB, and 8 KiB × 30 = 240 KiB. Accept this method. max 2 for working. 245.76 (÷ 1000) scores 0 for the answer.
6(a) 0478 1.3.2	Divided by 1000 instead of 1024 // should divide by 1024 (1 KiB = 1024 bytes) 4 (KiB)	**2**	4096 ÷ 1024 = 4. Do not accept "the first line is wrong" (the first two lines are correct).
7(a) 0478 1.2.2	The file size decreases // fewer samples (per second) are stored The accuracy of the recording decreases // the recording is less like the original sound	**2**	One mark per effect. Do not accept "sound quality gets better" or "file size increases".

Total: 20 marks