

1.1 PROCESSORS, INPUT/OUTPUT AND STORAGE · 1.1.1

Processor performance & pipelining — Mark scheme

37 marks · spec 1.1.1(c)(d)

AO key: AO1 = knowledge & understanding · AO2 = application · AO3 = reasoned judgements. Accept any valid alternative wording; do not award the same point twice.

Q	ANSWER	AO	MARKS
1(a)	1 mark per factor, max 2: clock speed / number of cores / amount (and type) of cache. (2)	AO1	2
1(b)	Hertz (Hz). (1) Accept GHz.	AO1	1
1(c)	Cache. (1)	AO1	1

Q	ANSWER	AO	MARKS
2(a)	<ul style="list-style-type: none"> a higher clock speed means more clock cycles per second (1) so more fetch-decode-execute cycles / instructions are carried out per second (1) 	AO1/ AO2	2
2(b)	<ul style="list-style-type: none"> a processor/chip containing more than one core (processing unit) (1) each core can fetch and execute instructions independently / at the same time (1) 	AO1	2
2(c)	1 mark per point, max 3: <ul style="list-style-type: none"> the improvement depends on the software (1) the software must be written to run in parallel / be multi-threaded (1) sequential tasks cannot be split, so extra cores sit idle (1) Allow: overhead of coordinating/sharing data between cores.	AO2	3

Q	ANSWER	AO	MARKS
3(a)	<ul style="list-style-type: none"> very fast memory located inside / close to the CPU (1) stores frequently used data/instructions so they can be fetched faster than from RAM (1) 	AO1	2
3(b)	L1, then L2, then L3. (1) Must be in the correct order.	AO1	1
3(c)	1 mark per point, max 3: <ul style="list-style-type: none"> more data/instructions can be held close to the CPU (1) so there are fewer cache misses / fewer slow trips to RAM (1) the CPU stalls/waits less, so does more useful work even at a lower clock speed (1) 	AO2	3

Q	ANSWER	AO	MARKS
4(a)	1 mark per point, max 3: <ul style="list-style-type: none"> • overlapping the stages of the fetch-decode-execute cycle (1) • for different / consecutive instructions (1) • so that while one instruction executes, the next is decoded and another is fetched (1) 	AO1	3
4(b)	<ul style="list-style-type: none"> • parts of the CPU are kept busy instead of idle (1) • so more instructions are completed per unit time (higher throughput) (1) • without reducing the time taken by a single instruction (1) 	AO2	3

Q	ANSWER	AO	MARKS
5(a)	1 mark per valid feature, max 2: higher clock speed / more cores / more (or faster) cache / supports pipelining. (2)	AO2	2
5(b)	1 mark per point, max 3: <ul style="list-style-type: none"> • pipelining overlaps the stages of instructions (1) • so more instructions are completed per second / programs run faster (1) • the charity's computers are more responsive for office tasks at the same clock speed (1) 	AO2	3

Q	LEVELS-OF-RESPONSE MARK SCHEME	AO	MARKS										
6	<p>Mark using the levels descriptors below. AO1 (knowledge of the features), AO2 (application to the two task types) and AO3 (justified recommendation).</p> <table border="1"> <thead> <tr> <th>LEVEL</th> <th>DESCRIPTOR</th> </tr> </thead> <tbody> <tr> <td>Level 3 (7–9)</td> <td>Thorough discussion of the relevant features applied to both the sequential rendering task and the parallel image operations, leading to a clear justified recommendation. Accurate terminology; well structured.</td> </tr> <tr> <td>Level 2 (4–6)</td> <td>Some features discussed with some application to the context. A recommendation is made but justification may be partial or one-sided.</td> </tr> <tr> <td>Level 1 (1–3)</td> <td>Basic points about one or more features with little application to the context and little or no justified recommendation.</td> </tr> <tr> <td>0</td> <td>Nothing creditworthy.</td> </tr> </tbody> </table> <p>Indicative content (not exhaustive; credit any valid point):</p> <ul style="list-style-type: none"> • Sequential rendering: cannot be split across cores, so benefits most from a high clock speed, pipelining and a large cache to keep one core fed. • Parallel image operations: each frame is independent, so the work is highly parallelisable and benefits from many cores. • Cache helps both task types by reducing waits on RAM; higher clock speed costs more heat/power. • Justified recommendation: choose a CPU that combines a high clock speed and large cache (for rendering) with several cores (for the batch image work); prioritise according to which task dominates. 	LEVEL	DESCRIPTOR	Level 3 (7–9)	Thorough discussion of the relevant features applied to both the sequential rendering task and the parallel image operations, leading to a clear justified recommendation. Accurate terminology; well structured.	Level 2 (4–6)	Some features discussed with some application to the context. A recommendation is made but justification may be partial or one-sided.	Level 1 (1–3)	Basic points about one or more features with little application to the context and little or no justified recommendation.	0	Nothing creditworthy.	AO1 ×3 AO2 ×3 AO3 ×3	9
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