



2007 Computing

Advanced Higher

Finalised Marking Instructions

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SECTION I – Software Development & Developing a Software Solution

		<i>Marks</i>
1.	(a) (i) Legal – investigation of laws concerning storing of biometric information on children Economic – are costs within budgetary constraints of government? Answer <u>must</u> be a description	2
	(ii) <ul style="list-style-type: none">• Technical – biometric accuracy in the identification of children.• Investigate current system for suitability of hardware.• Specification of hardware to run such a system.• Existence of current software for biometric identification.• Any other acceptable answer – answer should relate to scenario	2
	(b) (i) Systems analyst	1
	(ii) <ul style="list-style-type: none">• Functional specification of what the system will do.• Boundaries scope of the system.• Physical specification of hardware.• Data requirements of the system.• Preliminary estimate of costings.• Preliminary estimate of timings.• Details of user training and documentation required. Any other acceptable answer.	3
	(iii) <ul style="list-style-type: none">• Legally binding document detailing exactly what is required.• Additional demands not in ORD do not need to be accepted.• Additional demands will require costing and agreement.	2
	(c) (i) <ul style="list-style-type: none">• Identification of subtasks and• Setting timescales and deadlines or• Gantt charts identifying time dependencies, sequential and parallel activities or• CPA – critical path analysis identifies all tasks that must be complete, minimum time length	2
	(ii) <ul style="list-style-type: none">• Subtasks can run concurrently and not in a linear fashion.• People will work more effectively to deadlines set by the timescales.	2
	(d) <ul style="list-style-type: none">• Computerised generation of graphical designs and information shared across the system would be monitored.• Automated data dictionaries.• Tools to track dependencies. Do not allow compilers, editors, debuggers or other software development type answers	2

- (b) (i)

89	55	45	91	43	36	14	2
89	55	91	45	43	36	14	2

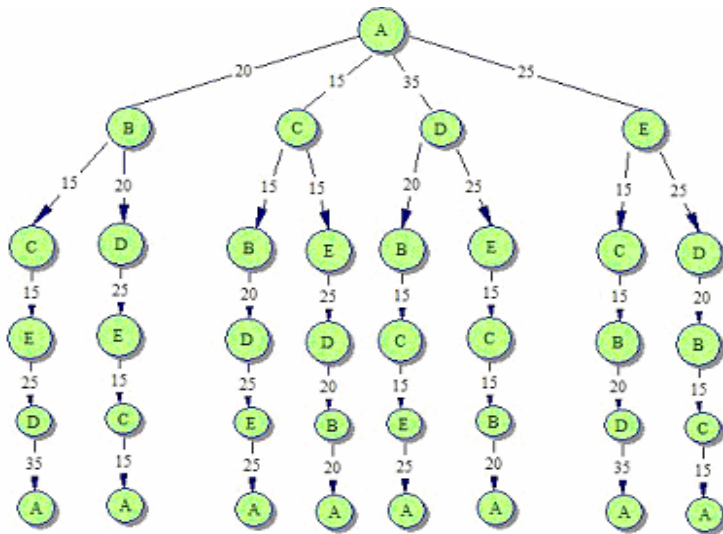
2
- (ii) Simple sort (1) 2
 Simple sort uses the same memory (1), performs fewer exchanges on a randomly ordered list, must make n-1 passes through the list even when fully sorted or partially sorted, bubble sort makes excessive exchanges but less so with a partially sorted list and can detect when sorted as no swaps take place.
 Selection sort using two lists (1). This uses almost double the memory (1)
- (iii) The simple sort (1) is recommended as this list will tend towards randomly ordered (1) as competitors are likely to be randomly skilled. Bubble sort is more efficient on a partially sorted list which this would not be. 2
 The bubble sort is the most inefficient when the list is randomly ordered as would be the case here because it will require more swaps to take place and for a randomly ordered list the number of comparisons will be almost as large.
4. (a) Objects define the data and the methods that manipulate the data. 2
- (b) Because of the hierarchy of classes data and operations defined for the account class are automatically inherited for the subclasses reducing the need for coding. Whereas procedural would require more lines of coding. 4
 Maintenance will be more efficient since changes to software may only affect a single class/subclass and this will be independent of the others.
 Error is likely to be with the account class since it affects every type of account. Once the error is corrected in the class then all subclasses should work accordingly.
5. (a) 12 comparisons 1
- (b) (i) 5
- | lower | upper | middle | |
|------------|------------|------------|---------------------|
| 0 | 14 | 7 (1 mark) | 42 is not >56 |
| 0 | 6 (1 mark) | 3 | 42>21 is true |
| 4 (1 mark) | 6 | 5 | 42 is not >45 |
| 4 | 4 (1 mark) | 4 | 42>25 |
| 5 (1 mark) | 4 | | 5>4 loop terminates |
- 1 mark for each row. Last column of table is not required.
- (ii) Use a Boolean variable set to false initially (1) which can be changed to true when the item is found (1). Then use if statement to report (1). 3
- or
- if value[middle] = search_item (1) then
 write out 'item found at position', middle (1)
 else
 write out 'item not in the list' (1)
 end if

SECTION II – Part A – Artificial Intelligence

Marks

6. (a)

4



1 mark for completeness (8 branches)

2 marks for correct order of nodes (reduce by 1 for each incorrect branch)

1 mark for distances shown

- (b) (i)
 - Search tree has single root node; state space graph has no single root node (1).
 - State space graph may have cross branches; not allowed on search tree (1).
 - On a graph each node only occurs once, but can be repeated on a tree.
 - Search tree has uni-directional arrows; state space graph may have bi-directional arrows (1).
- (ii) From L to R on diagram above: 110, 95, 100, 95, 110, 110, 110, 100 (1 if all correct). 2
- The 2nd and 4th routes are the same, but in opposite direction (1).

7. (a) Hill-climbing (1) 1

(b) (i) Best-first (1) 1

- (ii) A – C – G – H – B – F – K (1) 5
- C is best successor to A; G is best successor to C (1); no successor to G; H is next best, but also has no successor (1); B is next best node considered so far (1); F is its best successor; K is best successor to F, and is a goal state (1).

- (c) A measure (or estimate) of the cost of getting from state to state. **1**
- (d) When the tree represents a 2-player game (or similar situation). **1**

8. (a) (i) 4

mammal	
has-legs	4
reproduces-by	live young

platypus	
subclass	mammal
reproduces-by	lays eggs

dog	
subclass	mammal

bouncer	
instance	dog
has-legs	3

1 mark for each completely correct frame

- (ii) A default value is inherited, unless it is assigned a value within the frame (1). For example, has-legs (in bouncer frame) would have default value 4, but is given the value 3 in the frame (1) (or reference to reproduces-by in the platypus frame). **2**

- (b) (i) reproduces_by(X, live_young):- subclass(X,Y),
reproduces_by(Y, live_young). **4**
reproduces_by(X, live_young):- instance(X,Y),
subclass(Y,Z), reproduces_by(Z, live_young).

2 marks for each rule; deduct 1 for each error

- (ii) Bouncer is now an instance of a subclass of a subclass (1). A recursive rule could ensure the property is inherited for any number of subclass links (1). **2**

			<i>Marks</i>
9.	(a)	(i) False (or no)	1
		(ii) X=mercury, X=venus, X=earth, X=mars	1
	(b)	<p>Uses first rule to check if mars is the first member of the list. Fails (1).</p> <p>Uses second rule to generate a new sub-goal: is mars a member of the tail [venus, earth, mars] (1).</p> <p>Uses first rule to check if mars is the head of the tail. Fails.</p> <p>Uses second rule to generate a new sub-goal: is mars a member of the new tail [earth, mars] (1).</p> <p>Uses first rule to check if mars is the head of the tail. Fails.</p> <p>Uses second rule to generate a new sub-goal: is mars a member of the new tail [mars] (1).</p> <p>Uses first rule to check if mars is the head of the tail. Succeeds.</p> <p>Reports “True” (1).</p>	5
10.	(a)	(i) <ol style="list-style-type: none"> 1. IF temp>50 AND pressure<0.5 THEN pump B is faulty CF 0.9 (or 90) 2. IF warning_light_3 is on AND warning_light_4 is flashing THEN pump C is faulty CF 0.75 (or 75) <p>(1 mark for each valid certainty factor)</p>	2
		(ii) CF of conclusion is 0.75 (or 75) (1) as it is the minimum of the CFs of the 2 conditions (1)	2
	(b)	(i) The list of rules which could be triggered as their conditions are all true.	1
		(ii) To choose which rule from the conflict set should be triggered next.	1
11.	(a)	(i) 1, 4, 6, 11 (2 marks for all 4, 1 mark for 3)	2
		(ii) 2, 5, 9, 12 (2 marks for all 4, 1 mark for 3)	2
		(iii) 7	1
	(b)	On the first pass of the algorithm, there may be insufficient information to label every edge (1). On the second pass, more edges are labelled, which may allow further vertices to be identified, and so on (1).	2
12.	<i>Learning by analogy</i> involves using a method discovered in one context to solve a problem in a different context (1). Suitable example (1).		2

		<i>Marks</i>
13.	(a) Module testing would test a single module (eg speech recognition) (1) during implementation (1). Acceptance testing would test the whole system (1) after implementation is complete (1). Also accept module testing by development team, acceptance testing by independent testers. Deduct 1 if no reference to context.	4
	(b) (i) Syntactic analysis	1
	(ii) To extract meaning	1
	(iii) Any example where contextual information is required	2
	1 mark for example, 1 mark for mention of context.	

[END OF SECTION II – Part A]

SECTION II – Part B – Computer Architecture

			<i>Marks</i>	
14.	(a)	1. The contents of the PC are copied into the MAR;	4	
		2. The contents of memory at the location designated by the MAR are copied into the MDR;		
		3. The PC is incremented;		
		4. The contents of the MDR are copied into the IR.		
(b)	(i)	Cost per bit	2	
		Registers: cost per bit higher than main memory. Access time Main memory: access times slower than registers.		
		(ii) Processing will be speeded up because the use of so many registers will reduce the need for the processor to access slower main memory since it has an increased capacity to store and manipulate data in its register.		2
		(iii) Static RAM has a fast access rate making it suitable for fast access cache memory. It is relatively more expensive to manufacture and so, because of the larger capacity of main memory, would raise costs significantly if it were used for main memory.		2
	(iv)	It has a 128 bit data bus.	1	
15.	(a)	(i) Any three of:	3	
		<ul style="list-style-type: none">• a small number of simple instructions that mostly have the same format• a minimal number of addressing modes• a large number of general-purpose registers• register orientated instructions.		

- (ii)** A small number of instructions that mostly have the same format: **6**
 this eliminates the need for the added hardware complexity in the instruction decoder required when a processor has a complex instruction set, making the design of the control unit much simpler
 or
 this eliminates delays in the pipeline, improving the throughput of instructions. Because RISC instructions are identical in size and format it is not necessary to wait until the length of the previous instruction is known in order to fetch and decode the next instruction.
- A minimal number of addressing modes:
 limiting addressing modes in order to simplify the process of locating data in memory and reduce the number of accesses to main memory to eg limiting address modes to direct addressing thus eliminating the need to access one memory location to locate the address of an operand.
- A large number of general-purpose registers:
 by enhancing the processor's ability to store and manipulate data within its registers, the use of large number of general purpose registers enables the processor to reduce the frequency of access to main memory store and thus improves performance.
- Register orientated instructions;:
 RISC instruction sets typically supply only a few LOAD and STORE instructions and most of the instructions operate with registers. Because most instructions involve manipulating data by transferring them between registers, this limits the number of slower accesses main memory, thus providing the performance gain.
- (b) (i)** A DMA controller is attached to the system bus. When the processor requires to make a block data transfer, it sends a command to the DMA controller. **3**
 The DMA controller (DMAC) then takes over and transfers data between main memory and the I/O module.
- (ii)** It enables high speed data transfers of large blocks of data between main memory and a peripheral, leaving the processor free to carry on with other tasks (so long as they do not require access to the system bus). **2**

			<i>Marks</i>
16.	(a)	(i) With a pipeline, processing is divided into stages. In this diagram three instructions being processed at different stages, case fetch decode and execute, simultaneously.	2
		(ii) Given that each of these stages takes a clock cycle, without a pipeline an instruction is executed every three cycles; with this pipeline an instruction still takes three cycles, but one instruction is completed each cycle, giving a three-fold increase in speed.	3
	(b)	If the wrong branch is in the pipeline, the pipeline must be flushed and refilled wasting processing time. OR An instruction from a wrong branch, that should not have been executed, can alter a previous result that is still needed.	2
	(c)	(i) The processor looks ahead in the instruction code and predicts which branches are likely to be processed. It then pre-fetches the instructions ready to feed into the pipeline.	2
		(ii) Branch prediction will not eliminate the negative effect on pipeline performance because predictions are never 100% accurate and, when the prediction is wrong, the pipeline will stall since instructions in the wrong branch will have been loaded into the pipeline.	2
	(d)	Predication enables the processor to pre-fetch and execute instructions along both branches of a program, then discard the "not chosen" branch results. So, regardless of which branch is taken processing continues without any delay.	3

17. (a) • Each processor has its own cache memory and local memory. 2
• There is a bank of global memory which all processors can access.

- (b) • In a parallel computer the processors are arranged in an interconnected array which serves as a network. 3
• Packet switching techniques, similar to those on a network, are used in which data packets are assigned the addresses of specific nodes (processors) on the array.
• This enables any processor on the array to access the local memory of any other processor on the array or to pass data or instructions to other processors.

18. (a) (i) In a multi-tasking system several processes may be contending for access to the processor and so there is a need for a system for allocating the processor's time. 1

- (ii) Pre-emptive scheduling enables the operating system to control the amount of time each active process can engage the processor. 2
It enables the operating system to suspend one process, at any point, and give another process a turn.

- (b) Multi-level feedback queue 5

A multi-level feedback queue maintains several job queues. In the first level queue it assigns each process a short length of time.

Succeeding lower level queues double the time slice allocated to each process at each level, with processes moving down the queue levels until the process is complete.

This scheduling strategy is most suited because:

- I/O based processes which only require a short amount of processor time initially are dealt with rapidly. They then have to deal with I/O for a longer time independently of the processor using DMA
- longer processes are catered for efficiently by being given a short time slice in the top level queue and then, in order that the top level queue is not held up, moved down to succeeding lower level queues, where the time slice is doubled on each level, until the process is complete.

- (c) (i) An incoming process is fitted into the first memory space large enough to contain it. **1**
- (ii) Best fit leaves Block A with 3Mb free, Block B with 3Mb free, Block C with 3Mb free and Block D with 90Mb free. **3**
Worst fit leaves Block A with 20Mb free, Block B with 20Mb free, Block C with 20Mb free and Block D with 39Mb free.
- (d) Demands on the system memory caused by: **4**
- the need to maintain a complex screen display with several objects open at once
 - to keep track of the active window and ensure the relevant application or file is loaded into memory and allocated processor time
 - the screen display will need to be updated as a consequence of the user's commands, placing demands on the memory and internal buses.
- Demands on the processor time caused by:
- the need to read in and interpret the user's instructions related to manipulation of the windows by following a combination of the movements of the cursor, the clicks of the mouse, menu selections and possibly commands from the keyboard
 - these instructions, will then need to be fetched from memory, decoded and executed creating demands on the processor and system buses.
- (Any 4)**

[END OF SECTION II – Part B]

SECTION II – Part C – Computer Networking

Marks

19. (a) • If hardware standards are not created then the purchase of hardware becomes increasingly complex to ensure compatibility. 4
- Hardware prices will rise as the market breaks into more and more sub-groups.
 - If software/data standards were not used then the exchange of data would be far more difficult.
 - Standards, particularly open standards, ensure that no single company can monopolise any aspect of data communication.
 - Communication is an integral part of our society (must clearly indicate therefore that allowing monopoly control is too dangerous)
- 1 mark for each valid point, other well made arguments may be accepted.*
- (b) (i) SMTP and MIME 1
- (ii) **Retain** 4
- To – no matter which protocol is used to send e-mails it will still have to have a destination address.
 - Subject – e-mail clients will always want a summary of e-mail contents.
 - Date – most people want to know when a message was sent. *1 mark each for any 2 suitable items with reasons.*
- Discard**
- MIME version as MIME will no longer be used.
 - Content-type is MIME information that may not be required, at least in its current form. *1 mark each for any 2 suitable items with reasons.*
20. (a) • Fibre optic cable can deliver higher bandwidth than UTP, as the single connection to the local authority could conceivably be utilised simultaneously by each computer in the school then it should be the fastest connection possible. 4
- Within the school the network will be sub-divided into collision domains or other logical groups and the level of contention will be far less on single UTP cable than with the fibre optic link to the authority.
 - The connection from school to Local Authority is probably several miles and since fibre optic cable can carry a signal for far greater distances than UTP the signal will need repeated a lot fewer times.
 - Within the school, no computer is likely to be greater than 100m from a switch, hub, bridge, or other network device which would be repeating the signal.
 - Movement and access to cables within the school is relatively controlled and so tapping of wires by external elements is less likely so the less secure UTP cable is acceptable.
 - Access to cables laid by telecom companies across open land is difficult to control and therefore the more secure fibre optic line is preferable.

1 mark for each valid point directly related to scenario.

(b) (i) WAP access point, wireless hub, wireless router. 1

(ii) 4

	802.11a	802.11g
Range	18m indoors and 30m outdoors, can extend to 100m in and 350 out but only with a substantial decrease in bandwidth.	50m internal, 250m external
Frequency	5 GHz	2.4 GHz

1 mark should be awarded for each correct statement of the range and frequency of the two protocols.

(iii) Discussion may highlight the reduced chance of interference with 802.11a using the regulated frequency whilst the range and lower cost are advantages for 802.11g. Two marks are for discriminating on the range in favour of 802.11g and frequency in favour of 802.11a. Final mark is for selection of range being the most important factor and therefore selecting 802.11g. 3

(iv) • The access point must be set up to ensure that a userID and a password is required to connect to the network. 3
 • Encryption should be used.
 • Access to network could be checked against permitted IP addresses or MAC addresses.
 • Have a firewall between the wireless access point and the rest of the network.

1 mark each for up to 3 items.

(c) (i) This may identify at which point the packets failed to forward eg a router within the school LAN or the local authority proxy server, or the local authority router, the DNS server, a cable break or the target web server itself. 3

1 mark each for a device or location.

(ii) • Traceroute sends a UDP packet with a very short TTL (time to live) to the destination address. 4
 • The first host to receive the packet will send a “time to live exceeded” message back along with its own IP address.
 • Another packet is then sent with an increased TTL which will get as far as the second host which will then return a “time to live exceeded” message back along with its own IP address.
 • This is repeated and displayed in a table of IP addresses and/or domain names along with a time in milliseconds of how long each hop took.

1 mark for each of the 4 bullet points.

			<i>Marks</i>	
21.	(a)	(i)	Place the text Yellow Hat Building Company in the Header section of the Window. <i>1 mark for appropriate description.</i>	1
		(ii)	<ul style="list-style-type: none"> • The sentence between the <p> tags will be placed in a paragraph on the page. • The words Edinburgh Plaza will be shown as a link. • When clicked on this link will open the web page http://www.edinburghplaza.co.uk. <i>1 mark for each bullet point.</i> 	3
	(b)		Any suitable examples could be accepted which clearly state an object (1 mark) and a suitable operation that could be performed on it (1 mark).	2
			eg an image could be placed in a table, a piece of text may have its size and colour changed etc.	
	(c)		The semantic of the statement is the meaning, in this case the text “Yellow Hat Building Company” is to be displayed in red using font size 3. The syntax of the statement is the rules which govern the way the statement is written in HTML eg the statement must begin with <font.	2
			<i>1 mark each for syntax and semantics.</i>	
	(d)	(i)	<ul style="list-style-type: none"> • ActiveX can only run on Windows based machines, therefore excluding some potential customers. • ActiveX is a known security weakness and many computers may be restricted from allowing its use. 	2
			<i>1 mark for each bullet point.</i>	
		(ii)	<ul style="list-style-type: none"> • Java applets are able to run on any platform as they rely on being translated by a virtual Java interpreter, a version of which is available for all common platforms. • Java applets run in a sandbox and therefore cannot affect the local hard disk, therefore they are less likely to give rise to security problems. 	2
			<i>1 mark for each bullet point.</i>	
	(e)		The server sends the data back to the client as lines of ASCII text. The first line is typically: HTTP/1.0 200 OK (HTTP version and Response code) OR Inclusion of other parts of the initial response: web server, date and time on server, MIME type.	2
			<i>2 marks for a clear description.</i>	

22. (a) • Conventional encryption requires the secure exchange of a private key whilst public key encryption does not. 2
 • As first contact is via the WWW and no personal contact is likely in the short term between customer and company then there is no secure way to exchange a private key.

1 mark for each bullet point.

- (b) • A string (message digest) is created using a hashing formula applied to the data to be transmitted (1). 5
 • The private key is then used to encrypt the added message digest (1).
 • The public key is then used to decrypt the added message digest (1).
 • The hashing formulae is then applied to the data to calculate its own message digest and this is compared to the one transmitted (1).
 • If they match then the data has arrived untampered (1).

1 mark for each bullet point.

- (c) (i) • In this attack, the perpetrator sends an IP ping (or “echo my message back to me”) request to a receiving site. 4
 • The ping packet specifies that it be broadcast to a number of hosts within the receiving site’s local network.
 • The packet also indicates that the request is from another site, the target site that is to receive the denial of service. (Sending a packet with someone else’s return address in it is called spoofing the return address).
 • The result will be lots of ping replies flooding back to the innocent, spoofed host. If the flood is great enough, the spoofed host will no longer be able to receive or distinguish real traffic.

1 mark for each main point

- (ii) • Configure routers or firewalls to block ICMP echo replies. 1
 • Configure routers not to forward directed broadcasts onto network.
 • Configure servers not to respond to a directed broadcast request.

Any 1 of the above.

- (iii) • A competitor may have been wishing to take their web site offline so that the firm would lose potential clients and/or be more likely to use their own services. 1
 • Political reasons.

Any other valid point can be made for 1 mark.

- (d) (i) To allow a VPN to be established into their intranet OR to allow secure access to their intranet. **1**

1 mark for either point.

- (ii) PPTP. Point to Point Tunnelling Protocol. **1**

1 mark for name or acronym

[END OF SECTION II – Part C]

[END OF MARKING INSTRUCTIONS]