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