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