CAMBRIDGE IGCSE (0478)

Module H: Software

Workbooklet mark scheme · 7 parts · 141 marks

H8 is GCSE (OCR) only and not on 0478.

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	Total	**141**

MODULE H SOFTWARE · H1

System software vs application software: mark scheme

20 marks · Cambridge 0478 syllabus 4.1.1 (describe the difference between system software and application software and provide examples of each; system software, including the operating system and utility software, provides the services the computer requires; application software provides the services the user requires)

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. No marks for brand names of software.

QUESTION	ANSWER	MARKS	GUIDANCE
1(a) 0478 4.1.1	One mark for each correct row: Word processor: application software Operating system: system software Web browser: application software Encryption software: system software Photo-editing software: application software	**5**	A row with both boxes ticked scores 0.
2(a) 0478 4.1.1	One mark for each correct number, one mark for each matching correct rewrite: Statement 2 ... Application software provides the services that the user requires // System software (not application software) provides the services that the computer requires Statement 4 ... The operating system is a type of system software // The operating system and utility software are (both) types of system software // The operating system is not utility software	**4**	The rewrite mark is only awarded with the matching correct number (2 or 4). Numbers 1 and 3 score 0, and so does any rewrite of them. Accept "Application software lets the user carry out tasks" for statement 2. Do not accept "the operating system is application software" for statement 4.
3(a) 0478 4.1.1	One mark for the type, one mark for the reason: Application software ... it provides a service that the user requires // it lets the user / staff carry out a task (working out the cost / printing a quote)	**2**	Reason mark only if the type is correct. Do not accept "it is a program the user uses" alone.
3(b) 0478 4.1.1	One mark for the type, one mark for the reason: System software // utility software ... it provides a service that the computer requires // it maintains / looks after the computer (its storage) // it is defragmentation software, which is utility software // it does not carry out a task for the user	**2**	Reason mark only if the type is correct. Accept "it is a utility" as the reason when the type is given as system software. Accept "it helps the computer access files faster".

QUESTION	ANSWER	MARKS	GUIDANCE
4(a) 0478 4.1.1	Any two from: Compression software is utility software // utility software is (a type of) system software It provides a service that the computer requires // it maintains / looks after the computer // it manages storage, e.g. makes files take up less storage space The type of software depends on what the software does, not on who chooses to run it Application software provides the services the user requires // carries out the user's task, e.g. writing / sending the email	**2**	max 2. Accept "compression software is system software" for the first point. Do not accept "the user does not use it".
4(b) 0478 4.1.1	Any one from, e.g.: Defragmentation software // disk defragmenter Encryption software Anti-virus // anti-malware software Backup software Disk clean-up software Firewall (software)	**1**	Credit any other valid utility. Do not accept operating system (it is system software but not utility software). Do not accept functions of an operating system, e.g. "memory management". Do not accept compression software. No marks for brand names.
5(a) 0478 4.1.1	Any four from: **System software:** provides the services that the computer requires // lets the computer (hardware) work / run e.g. the operating system manages the computer's hardware / files / memory // provides an interface application software cannot run without the operating system // the operating system provides a platform for running the applications utility software maintains / looks after the computer, e.g. anti-malware protects the booking records // backup software keeps copies of the records **Application software:** provides the services that the user requires // lets staff carry out (their) tasks e.g. a database / spreadsheet to keep the booking records e.g. a word processor to write the letters without application software staff could not do their tasks // system software alone does not carry out the user's tasks	**4**	max 4. Max 2 if only one type of software is explained. An example earns a mark only when it is linked to what it does here; a bare list of names earns at most 1 mark for each type. Do not accept "system software makes the computer faster" alone.

Total: 20 marks

MODULE H SOFTWARE · H2

What an operating system does: mark scheme

20 marks · Cambridge 0478 syllabus 4.1.2 (describe the role and basic functions of an operating system: managing files, handling interrupts, providing an interface, managing peripherals and drivers, managing memory, managing multitasking, providing a platform for running applications, providing system security, managing user accounts)

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. No marks for brand names of software.

QUESTION	ANSWER	MARKS	GUIDANCE
1(a) 0478 4.1.1, 4.1.2	Any two from: It is system software // provides the services that the computer requires Manages / controls the computer's hardware // resources Manages the software / applications that are running Provides an interface between the user and the computer / hardware Provides a platform for (running) applications Carries out basic functions, e.g. managing files / memory / peripherals / user accounts	**2**	max 2. A list of functions alone scores max 1 (last bullet). Do not accept "lets the user carry out tasks such as bookings" (that is application software).
2(a) 0478 4.1.2	Any two from: A driver is software that lets the operating system communicate with / control the printer It translates data / instructions from the computer into a form the printer understands Different printers / models work differently // need different instructions, so each needs its own driver Without the driver the printer would not work // would not print correctly	**2**	max 2. Do not accept "a driver is hardware / a cable". Do not accept "to connect the printer" alone.
2(b) 0478 4.1.2	Any one from: Sends data to the printer // controls the transfer of data to the printer Manages a queue of print jobs // prints jobs in order Holds data until the printer is ready // spooling // buffering Deals with signals / interrupts from the printer, e.g. out of paper, paper jam Detects when the printer is connected / disconnected Updates the printer's driver Shows the printer's status / error messages to the user	**1**	Mark the first answer only. Do not accept "installs the driver" (not another task). Credit any other valid peripheral-management task.

QUESTION	ANSWER	MARKS	GUIDANCE
3(a) 0478 4.1.2	One mark for each correct row: New / removed staff accounts: managing user accounts Barcode scanner software installed: managing peripherals and drivers RAM freed when an application closes: managing memory Folder renamed and moved: managing files Key press signal, task paused: handling interrupts Processor time shared between applications: managing multitasking	**6**	One function per row; if two functions are written in a row, 0 for that row. Accept clear equivalents (e.g. "user account management", "file management", "memory management").
4(a) 0478 4.1.2	Any three from: Each member of staff has their own user account Staff must log on with a username and password // biometric // the OS checks who is using the computer Access rights / permissions are set for the file // for its folder Only the managers' accounts are given access to open the file Other staff accounts are given no access // the file is hidden from them // the OS refuses to open it for them The OS checks the account's access rights before it opens the file	**3**	max 3. Accept answers using a "managers" group of accounts. Do not accept "put a password on the computer" alone for more than one mark. Do not accept "delete the file".
4(b) 0478 4.1.2	Any one from: Firewall (Automatically) installs security updates // patches Anti-malware // anti-virus scanning (built into the OS) Encrypts files / data stored on the computer Access rights // permissions on files / folders Locks the screen / logs the user off after a period of no use Locks the account after several failed log-on attempts	**1**	Mark the first answer only. Do not accept user accounts / passwords (excluded by the question). Credit any other valid security feature an OS provides.

QUESTION	ANSWER	MARKS	GUIDANCE
5(a) 0478 4.1.2	Any five from: **Managing memory** Loads each application (from secondary storage) into RAM when it is opened Allocates each application its own area / space in memory Makes sure applications do not use / overwrite each other's memory Keeps track of which memory is in use and which is free Frees an application's memory when it is closed Uses virtual memory // moves pages of data to secondary storage if RAM is full **Managing multitasking** Shares the processor's time between the applications // allocates processor time to each in turn Switches between the applications very quickly ... ... so they appear to run at the same time Decides which application / task uses the processor next // gives tasks priorities Makes sure each application gets the resources (e.g. memory, processor time) it needs	**5**	max 5. Max 3 if only memory or only multitasking is described. Do not accept "stores the applications in ROM".

Total: 20 marks

MODULE H SOFTWARE · H3

Memory management and multitasking: mark scheme

20 marks · Cambridge 0478 syllabus 4.1.2 (describe the role and basic functions of an operating system, including managing memory and managing multitasking) and 3.3.4 (describe what is meant by virtual memory, how it is created and used and why it is necessary)

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. No marks for brand names of software or hardware.

QUESTION	ANSWER	MARKS	GUIDANCE
1(a) 0478 4.1.2	One mark for each correct row: Allocates memory when an application is opened: True More than one application open and running at the same time: True Two applications store data in the same memory location: False Memory of a closed application can be used by another: True Single-core processor can only have one application open: False	**5**	A row with both boxes ticked scores 0.
2(a) 0478 4.1.2	Any three from: (The application's instructions / data are) transferred / loaded from secondary storage into RAM / main memory The operating system allocates / reserves (free) memory / memory locations / space in RAM for the application It checks there is enough free memory (for the application) It keeps track of which memory (locations) are in use / free // which memory belongs to which application It keeps the application's memory separate from other applications' memory // stops other applications using / overwriting the same memory locations The processor / CPU can then access the application's instructions / data directly from RAM	**3**	max 3. Accept "primary storage" for RAM. Do not accept ROM or cache for RAM. Do not accept "it manages the memory" alone.

QUESTION	ANSWER	MARKS	GUIDANCE
2(b) 0478 4.1.2	Any four from: The processor / core can only process (the instructions of) one task / application at a time The operating system shares processor time between the tasks / applications // gives each task a (short) turn / time slice It switches between the tasks very quickly / many times a second ... so (to the receptionist) both tasks appear to happen at the same time / simultaneously It decides which task is processed next / how long each task gets // it uses priorities / scheduling It manages / uses interrupts to switch between tasks // the printer sends an interrupt (e.g. when it needs more data) and the processor is given to that task Both applications are held in RAM / memory at the same time // each has its own area of memory It keeps the state of each task so it can carry on from where it stopped	**4**	max 4. The words "scheduling" and "interrupt" are not required. Do not accept "the processor does both tasks at the same time" or "it uses another core" (the processor has one core). Do not accept "it is fast" alone.
3(a) 0478 3.3.4	(On / in) secondary storage // (on / in) the hard disk drive / HDD / solid-state drive / SSD	**1**	Do not accept RAM, ROM, cache or the cloud.
3(b) 0478 3.3.4	Any three from: Part of secondary storage is used as (if it is) extra RAM / memory Pages of data / data not currently in use (e.g. from the email application / web browser) are transferred from RAM to virtual memory This frees space in RAM for the video call application When the data / pages in virtual memory are needed, they are transferred back into RAM ... and other pages / data not in use are transferred out to virtual memory to make room The processor can only access data in RAM // data in virtual memory must be moved to RAM before it is used	**3**	max 3. Do not accept "data is stored in virtual memory" alone: the answer must show data moving between RAM and virtual memory.
3(c) 0478 3.3.4	Any two from: RAM is (nearly) full // there is not enough free RAM for the video call application // only 1 GiB is free but 2 GiB is needed Without it the application could not be opened / run // the computer could crash / freeze // the receptionist would have to close another application It lets the computer run more / larger applications than the RAM can hold (at once)	**2**	max 2. Accept "1 GiB more is needed" for the first point. Do not accept "to make the computer faster".

QUESTION	ANSWER	MARKS	GUIDANCE
4(a) 0478 4.1.2	Any two from: It frees / releases / deallocates the memory // marks the memory (locations) as free / available It updates its record of which memory is in use / free The memory can then be allocated to another application // used by applications that are still open Data / pages in virtual memory can be moved back into RAM (because there is now free space) // less virtual memory is needed	**2**	max 2. Do not accept "it deletes the application" or "it saves the memory".

Total: 20 marks

MODULE H SOFTWARE · H4

Peripheral management, drivers and the user interface: mark scheme

21 marks · Cambridge 0478 syllabus 4.1.2 (describe the role and basic functions of an operating system, including providing an interface and managing peripherals and drivers)

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. No marks for brand names.

QUESTION	ANSWER	MARKS	GUIDANCE
1(a) 0478 4.1.2	One mark for each correct row: The barcode scanner is a peripheral: True A device driver is part of the stock-control software: False A new model … can always use the driver written for the old model: False The operating system uses device drivers to communicate with the peripherals: True	**4**	A row with both boxes ticked scores 0.
2(a) 0478 4.1.2	Any two from: Software // a program … that allows the operating system to communicate with / control a (hardware) device / peripheral … translates (general) instructions / data from the operating system into commands / a form the device understands (and back) … written for one specific device / model / type of hardware	**2**	max 2. "Software" alone scores 1 mark only. "It makes the device work" alone is too vague. Do not accept "hardware".
2(b) 0478 4.1.2	Any two from: A device driver is specific to one device / model (of printer) The new model is different hardware // may use different commands / instructions (from the old model) The old driver may not translate the operating system's instructions into commands the new printer understands Without the correct driver the operating system cannot communicate with / control the new printer // the new printer would not print (correctly)	**2**	max 2. "Because it is a new printer" alone is too vague.
2(c) 0478 4.1.2	Any one from: To fix bugs / errors (in the old driver) To add new features // support new functions of the device To keep the device compatible with an updated operating system To fix a security weakness / vulnerability To improve the performance / reliability of the device	**1**	"To make it better" / "faster" alone is too vague.

QUESTION	ANSWER	MARKS	GUIDANCE
3(a) 0478 4.1.2	Any three from: The scanner sends (the barcode) data to the computer / processor The scanner sends an interrupt (signal) to the processor (to show data is ready) The operating system uses the scanner's device driver ... ... to translate / interpret the data from the scanner into a form the operating system / processor can use The operating system manages the transfer of the data (from the scanner) to memory / RAM // holds the data in a buffer The operating system passes the data to the stock-control software // provides a platform so the application can use the scanner	**3**	max 3. "It manages the scanner" / "it controls the scanner" alone repeats the question and is not credited. The interrupt point is credit for valid extra knowledge (0478 4.1.4); it is not required for full marks.
4(a) 0478 4.1.2	Any two from: It allows the user to communicate / interact with the computer / hardware / software It receives / accepts input from the user, e.g. touches on the screen It displays output / feedback to the user, e.g. messages It hides the complexity of the hardware // lets the user use the computer without knowing how the hardware works It provides a graphical user interface // icons / menus / windows // a command line interface	**2**	max 2. "Lets the user use the computer" alone / "makes it easy to use" alone is too vague.
4(b) 0478 4.1.2	Any two from, e.g.: A confirmation that the label has printed // that the parcel has been recorded An error message about a peripheral, e.g. printer out of labels / paper jam // barcode not read A message that a device is not recognised // a driver is missing / being installed A prompt / instruction, e.g. scan the next parcel Icons / menus / buttons to choose a task Details of the order / parcel, e.g. items to pack, delivery address	**2**	max 2. Two answers that say the same thing in different words score 1 mark only. "Information" / "messages" alone is too vague.

QUESTION	ANSWER	MARKS	GUIDANCE
5(a) 0478 4.1.2	Any five from: The operating system detects / recognises that a new device has been connected It checks whether the correct device driver is installed If not, the correct driver is installed // the operating system finds / downloads the driver // the user is asked to install it (e.g. from the manufacturer) It uses the interface to tell the user the printer is ready // that a driver is needed The stock-control software sends the print request / label data to the operating system The operating system uses the driver to translate the label data / instructions into commands the printer understands The operating system manages the transfer of the data (from memory) to the printer // holds the data in a buffer / print queue until the printer is ready The printer sends signals back, e.g. ready / busy / out of labels, and the operating system shows any error to the user	**5**	max 5. Max 3 if the device driver is not mentioned. "The operating system controls the printer" alone is not credited. Credit a valid point about the printer sending an interrupt to the processor (0478 4.1.4).

Total: 21 marks

MODULE H SOFTWARE · H5

User management and file management: mark scheme

20 marks · Cambridge 0478 syllabus 4.1.2: the role and basic functions of an operating system, including managing files, providing system security and managing user accounts

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. Credit any other valid answer that shows the same understanding. No marks for brand names.

QUESTION	ANSWER	MARKS	GUIDANCE
1(a) 0478 4.1.2	One mark for each correct row: More than one user account on the same computer: True Moved file also stays in its original folder: False Managing user accounts and providing system security are OS functions: True Any user can change another user's access rights: False	**4**	A row with both boxes ticked scores 0.
2(a) 0478 4.1.2	Any three from: The manager logs in with an administrator account // only an administrator can create accounts Creates a new user account for the receptionist Sets a username / user ID for the account Sets a (first) password // makes the receptionist set their own password (at first login) Sets the access rights / permissions for the account, e.g. which files / folders / programs the receptionist can open or edit Sets the type of account, e.g. standard user (not administrator) Gives the receptionist their own folder / storage area	**3**	max 3. Credit any other valid step in setting up an account. Do not accept "gives them a login" alone.

QUESTION	ANSWER	MARKS	GUIDANCE
3(a) 0478 4.1.2	One mark for each way (max 2) and one mark for each matching description (max 2), e.g.: Requires a username and password (to log in) ... so only authorised users can use the computer // see the guest records Locks an account after a number of incorrect password attempts ... so someone cannot keep guessing / trying passwords Access rights / permissions for files and folders ... so only users who need the guest records can open / edit them // other users are blocked Locks the screen / logs the user out after a period with no use ... so a person cannot use an unattended computer that is still logged in Keeps each user's files separate / private ... so other users cannot open / change them Provides a (built-in) firewall ... that checks / blocks unauthorised traffic into or out of the computer	**4**	max 4. A description mark only with its matching way. Credit any other valid security feature an operating system provides. Do not accept "makes it secure" / "stops hackers" alone. Two ways that are the same idea (e.g. password and login) score the way mark once.
4(a) 0478 4.1.2	Move // cut and paste // drag (the file) to the 2027 folder	**1**	Do not accept copy / save / rename.
4(b) 0478 4.1.2	One mark for each: **Can:** open / read / view / print the files // copy the files **Cannot:** edit / change / save changes to the files // delete the files // rename the files	**2**	Mark the first answer on each line. A "can" answer written on the "cannot" line (or the other way round) scores 0 for that line.
4(c) 0478 4.1.2	Any two from: Gives the file its name (and file type / extension) Stores / writes the file to secondary storage // puts it in the chosen folder (2027) Records where the file is stored // adds it to the folder structure ... so it can be found / opened later Checks the user has permission / access rights to save in that folder Checks / warns if a file with the same name is already in the folder	**2**	max 2. Do not accept "stores it in RAM / primary storage". Do not accept "saves it" alone.

QUESTION	ANSWER	MARKS	GUIDANCE
5(a) 0478 4.1.2	Any four from: Each receptionist has their own username and password // only they know their password Access rights can be set for each receptionist (to suit their job) Each receptionist's files / settings are kept separate / private It can be seen / recorded who logged in // who made a change When a receptionist leaves, their account can be deleted / disabled without changing everyone else's password A shared password is easier to pass on / find out // more people know it If one account is locked / compromised, the other receptionists can still log in	**4**	max 4. Do not accept "it is more secure" / "safer" alone (too vague). Credit any other valid reason.

Total: 20 marks

MODULE H SOFTWARE · H6

Interrupts and the interrupt service routine: mark scheme

20 marks · Cambridge 0478 syllabus 4.1.4 (the role and operation of interrupts: how an interrupt is generated, how it is handled using an interrupt service routine, what happens as a result; software and hardware interrupt examples)

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 4.1.4	A signal (from hardware or software) sent to the processor / CPU … to show that something / an event needs its attention // to request processor time	**1**	Both ideas needed: a signal to the processor, and needing attention. "A signal" alone is too vague. Do not credit "a message to the user that there is a problem" or "something that stops the current program".
1(b) 0478 4.1.4 (notes)	Divide by zero: Software Mouse moved: Hardware Two processes, same memory location: Software Key pressed: Hardware	**4**	One mark per correct row. A row with both boxes ticked scores 0.
2(a) 0478 4.1.4	The letter / character M appears / is displayed on the screen (in the booking program)	**1**	Accept "M is shown in the guest details". Do not credit "an error message" or "the program stops".
2(b) 0478 4.1.4	Any one from: An error message is displayed // the user is told the calculation cannot be done The (second) program / calculation is stopped / halted	**1**	Accept "the program crashes / closes". Do not credit "the computer turns off" or "the answer is zero".
2(c) 0478 4.1.4	Interrupt service routine // ISR // interrupt handler	**1**	Do not accept "operating system" alone or "interrupt queue".
3(a) 0478 4.1.4	Checks after each FDE cycle: True Every interrupt handled straight away: False Register values saved: True Paused task starts again from its first instruction: False	**4**	One mark per correct row. A row with both boxes ticked scores 0.
4(a) 0478 4.1.4	Any two from: **Task:** the processor carries on with the task // the task is not paused // the next FDE cycle of the task is run **Interrupt:** the interrupt waits (in the interrupt queue) // is not handled yet … it is handled later, when it has the highest priority // when no higher-priority task or interrupt is waiting // when the task has finished	**2**	max 2. Max 1 if only the task or only the interrupt is described. Do not credit "the interrupt is deleted / ignored for good" or "the task is paused".

QUESTION	ANSWER	MARKS	GUIDANCE
5(a) 0478 4.1.4	Any six from: Moving the mouse generates a (hardware) interrupt // the mouse sends a signal to the processor The interrupt is given a priority ... and is placed in the interrupt queue The processor finishes its current FDE cycle (of the 3D image task) ... then checks for interrupts // checks the interrupt queue The interrupt has a higher priority than the 3D image task, so the task is paused The state of the task // the values in the registers are saved (on a stack) The source / type of the interrupt is identified ... ... and the matching interrupt service routine // ISR // interrupt handler is run The ISR handles the interrupt, e.g. the pointer moves on the screen The processor checks for any other higher-priority interrupts (and handles them first) The saved values are restored (to the registers) ... and the 3D image task carries on from where it was paused	**6**	max 6. Points need not be in this order. Do not credit "the 3D image task is cancelled / starts again from the beginning" or "the mouse converts analogue data to digital". "The task stops" is credited only with the idea that it is paused / its state is saved.

Total: 20 marks

MODULE H SOFTWARE · H7

Firmware, the bootloader and how software layers run: mark scheme

20 marks · Cambridge 0478 syllabus 4.1.3 (hardware, firmware and an operating system are required to run applications software), with 3.3.1 (RAM and ROM)

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. No marks for brand names of software or hardware.

QUESTION	ANSWER	MARKS	GUIDANCE
1(a) 0478 4.1.3	One mark for each correct box: Top box: application software // (the) drawing application Second box: operating system // OS Third box: firmware // bootloader	**3**	Mark each box on its own. Do not accept "system software" for the second box. Accept BIOS for the third box; do not accept ROM (hardware).
1(b) 0478 4.1.3	Any one from: Bootloader // boot loader Bootstrap // bootstrap loader	**1**	Allow BIOS. Do not accept "firmware" alone (it repeats the question). Do not accept operating system or ROM.
2(a) 0478 4.1.3, 3.3.1	One mark for each correct row: The bootloader is a type of firmware: True The drawing application is run on the operating system: True The bootloader is run on the operating system: False Firmware is lost when the computer is switched off: False The operating system is run on the firmware: True	**5**	A row with both boxes ticked scores 0 for that row.
3(a) 0478 3.3.1, 4.1.3	Any three from: ROM is non-volatile // ROM keeps its contents when the power is off // ROM stores data permanently RAM is volatile // RAM loses its contents when the power is off ... so (if it were in RAM) the bootloader would not be there when the computer is switched on // RAM is empty at start-up The bootloader is needed as soon as the computer is switched on // it must run (on the hardware) before the operating system can be loaded The bootloader does not need to change // ROM cannot (normally) be changed / written to ... so the bootloader cannot be (accidentally) changed / deleted	**3**	max 3. Do not accept "ROM is faster" or "RAM is too small". Do not accept "ROM is permanent" when it only means the chip cannot be removed. Accept a correct statement about ROM and the matching opposite about RAM as two separate points.

QUESTION	ANSWER	MARKS	GUIDANCE

4(a)
0478 4.1.3
	Any three from:
	The bootloader cannot run (on the hardware) // the computer cannot start up / boot (properly)
	... so the operating system is not loaded (into RAM) // the operating system cannot run
	The operating system is run on the firmware / bootloader
	The drawing application is run on the operating system
	... so with no operating system running, the drawing application cannot be run / opened
	Working hardware alone cannot run the application // each layer needs the layer below it
		3	max 3. Do not accept "the computer is broken" or "the application is corrupted". Do not accept "the hardware cannot run" (the stem says the hardware works).

5(a) 0478 4.1.3	Any five from: When the computer is switched on, the bootloader / firmware is run on the hardware The bootloader / firmware is stored in ROM // non-volatile memory, so it is there at start-up The bootloader loads the operating system (from secondary storage) into RAM // starts the operating system The operating system is run on the firmware The operating system provides a platform for running applications // manages the hardware / memory / peripherals for the application When the architect opens the drawing application it is loaded into RAM // the drawing application is run on the operating system The hardware / processor / CPU carries out / executes the instructions (of all the software) // without the hardware no software can run Each layer needs the layer below it // if any layer is missing the drawing application cannot run	**5**	max 5. Max 4 if only two of the three (hardware, firmware, operating system) are described. The order of the description is not marked. Do not accept "the application is run on the hardware directly" or "the bootloader is run on the operating system".

Total: 20 marks