2013 Computing
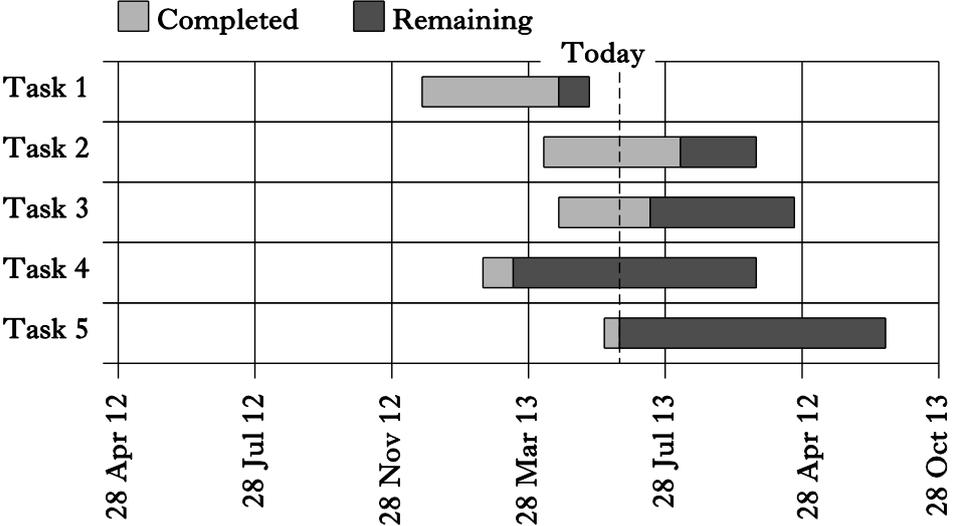
Advanced Higher

Finalised Marking Instructions

Marking Instructions for each Question
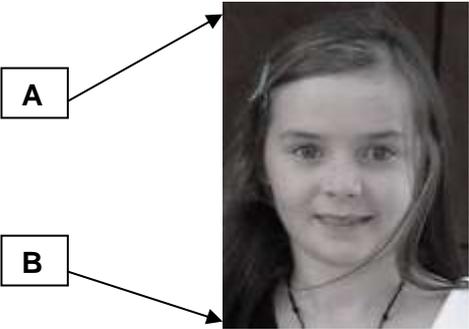
Section I

Software Development & developing a Software Solution

Question			Expected Answer/s	Max Mark	Additional Guidance
1			**The Scottish Government is considering the introduction of a new electronic voting system for elections. The government appoints a small team to undertake a *feasibility study*. Some of the concerns include:** • **voters' accessibility to a suitable computer system** • **the possibility of electoral fraud** • **the cost of such a system**		
	a		**The government creates a document specifying the features of the new system. State the name of this document.** Project proposal	**1KU**	
1	b	i	**People will not be charged to vote. Explain why aspects of *economic feasibility* would still need to be considered.** • Comparing costs of existing system with those of a new system. • The initial costs of any new equipment. • Running costs in terms equipment and personnel. • Any other reasonable.	**1PS**	
1	b	ii	**Name one other type of feasibility and explain why it would be considered for the voting system.** • Legal - Data Protection Act for the holding of personal details of the electorate. Computer Misuse Act to keep system secure from hackers. • Technical – concept of whether current software/hardware exists to deliver voting system • Schedule/time - can system be delivered on time/meet deadlines. • Any other reasonable.	**1PS** **1KU**	

Question			Expected Answer/s	Max Mark	Additional Guidance
1	c		**The government decides to proceed and a full system investigation results in an Operational Requirements Document (ORD).**		
		i	**The ORD contains details of the *scope and boundaries* of the voting system. Explain what is meant by scope and boundaries.** • The limits of what the voting system can handle. • Identifying aspects/features that will not be included.	2KU	
1	c	ii	**State one other item specified in the ORD.** • Functional requirements • Inputs/outputs • System Prospectus • Data requirements • Any other valid.	1KU	Description entailing - exact/detailed features. Do not award two marks for two things from the same bullet point.
1	d		**During the design stage, the development team decide to create their design using a standardised design notation. State two advantages of having a completed design written in a standard design notation.** • Opportunity to automate the creation of code. • Aids maintenance as design is standard • Will make designs more portable to other projects. • Will make designs more understandable to wider variety of developers. • Any other valid. Not weak descriptions – easy to translate to code	2PS	

Question			Expected Answer/s	Max Mark	Additional Guidance
1	**e**		**The team use a number of *project management techniques*. An example is shown below:**	**2KU**	

Completed   Remaining

Today

Task 1

Task 2

Task 3

Task 4

Task 5

28 Apr 12   28 Jul 12   28 Nov 12   28 Mar 13   28 Jul 13   28 Apr 12   28 Oct 13

This chart shows how much of a task has been completed. State two other project management techniques that are incorporated in this diagram.

- Identifying sub-tasks
- Identifying concurrency of subtasks
- Settling deadlines/completion dates
- Setting start dates for subtasks

Question			Expected Answer/s	Max Mark	Additional Guidance
2			A computerised version of a card game based on various animals native to Scotland is being developed for a website. There are forty cards in the game.		

	a	i	Define a suitable *record structure* to store the four items of data below the image.
			
			Type carddetails
			    name:string
			    weight:single
			    young:integer
			    power:integer
			End type
			(1) record name, **(1)** all fields with appropriate types, **(1)** for structure with begin/end
				3PS	Data type for weight.
					
					Syntax should not be penalised.

2	a	ii	Declare a suitable variable that can store the data for forty cards. Deck(40) as carddetails **(1)** array indexed to 39/40, **(1)** for matching data type	2PS	
2	b		During game play, players can take a card from or place a card on a pile of cards. A *stack data structure* will represent this pile of cards.		Putting FIFO but having correct description of stack operation.
		i	Explain what is meant by a *stack data structure*. Last in first out – add and remove from the same end.	1KU	

Question			Expected Answer/s	Max Mark	Additional Guidance
2	b	ii	The stack is held in a 1-D array and the last item placed in the stack was the Golden Eagle. The 1-D array in which the stack is held is shown below: Index Character 1 Ptarmigan 2 Otter 3 Golden Eagle 4 5 An item is added to the stack by 'pushing' and removed by 'popping'. Draw the final state of the stack after the following five operations: 1. Pop 2. Push Loch Ness Monster 3. Pop 4. Pop 5. Push Grouse Ptarmigan and Grouse in stack at position 1 and 2 respectively.	2PS	Award 1 for grouse at top of stack.
2	b	iii	Apart from the 1-D array, describe another item of data required to implement a stack. Stack pointer/integer variable **(1)** used to store the **index/position** of current top value of the stack/next available space.**(1)**	2KU	
2	b	iv	When a stack is implemented using a 1-D array adding a valid item can cause a runtime error. Explain why a runtime error can occur in this situation. Stack is full or Stack overflow **(1)** Attempting to push an item to a full stack Attempting to access an index value past the end of the array **(1)** or An array is of a fixed size -attempting to exceed this index will give an out of range error.	2PS	

Question			Expected Answer/s	Max Mark	Additional Guidance
3			**A program is to be written to edit photographs. The program will make it possible to flip a photograph vertically. This can be achieved by swapping the values of corresponding pixels such as those marked A and B.**		
			Original		
			After flip vertical		
			The image is 400 pixels high by 300 pixels wide and is stored in a 2D array of integers called ***photo***. Each integer will represent the colour of the pixel. photo(1 to 400, 1 to 300) of integers		
	a		**The pixel at the top left corner of the photo marked A is *photo (1, 1)*. In order to flip vertically it must swap values with the pixel marked B at the bottom left corner of the photo. State the array element of the pixel at B.** photo(400,1)	**1PS**	Question clearly indicates row dominance.

Question			Expected Answer/s	Max Mark	Additional Guidance
3	b		The vertical flip will be achieved by swapping the values in the first row of pixels with the bottom row of pixels, the second row with the second last row. State the number of pairs of rows to be swapped in order to flip the photograph. 200 rows **(1)**	1PS	
3	c		The following table shows some information on the rows and their corresponding swap row.		
			<table><tr><td>Row</td><td>Swaps with Row</td></tr><tr><td>1</td><td>400</td></tr><tr><td>2</td><td>399</td></tr><tr><td>3</td><td>398</td></tr><tr><td>....</td><td>....</td></tr><tr><td>....</td><td>....</td></tr><tr><td>100</td><td>301</td></tr><tr><td>101</td><td>300</td></tr><tr><td>j</td><td>?</td></tr></table>		
3	c	i	The letter j represents any row. State the row with which it swaps. 401-j	1PS	Watch for other expressions such as • 400-j+1 • 400-(j-1)
3	c	ii	The rows must be swapped pixel by pixel. The pixel at the centre of her right eye is photo(180,75). State the array pixel with which it must swap its value. • Photo(221,75) Award 1 mark for row number and one mark for column number.	2PS	Watch double jeopardy – award mark for **row** value which matches their answer in (c)(i)

Question			Expected Answer/s	Max Mark	Additional Guidance

3	d		**An algorithm is to be written to flip the picture vertically by swapping the values of the corresponding pairs of pixels. Use detailed pseudocode to write this algorithm.**
			
			Loop for row 200 times **(1)**
			    Loop for column 300 times **(1)**
			        Temp= photo(row, column) **(1)**
			        Photo(row, column)=photo(401-row, column) **(1)**
			        photo(401-row, column)=temp **(1)**
			    next column
			next row
				5PS	Implementing swap – 1 mark
					
					Nested loops without termination.
					
					Switching indices

Question			Expected Answer/s	Max Mark	Additional Guidance
4			An *object-oriented language* is being used to create a vector graphics drawing package. The class definition for a Shape is shown below: Shape positionX:integer positionY:integer ⟵ A getX() getY() ⟵ B move() The vector graphics package will also include classes for lines, rectangles and other shapes Class definitions consist of two sections.		
	a	i	Explain the purpose of the section marked A in a class definition. Contains the data/fields/attributes which store the characteristics/state of an object.	2KU	Answer cannot simply state information in stem.
4	a	ii	Explain the purpose of the section marked B in a class definition. Contains the methods/behaviours/functions **(1)** which can manipulate these attributes.**(1)**	2KU	Examples acceptable.
4	b		The vector graphics package allows for many different types of shapes to be drawn.		
		i	A rectangle is a shape, explain how a class for rectangles would be created. Rectangle will be a subclass of Shape **(1)** with additional data/fields/attributes and methods defined in that class.**(1)**	2PS	
	b	ii	Explain the benefit of an object-oriented language when coding additional shapes such as lines and rectangles. • Reduced coding time because rectangle inherits all code from Shape. • Improved error location by checking behaviour of classes and subclasses. • Any other valid	2KU	Must state benefit for second mark.

Question			Expected Answer/s	Max Mark	Additional Guidance

5			A program has been written to calculate a sequence of numbers in which each successive number is the sum of the two preceding numbers.
			
			A programmer has written the following algorithm which contains an error.
			
			`1. first  =2`
			`2. second =3`
			`3. print first`
			`4. print second`
			`5. for counter      = 1 to 5`
			`6.        sum     = first + second`
			`7.        first   = second`
			`8.        second  = sum`
			`9.        print first`
			`10. end loop`		

	a		The programmer decides to create a trace table to locate the error. The trace table shows the value of variable first, second and sum at the end of each pass though the loop. Copy and complete the trace table shown below:	**2PS**	

<table>
<tr><th>Counter</th><th>sum</th><th>first</th><th>second</th></tr>
<tr><td>1</td><td>5</td><td>3</td><td>5</td></tr>
<tr><td>2</td><td>8</td><td>5</td><td></td></tr>
<tr><td>3</td><td></td><td></td><td></td></tr>
</table>

You must follow through their working if they make a mistake in row 2.

<table>
<tr><th>Counter</th><th>sum</th><th>first</th><th>second</th></tr>
<tr><td>1</td><td>5</td><td>3</td><td>5</td></tr>
<tr><td>2</td><td>8</td><td>5</td><td>8</td></tr>
<tr><td>3</td><td>13</td><td>8</td><td>13</td></tr>
</table>

1 mark both 8, 1 mark both 13

Question			Expected Answer/s	Max Mark	Additional Guidance
5	**b**		The expected output is 2, 3, 5, 8, 13, 21, 34. The actual output does not match.		
		i	State the actual output of the algorithm for the first five values. 2, 3, 3, 5, 8	**1PS**	Do not penalise extra values.

Question			Expected Answer/s	Max Mark	Additional Guidance
5	b	ii	**Explain how the algorithm could be corrected.** Change Print line at 9 to Print sum or Print second Remove line 4	**1PS**	
5	c		**A programmer can use *breakpoints* to pause the execution of a program. Describe how pausing the execution of the code can be used to find errors.** Can inspect the contents of variables **(1)** to ascertain if they contain the expected values **(1)**. Can localise the area or section of code where a program stops responding **(1)** allowing fewer lines of code to be examined **(1)**. Programmer can step through the code after a certain breakpoint **(1)** to inspect the behaviour of a smaller area of code **(1)**.	**2PS**	No marks for describing breakpoints – stated in stem.

	Question		Expected Answer/s	Max Mark	Additional Guidance
6			A computer game includes a high score table with the names and scores of the top five players stored in two 1-D arrays.		
	a		A bubble sort can be used to sort a 1-D array. Explain how a bubble sort rearranges a list into ascending order. • Compares adjacent items eg 1and 2, 2 and 3 etc • If the first is larger than the second then items are swapped • Repeat the process from the beginning of the list with the unsorted part of the list • Stops when no more swaps take place	2KU	
6	b		The 1-D array that holds the scores is shown below:		

Index	1	2	3	4	5
Scores	23	25	27	50	58

Senga plays the game and scores 48. Her score of 48 replaces the lowest score that was in position 1. The 1-D array for the scores is now:

Index	1	2	3	4	5
Scores	48	25	27	50	58

The bubble sort is used to sort the scores. After the first pass the list will be sorted:

Index	1	2	3	4	5
Scores	25	27	48	50	58

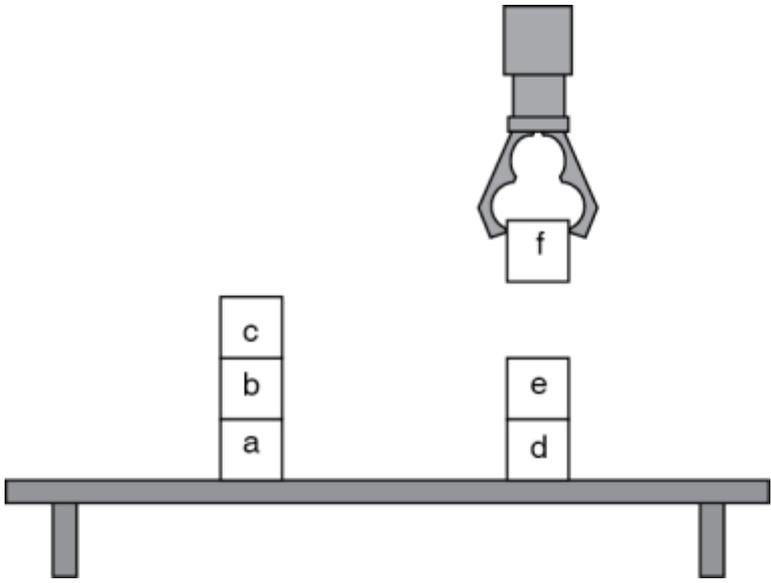|	Question		Expected Answer/s	Max Mark	Additional Guidance
6	b	i	State the two exchanges that took place in this pass. 48 and 25, 48 and 27 Values at index 1 and 2, 2 and 3	2PS	

Question			Expected Answer/s	Max Mark	Additional Guidance
6	b	ii	**Explain why the bubble sort will make another pass through the list even though it is sorted.** A swap has taken place (and so the Boolean variable will be true) and the terminating condition of no swaps will not have been met until the end of the second pass.	2KU	
6	b	iii	**The high score table is displayed as shown:** **Identify the error in the table and explain one possible cause of this error.** Senga's name is in the wrong position **(1)** because the algorithm does not swap the names when the scores are swapped **(1)** so three lines of code are needed.	2PS	
6	b	iv	**Morag plays the game and is added to the high score table with a score that results in the bubble sort only making one pass. State one possible score that Morag could have achieved and explain why only one pass was necessary.** 26 or 27 **(1)** resulting in a pre-sorted list with no swaps taking place in the first pass.	2PS	
6	c	i	**Name another sort that could be used to sort the list.** *Simple sort* *Selection sort*	1KU	
6	c	ii	**Explain how many comparisons the sort algorithm answered in (*c*)(i) would make.** Simple sort -10 or 5 x 4/2 or 4+3+2+1 Selection sort = 5 x 5 = 25	2PS	Award 1 mark for working with incorrect answer
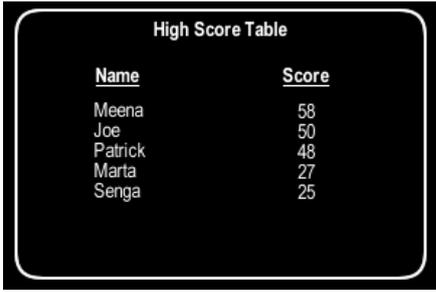
Section II

Part A – Artificial Intelligence

Question			Expected Answer/s	Max Mark	Additional Guidance
7			**The diagram below shows a typical *blocks world* scenario.** 		
	a		**Explain each of the following states in a blocks world environment. Use the diagram above to give an example of each of the states.**		
		i	**clear** Means that the block <u>has nothing on top of it</u> **(1 mark)** eg block c is clear (also block e) **1 mark**	**1KU 1PS**	
7	**a**	**ii**	**holding** The moving <u>arm is currently holding a block</u> **(1 mark)** eg holding(f)	**1KU 1PS**	

Question			Expected Answer/s	Max Mark	Additional Guidance
7	b		**Stack is an action that can happen in blocks world. It can be defined as** **stack(x, y): place block x on top of block y.** **Some pre-conditions must be satisfied to allow actions to take place. To carry out stack(x,y), two pre-conditions are needed** **Use the states in part (a) to write down what these two pre-conditions are.** For actions to happen, some pre-conditions must be satisfied to allow the action to take place. To carry out stack(x,y), two pre-conditions are needed. clear(y)**(1 mark)** holding(x) **(1 mark)**	2PS	A description would be acceptable
7	c		**In another scenario, the blocks are placed as follows.** **The blocks need to be moved to the following positions:** **Using the states "on", "ontable" and "clear", describe the goal state of this blocks problem. "On" and "ontable" are defined as follows:**		
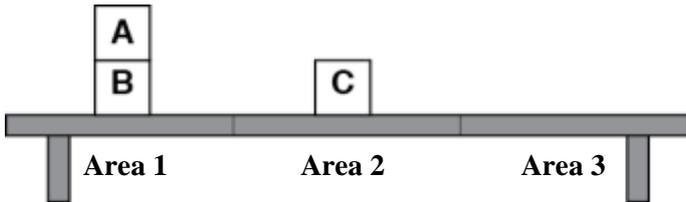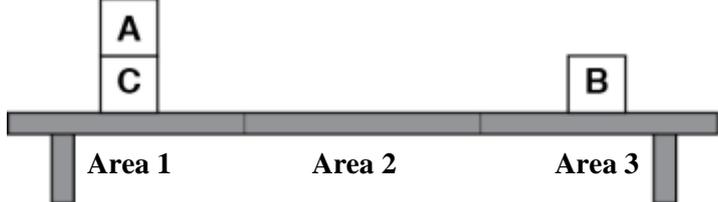
Using the states "on", "ontable" and "clear", describe the goal state of this blocks problem. "On" and "ontable" are defined as follows:

on(x, y)	block x is on top of block y
onground(x,m)	block x is on the table at Area m

3PS

ontable(C, 1) ⎫
ontable(B,3) ⎬ **1 mark**

on(A,C) **1 mark**

clear(A) ⎫
clear(B) ⎬ **1 mark**

2KU 7PS

Question			Expected Answer/s	Max Mark	Additional Guidance
8			A healthy diet will include food from the following five groups: **Fruit and vegetables** **Starchy foods** **Meat, fish, eggs and beans** **Milk and dairy foods** **Foods containing fat and sugar** Pork and beef are well known meats, and dairy foods include yogurt and cheese. Cheese is classed as a dairy food, that has an average fat content of about 65%. 'Crowdie' is a Highland cheese with only 5% fat and 'Caboc' is also a well known Scottish cheese but with close to the average fat content of cheese.		
	a		Use the above knowledge to distinguish between *classes* and *instances* in knowledge representation A class is a subgroup of foods eg 'fruit and vegetables' **(1 mark)** An instance is a specific example of a class eg pork is an instance of 'meat, fish, eggs and beans' **(1 mark)**	2PS	
8	b		Frames may be used to represent this knowledge during the design stage of the software development process. Name one other method of representing this knowledge. Semantic net **(1 mark)**	1KU	

Question			Expected Answer/s	Max Mark	Additional Guidance
8	c		**Use frame notation to represent all the knowledge about the food group 'Milk and dairy foods' contained above paragraph. Use the two frames below to start your representation.**	**4PS**	

food groups	
diet	healthy
quantity	in moderation

cheese	
sub-class	milk and dairy foods
average fat content	65%

1 mark for the two instances of cheese

crowdie	
instance	cheese
average fat content	5%
caboc	
instance	cheese

1 mark the average fat content of Crowdie not being the default value

1 mark

milk and dairy foods	
sub_class	food groups

1 mark

yogurt	
sub-class	milk and dairy foods

| 8 | d | | **State the purpose of *slots* in a frame.**

Each slot is filled with specific instances of data. | **1KU** | |

Question			Expected Answer/s	Max Mark	Additional Guidance
8	e		**A Prolog list structure could be used to represent the sources of milk and dairy foods. For example :** **[milk, yogurt, crowdie, caboc]** **Explain how this list would be searched to find out if Crowdie is a member of the list.**	**3PS**	
			Crowdie not equal to 'milk', the head of the list. **(1 mark)** Look at tail of the list : [yogurt, Crowdie, caboc] Crowdie is not equal to yogurt, the head of the list **(1 mark for recognising and mentioning the tail of the list)** Tail of the list is [Crowdie, caboc] Head of this list is Crowdie so match is found so answer is yes. **(1 mark)**		
8	f		**Fibre found in fruit and vegetables helps the body to digest food.**		
		i	**Represent this information as two Prolog facts.**	**2PS**	
			has (fruit_and vegetables, fibre). **(1 mark)** purpose (fibre, aid_digestion). **(1 mark)** Note: Accept other predicates names		
8	f	ii	**Write out one rule to ensure that all fruits and vegetables will be known to contain fibre.** has(X,fibre) if instance(X, Z), has(Z,fibre) **(1 mark)** **OR** has(X,W) if instance(X, Z), has(Z,W) **(1 mark)** Note: accept other predicate names, subject to being consistent with (i) above	**2PS** **2KU** **13PS**	

Question			Expected Answer/s	Max Mark	Additional Guidance
9			**Some modern computer games make use of machine learning.**		
	a		**Explain how a computer game could *learn by experience.***	2PS	
			Concept of identifying a strategy used by the computer's opponent within a game **(1 mark)** **1 mark for the computer adapting its play in the light of the experience**		
9	b		**Name one other type of machine learning and describe how it could be applied to computer games.**	2PS	
			Analogy/inductive/by examples/Rote/advice/ explanation based/discovery **(1 mark)**		
			Description relevant to chosen type **(1 mark)** eg		
			analogy: search through stored data to find a situation closely matching current position and apply corresponding strategy.		
			by examples : stored data would include strategy for given conditions		
			Note: rote/advice/inductive/explanation based are not usually appropriate for computer games; candidate would need to produce a convincing description of how it could be applied in order to get the mark		
9	c		**A computer game can be configured to have an authorised player list. When a player logs in to the game, a binary search routine is used to determine whether that player is on the authorised list.**		
		i	**Explain why a binary search is typically faster than a linear search.**	1KU	
			- Linear search can have up to N comparisons so may take longer, - For linear search, average search length is N/2 whereas for binary search the average is $\log_2 N < N/2$ - On average a binary search has fewer comparisons and so is quicker - Any other valid **1 mark for 1 reason**	2KU 4PS	

Question			Expected Answer/s	Max Mark	Additional Guidance
9	c	ii	**State one disadvantage of using a binary search rather than a linear search** List has to be pre-sorted **(1 mark)** Complexity of code **(1 mark)**	**1KU**	

Question			Expected Answer/s	Max Mark	Additional Guidance
10			**The Waltz algorithm is applied to a trihedral figure to produce valid labelling of all edges of the figure.**		
	a		**Explain the term 'trihedral figure'**	1KU	
			Each vertex of the figure is formed by three surfaces/planes/edges meeting **(1 mark)**		
			Consider the primal sketch a four sided dice :		
10	b		**Junction A has to be one of the following :**		
		i	**The symbols below are used by the Waltz Algorithm.** + - ▶ **Explain what each of these symbols denotes.** + denotes a convex edge **(1 mark)** - denotes a concave edge **(1 mark)** ◀ denotes a boundary edge with the visible surface to the right in the direction of the arrow **(1 mark)**		
10	b	ii	**Identify the arrow junction at Vertex A. Justify your choice.** Vertex (ii) **(1 mark)** AB and AD are boundaries so will be marked as ⟶ **(1 mark)**		
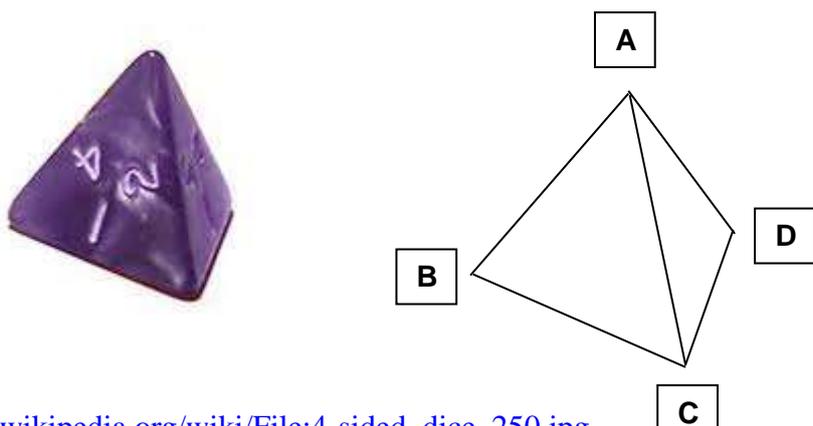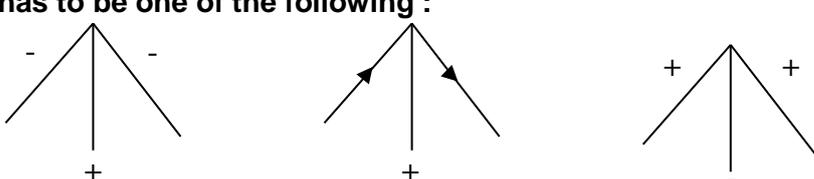
Question			Expected Answer/s	Max Mark	Additional Guidance

11			**Mycin is an expert system. A rule in Mycin is as follows:**
			
			 IF the identity of the germ is not known with certainty
			    AND the germ is gram-positive
			    AND the morphology of the organism is "rod"
			    AND the germ is aerobic
			 THEN the germ is of type enterobacteriacae
			 CF 80.		

	a	i	**Describe how *forward chaining* attempts to find a solution during a consultation with an expert system.** • Attempt to satisfy conditions by firing a rule **(1 mark)** • This results in new information being added to working memory • Until advice can be given **1 mark for each of any 2 of the 3 points**	2KU	
11	a	ii	**Describe how *backward chaining* attempts to find a solution during a consultation with an expert system.** • The system makes a hypothesis/goal/conclusion • then collects evidence to support it. • If it cannot be proved, another hypothesis is stated. **1 mark for each of any 2 of the 3 points**	2KU	
11	b	i	**State what "CF" stands for in "CF 80" as used in the last line of the rule.** Certainty factor **(1 mark)**	1KU	
11	b	ii	**Explain why CFs are needed in an expert system.** There is a chance (specified by the CF) that the advice given will be correct but there will be other possibilities which could arise from the information gathered. **(1 mark)**	1KU	
11	c		**Explain why conflict resolution strategies may be required during the consultation process.** Several rules may be available to be fired next **(1 mark)** A conflict resolution strategy will detail which of the conflicting rules should be taken next. **(1 mark)**	2KU	

Question			Expected Answer/s	Max Mark	Additional Guidance
12			**A search tree for a problem is shown below. The nodes have been labelled A to I**		
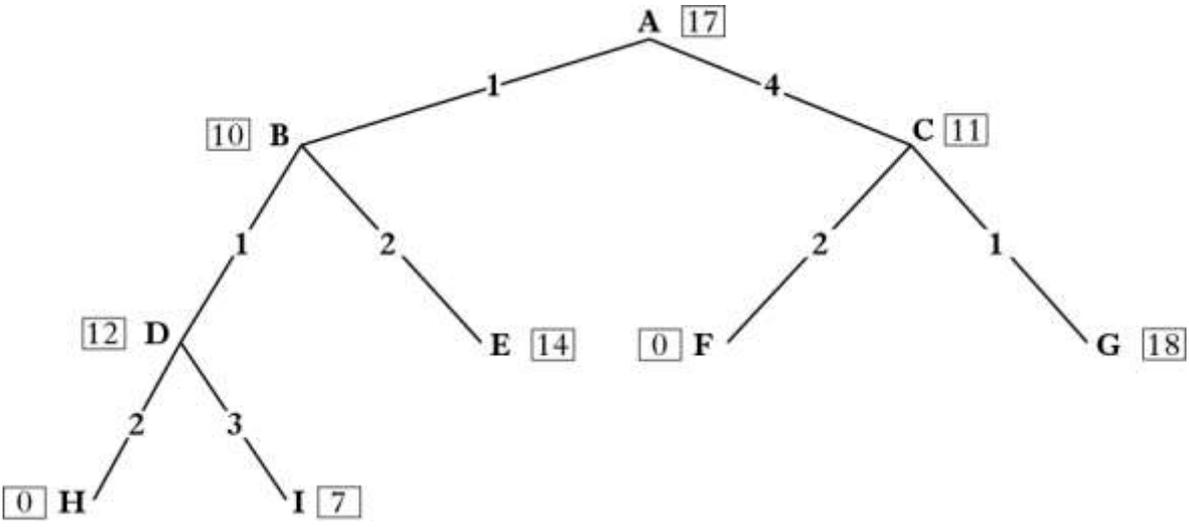
An evaluation function has been used to calculate a value for each node; this is shown as, for example, 17

The cost associated with each arc is shown on the arc.
The goal state has an evaluation function value of 0.

Question			Expected Answer/s	Max Mark	Additional Guidance
	a	i	**Explain the term *heuristic.*** A method for choosing which of several nodes is more likely to lead to the goal state. **(1 mark)**	1KU	
12	a	ii	**State one disadvantages of using a *heuristic*.** • Calculating the evaluation function for each node takes processor time • A heuristic function may mean that a solution, or a best solution, is missed • Any other valid point 1 mark for each of 2 disadvantages	1KU	

Question			Expected Answer/s	Max Mark	Additional Guidance
12	b	i	**Explain how the following search techniques will be applied to this problem. For each search strategy, clearly identify the order of nodes visited.** **hill-climbing** **Hill climbing** : A→ B **(1 mark)** Then sticks because sub-nodes D and E have values > the value at B **(1 mark)**	2PS	
12	b	ii	**best first** **Best-first** : • From node A nodes B and C are considered, select B **(1)** • Nodes D and E added (to agenda) so considering [C, D,E], select C **(1)** • Nodes F and G are added (to agenda) so considering [D,E,F,G], select F and stop since this is the goal state.**(1)**	3PS	
12	b	iii	**A*** Note : Adding in the cost functions : B=11, C=15, D=14, E=17, F=6, G=23, H=4, I=12 • From node A nodes B[11] and C[15] are considered, select B **(1)** • Nodes D[14] and E[17] added so considering [D,E,C], select D since this has lowest value **(1)** • Nodes H [4] and I[12] so considering [E,H,I], select H and stop since this is the goal state.**(1)**	3PS 2KU 8PS	

Question			Expected Answer/s	Max Mark	Additional Guidance
13			**The minimax procedure features in almost all computer board games programs, for example draughts and chess.**		
	a		**The minimax game tree below identifies the current state of a game at the top of the tree and shows a two move look ahead with player 1 about to take his turn. A positive evaluation function for a move outcome means a gain for player 1 whereas a negative evaluation function for a move outcome means a loss for player 1.**		

A

Player 1 takes move

B   C

Player 2 takes move

E   F   G   H   I

(13)   (–5)   (2)   (1)   (–4)

Question			Expected Answer/s	Max Mark	Additional Guidance
		i	**The best result for player 1 would be node E with a pay-off of 13. Explain why player 1 will not take the move to position B with a view to this payoff.** Using the evaluation scores for this game, if player 1 moves to B, player 2 will move to F, not E **(1 mark)** , since he will then have a payoff of 5/better pay-off **(1 mark)**	**2PS**	
13	**a**	**ii**	**Explain how the minimax search procedure would decide which move player 1 should take.** If player 1 moves to B, the result for player 1 will be -5 If player 1 moves to C, the result for player 1 will be -4 **(1 mark)** Whilst player 1 will always make a loss, the 'best' loss will be -4 so player 1 moves to C **(1 mark)** Award partial credit for an answer on general minimax procedure which does not use the values from this example.	**2PS**	
13	**b**		**State two reasons why minimax is unsuitable for many card games.** • The opponents hand can't be seen • all possible moves can't be seen • minimax needs 'perfect information' to work • card games can involve more than 2 players • any other valid **1 mark for each of 2 reasons**	**2PS**	

Section II

Part B – Computer Architecture
Answer ALL questions in this section.

Question			Expected Answer/s	Max Mark	Additional Guidance
14	a		A processor contains *registers* which are essential to its ability to process instructions. Some examples of these are the *MAR, MDR* and *general purpose registers* such as the accumulator.		
		i	Name two other registers found in a processor. Eg IR, PC, Stack pointer, status register **(2 x 1 mark)**	2	
14	a	ii	Describe the purpose of each of your chosen registers. Good description of each **(2 x 1 mark)**	2	
14	b		An assembly language instruction will usually comprise an *op-code* and an *operand*.		
		i	Using an assembly language with which you are familiar, state an example of a *data transfer instruction* which has both an op-code and an operand. Eg STA 1234. **(1 for a valid example)**	1	
14	b	ii	By reference to this example, explain what is meant by the terms op-code and operand. Op-code is the operation that the instruction will carry out – in this case a copy of data from register to memory. **(1)** Operand is the data (value or address) that will be used for the operation. In this case 1234 is the address that the data is copied to. **(1) (1 for descriptions only without reference to the example)**	2	

Question			Expected Answer/s	Max Mark	Additional Guidance
14	c		One of the general purpose registers in a particular processor is called the accumulator. "ASL" is an op-code in the assembly language for this processor which causes the contents of the accumulator to be shifted left by one bit. There is no operand with this op-code. A program segment contains two ASL op-codes to be executed in succession; ie ASL ASL Immediately before this program segment is executed, the value stored in the accumulator is 2.		
		i	State what the value stored in the accumulator would be after these instructions have been executed. 8 or 00001000 **(1)**	1	
14	c	ii	Justify your answer to (i). An ASL operation will cause the value of the accumulator to be doubled in value so two will cause the value to be quadrupled. **(1)** OR 2 is binary 00000010 so result is 00001000 which is value 8 **(1)**	1	

Question			Expected Answer/s	Max Mark	Additional Guidance
15			**The design of a processor may be classed as *RISC* or *CISC*.**		
	a		**One of the features of a RISC type processor is that the instruction set uses a small number of *addressing modes*.**		
		i	**Explain what is meant by an addressing mode.** An addressing mode specifies how an operand will be used by the processor. **(1)**	1	
15	a	ii	**Name and describe two addressing modes for a processor.** eg Direct addressing – the operand is the address in memory. Immediate addressing – the operand is the value to be used rather than a memory address. Implied addressing – the address is included in the op-code. **(2 x 1 marks for names + 2 x 1 for description)**	4	
15			**State two other typical features of RISC processors.** eg Instructions are all of the same length. Use of register oriented instructions and a large number of GP (general purpose) registers. Small instruction set of essential instructions only. (2 x 1marks)	2	
15	c		**Providing a *cache* is a way of improving the performance of a computer system.**		
		i	**Explain why the performance of a system is increased by the provision of a cache when a loop in a program is being executed.** Once the loop has been executed once, the code for the loop will be stored in cache **(1)**. Further executions of the loop will result in faster fetches from cache than from slower main memory. **(1)**	2	
15	c	ii	**Describe two disadvantages of providing a large cache.** Cache memory is very expensive to provide. **(1)** Cache needs to be searched to find the required data so if the cache is too large, this searching can take too long compared with going to main memory. **(1)** The physical size may not fit onto the processor chip or mean other features have to be left out. **(1)**	2	

Question			Expected Answer/s	Max Mark	Additional Guidance
16			**A computer system is available in two versions.**		
	a		**The more expensive system implements the technique of *memory interleaving.***		
		i	**Describe how memory interleaving operates.**	**2**	
			Memory is split into 2 or 4 banks with memory addresses being sequential across the banks. **(1)** Whilst waiting for the data to be ready during a memory read/write operation, the processor starts the next read/write operation which will be on the next bank. Effectively, this means that memory on each bank is being accessed concurrently. **(1)**		
16	a	ii	**Explain why memory interleaving is particularly suitable for writing to memory rather than reading from memory.**	**2**	
			Data that has been read may have to be decoded and processed before reading the next item and this may take a considerable time **(1)** When writing data, there is no processing needed so there is no waiting period between writing data items **(1)**		
16	b		**The cheaper system has a main memory which does not implement the technique of memory interleaving.**	**2**	
			Explain why processing time is wasted when non-interleaved memory is being used.		
			Main memory has a time delay between requesting/ writing data and the data being available/stored. **(1)** The processor has to wait doing nothing during this time delay before it can continue **(1)**.		

Question			Expected Answer/s	Max Mark	Additional Guidance
17			A computer system can be purchased with either a *PCI bus* or a *PCI-X bus.* The two bus options have a common purpose in the system but with different performance levels.		
	a		State the purpose of a PCI bus. To transfer data to/from peripherals **(1)**	1	
17	b		The PCI-X bus has a data throughput rate of 1 GB/s compared with only 132 MB/s for the PCI bus. State two reasons why the throughput rates for the two buses are different. PCI-X clock speed is (four times) greater; bus width is (two times) wider than PCI. **(1 for each reason)**	2	
17	c		These buses are designed with *multipoint topology* functionality. Describe what is meant by multipoint topology. The data bus is shared between all peripherals. They can be plugged into any of the sockets and all devices access the bus with the same priority. **(1)**	1	
17	d		Apart from the greater data throughput rate, state one other advantage of the PCI-X bus. Allows prioritisation of data from certain devices **(1)**. PCI-X is backwards compatible with PCI devices **(1)**	1	
17	e		Explain the effect of plugging a PCI device into the PCI-X bus. The PCI device would run normally **(1)** but throughput of the bus would be reduced as the PCI-X bus runs at the speed of the slowest attached device **(1)**.	2	

Question			Expected Answer/s	Max Mark	Additional Guidance
18	a		**The Intel 80386 was the first processor in the x86 series to include a *pipeline*. This was a six stage pipeline so it could theoretically give a six-fold improvement in processing speed compared with not having a pipeline.**		
		i	**State two reasons why it was not possible to achieve this improvement in practice.** The pipeline stages should all be of equal duration but this is unlikely to be achieved. Branch instructions may cause the pipeline to stall. Data dependencies may cause the pipeline to stall. Instructions may be of different lengths. *Any 2 reasons*	2	
18	a	ii	**The Intel Pentium processor further developed the use of pipelines by including two independent integer pipelines and one floating point pipeline in its design.** **Explain why this development improved processor performance.** Superscalar (parallel) processing is possible with more than one pipeline allowing two instructions to be processed simultaneously. **(1)** Each pipeline was optimised for different instruction lengths **(1)**	1	
18	b		**The technique of *branch prediction* can improve the performance of a processor containing a pipeline.**		
		i	**Describe this technique.** A table/register is used to record the way a branch was taken on the last transit. **(1)** The next time that the branch is encountered, the register is checked and the appropriate instructions are loaded into the pipeline, assuming it will follow the same route. This will prevent a stall for the majority of branches. **(1)**	2	
18	b	ii	**Explain why the performance of the processor would be improved by branch prediction when it is executing a sort procedure.** Sorting processes will have loops with the code repeated many times **(1)** so the branch will take the same route many times causing few stalls. **(1)**	2	

Question			Expected Answer/s	Max Mark	Additional Guidance
18	c		**Another technique that can improve performance is *predication*.** **Explain why predication should provide better performance than branch prediction.** With predication, 2 pipelines are used. **(1)** When a branch is detected entering a pipeline, both pipelines are used to load code for each of the possible paths **(1)** and when the branch is actually executed, the pipeline storing the correct branch is used and the other is disposed of. **(1)** There are therefore no stalls. **(1) (3 marks maximum)**	3	

Question			Expected Answer/s	Max Mark	Additional Guidance
19			**Multitasking computers require an operating system that has a *scheduling system*.**		
	a		**An operating system uses a *pre-emptive* scheduling system.** **State what is meant by a pre-emptive scheduling system.** The operating system controls when processes are running or suspended. **(1)**	1	
19	b		**Pre-emptive scheduling can be implemented by a *multi-level feedback queue*.**		
		i	**Describe how a multi-level feedback queue works.** The OS maintains a number of queues with different priorities. A task enters the top queue with the highest priority so it gets processed almost immediately but for a very short period. **(1)** It is then suspended and moves down to a queue with lower priority. This queue has a longer time slice and will normally run almost immediately since the priority will still be higher than other tasks. When suspended, it drops down to another queue with lower priority still and longer run time. **(1)** The bottom queue is a standard round robin queue with lowest priority. **(1)**	3	
19	b	ii	**Describe one reason a multi-level feedback queue may be more efficient than *round-robin scheduling*.** Tasks that run for a very short time are completed almost immediately with high priority **(1)** especially if they do not reach the round robin stage.	1	

Question			Expected Answer/s	Max Mark	Additional Guidance
20	a		**Explain why the file management system of an operating system has to map the logical view of files to their physical location.** The logical view is how the user sees the files on a drive (names and folders). This needs to be converted to a physical view so that the operating system can locate the files on the drive. **(1)**	1	
20	b		**The operating system saves files on the hard drive using a non-contiguous method of file allocation.**		
		i	**Describe one method of storing files non-contiguously on a hard drive.** Either a description of 'linked allocation 'or of 'indexed allocation'. **(1 for name, 1 for description)**	2	
20	b	ii	**Explain one advantage that non-contiguous file allocation has compared with contiguous file allocation.** Because it can use all blocks on the hard drive, the full capacity of the drive can be used **(1)**. With contiguous allocation, a 'drive full' message may be given when there is quite a lot of unused space. **(1)**	2	
20	b	iii	**Explain one disadvantage that non-contiguous file allocation has compared with contiguous file allocation.** Slower to transfer data **(1)** because of more head movement **(1)** OR more disc space used for the pointers/index **(1)** so less space available for user **(1)**.	2	

Question			Expected Answer/s	Max Mark	Additional Guidance
20	c		**An operating system provides a number of *services*, one of which is to provide a *standard look and feel* for applications.**		
		i	**State how an operating system may provide this service to applications.** The OS provides a library of routines (the API) **(1)**	1	
20	c	ii	**Explain why this provides a standard look and feel for applications.** Almost all applications will use the API to perform actions such as drawing windows, menus, etc, so they will all behave in the same way **(1)**	1	
20	d		**Another service provided by an operating system *allows communication between programs and the passing of data*.**		
		i	**Describe an example of a situation where this service would be required** eg A spreadsheet is encapsulated in a word processor document. Then, as the data in the spreadsheet changes, the document will be updated automatically. **(1)**	1	
20	d	ii	**Describe how this service may be implemented by the operating system.** Eg DDE – one program is the server and the other program is the client. A dialog is set up between the two to transfer data.**(1)** eg OLE –data from one program is encapsulated in an object and this is embedded in another document. The program associated with the object runs along with the program of the main document so that the object can be edited in its native format. **(1)** Any other acceptable answer.	1	
20	e		**The operating system provides a printer spooler service to manage printing. This service uses a queue structure to store the list of jobs waiting to be printed.** **Explain why a queue is used for this purpose.** Print jobs need to be handled first in, first out (or last in, last out). **(1)**	1	

Part C– Computer Networking
Answer ALL questions in this part.

Question			Expected Answer/s	Max Mark	Additional Guidance
21			**Rebecca is creating a website which she plans to use to sell makeup products.**		

	a		**Rebecca begins by writing the following HTML code.**
			
			`<html>`
			  `<head>`
			    `<title><b>Rebecca's Makeup</b></title>`
			  `</head>`
			  `<body>`
			    `Products`
			  `</body>`
			`</html>`		

		i	**The HTML code at line A above adds a title to the page, but it contains an error. Explain what this error is.** Formatting tags, eg `<b>` cannot be included in the `<head>` section.	1PS	

21	a	ii	**Write the HTML code that could be added to line B above to ensure the text "Products" appears as a section heading, centre aligned, and coloured blue.**
			
			Accept any one of the following:
			
			`<h1 align="center" ><font color="blue">My Subjects</font></h1>`
			
			or
			
			`<h1 style="text-align: center; color: blue;" >My Subjects</h1>`
			
			1 mark for section heading tag
			1 mark for appropriate alignment attribute
			1 mark for appropriate colour tag/attribute
				3PS	

Question			Expected Answer/s	Max Mark	Additional Guidance
21	b		Rebecca wants to include an animation on her web page. She will need to install a *plug-in*.		
		i	Once the plug-in has been installed, describe the process a web browser would follow in order to use the plug-in to view the animation.	2KU	
			Accept two of the following: • the browser will download the animation • the plug-in is loaded and passed the animation • the plug-in will display the animation in the browser window		
21	b	ii	Name a plug-in that Rebecca could use to display her animation. Adobe Flash	1PS	
21	c		As an alternative to using a plug-in Rebecca could redesign her animation as a *Java applet* or an *Active X* component. She decides to use a Java applet.		
		i	One advantage of Java applets is that they operate in a *sandbox*. Describe a sandbox, and explain how this would be an advantage to visitors to Rebecca's website • a sandbox prevents access to local memory and backing storage without user permission • visitors would be assured that programs and data on their local machine would not be compromised by running the downloaded code	1KU 1PS	
21	c	ii	State another advantage of Java applets over Active X components, and explain how this would be a benefit to Rebecca. • Java applets can run on multiple operating systems and are supported by many different browsers, whereas Active X is limited to Microsoft Windows and a restricted group of browsers • Rebecca's website would be available to a wider audience	1KU 1PS	

Question			Expected Answer/s	Max Mark	Additional Guidance
21	**d**		**Once Rebecca has completed her website it is made available on a web server.**		

		i	**Describe the stages of an HTTP communication when a client requests a web page from a web server.**
			
			Accept four of the following:
			     connection opened by the client – typically via port 80
			     clients request specific resource – eg GET/index.html1 HTTP/1.1
			     server returns response code and headers – eg HTTP/1.1 200 OK
			     server sends the requested data
			     connection can be closed by either the client or server
			1 mark for each point, maximum of 4 marks
				4KU	

21	**d**	**ii**	**When a web browser requests a web page from a web server a response code is returned. State two of these response codes and give their meaning.**
			
			Accept two of the following:
			    200 OK
			    301 Moved Permanently
			    401 Unauthorised
			    404 Not Found
			    500 Internal Server Error
			
			Or any other valid answer
				2KU	

Question			Expected Answer/s	Max Mark	Additional Guidance
22			Fraser is a travelling salesman. He uses his laptop each evening to connect from his hotel room to his office, to send a list of all orders he had made that day.		
	a		Fraser previously made use of a dial-up modem to communicate with his office. The modem makes use of the *SLIP* protocol to make the connection.		
		i	Name an alternative protocol to SLIP PPP	1KU	

22	a	ii	State two advantages of this alternative protocol over SLIP.
			
			Accept two of the following:
			        encrypted authorisation
			        data compression
			        error checking
			        authentication
			        encapsulation to allow multiple
			protocols to be used
			
			1 mark for each point, maximum of 2 marks
				2PS	

22	a	iii	State the layer of the OSI Model at which SLIP operates. data link	1PS	
22	a	iv	State the layer of the TCP Model at which SLIP operates. network	1PS	

Question			Expected Answer/s	Max Mark	Additional Guidance
22	b		**While travelling, Fraser makes use of a *tunnelling* protocol to connect to his office.** **State two characteristics of a tunnelling protocol.** Accept two of the following: Networking traffic encapsulated within tunnelling protocol Client uses features of remote network as if physically connected *1 mark for each point, maximum of 2 marks*	2KU	
22	c		**Fraser uses *conventional encryption* to send his daily list of orders to his office.**		
22	c	i	**State a precondition of using conventional encryption.** Conventional encryption requires that the decryption key is known by both ends of the communication.	1KU	
22	c	ii	**Explain why both a public and private key are required in order to make use of *public key encryption*.** recipient's public key to encrypt the data recipient's private key to decrypt the data	2KU	
22	d		**Fraser decides to send an e-mail to the clients he plans to visit the next day.**		
22	d	i	**State the technique that can be used to allow Fraser's clients to know that the e-mails originated from him and have not been spoofed or altered.** digital signatures	1PS	

Question			Expected Answer/s	Max Mark	Additional Guidance
22	d	ii	**Describe fully how this technique operates.** sender uses their private key to create a message digest from e-mail message digest is sent along with e-mail to recipient sender's public key is openly shared recipient uses sender's public key to validate message digest against the e-mail sent	**4KU**	

Question			Expected Answer/s	Max Mark	Additional Guidance
23			**Aufaewee Town Council maintains a website to keep local residents up to date with Council business.**		
	a		**The website becomes victim to a denial of service attack, which results in all traffic intended for the website being directed to a fake server.**		
		i	**Explain how the traffic could be directed to a fake server.** DNS poisoning/spoofing – injecting fake entries into the DNS database	**1PS**	
23	**a**	**ii**	**State a precaution that could be taken to ensure this type of attack is not successful.** Update to the latest version of the DNS software (BIND)	**1PS**	
23	**b**		**The Council web server is located on the Council's network, which is connected to the Internet**		

		i	**Describe one feature of a *gateway*.**
			
			Accept one of the following:
			    single entry point of traffic to network
			    requests for web pages forwarded on to web server
			    convert protocols between external and internal network
				1KU	

Question			Expected Answer/s	Max Mark	Additional Guidance

23	b	ii	**Explain how this feature could be used to protect the Council network.**
			
			Accept one of the following:
			    single entry point of traffic to network, can include firewall and filtering
			    requests for web pages forwarded on to web server, while hiding other devices
			    any other suitable
				1PS	

23	b	iii	**State two firewall rules that could be used to allow local residents access to the website while protecting other Council computers.**
			
			    deny all incoming traffic, except
			    allow incoming port 80 (HTTP) traffic
				2PS	

Question			Expected Answer/s	Max Mark	Additional Guidance
24			**A group of friends decide to meet up in order to play some networked games. They bring their computers to a single house to connect them together.**		
	a		**The friends debate whether they should use a wired or wireless network to connect their computers.**		
		i	**Name a suitable wired network standard that could be used to create the network.**	**1PS**	

			One of the following:
			    10/100/1000BaseT
			    UTP Ethernet		

24	a	ii	**Name a suitable wireless network standard that could be used to create the network.** 802.11g/n	**1PS**	
24	a	iii	**Compare these two network technologies in terms of range and bandwidth.** 10/100/1000BaseT: Range: 100m (restricted by route of cable) Bandwidth: 10/100/1000Mbps 802.11g/n Range: 50m (indoors) Bandwidth: 54/150Mbps	**4KU**	
24	b		**The friends decide to network their computers wirelessly, and configure a secured wireless access point for the computers to connect to.**		

		i	**Name the two pieces of information that they need in order to connect their computer to the wireless access point.**
			
			    SSID
			    encryption key/password
				2PS	

Question			Expected Answer/s	Max Mark	Additional Guidance

24	b	ii	**State three security precautions that the friends could take to ensure that their wireless network remains private and secure.**
			
			Accept the following:
			    restrict access to specific MAC addresses
			    hide the SSID
			    use encryption (WEP/WPA)
				3PS	

Question			Expected Answer/s	Max Mark	Additional Guidance
25			**LAN Drovers Ltd are networking specialists that build and configure networks for their clients. They have been asked to build a network for a client who plans to purchase a Class B range of IP addresses.** **The client's intended Class B network address in dotted decimal notation is 129.44.27.0.**		
	a		**Calculate the number of hosts that can exist on the client's proposed network.** 65,536 or 2^{16} less two for network/broadcast addresses	2PS	
25	b		**The client only needs to network 1000 hosts.**		
		i	**Explain why using CIDR is a more efficient method for distributing IP addresses in this example.** CIDR would allocate only 1024 IP addresses remaining 64,412 addresses can be allocated to another network Less waste of IP addresses than allocating entire class	2PS	
25	b	ii	**Calculate the CIDR address which would be suitable for the client, rather than using the Class B address 129.44.27.0. You should include your working.** 1000 hosts require a minimum of 1024 addresses **(1 mark)** 1024 addresses requires 10 bits for the host addresses, therefore 22 bits are used for the network address **(1 mark)** network address: 129.44.27.0/22 **(2 marks)** *maximum of 2 marks*	2PS	

Question			Expected Answer/s	Max Mark	Additional Guidance
25	c		The client has four buildings each of which will contain 250 hosts. The network specialists decide that the most efficient way to implement the network would be to set up a *subnet* in each building.		

		i	Describe an advantage to the client of setting up a subnet in each building.
			
			Accept one of the following:
			  decreased network congestion **(1 mark)**
			  greater security **(1 mark)**
			Also accept:
			  by containing traffic with a building to a single subnet **(1 mark)**
				2PS	

	c	ii	Calculate the value of the subnet mask that would be used to allocate a subnet for each building. State your answer in dotted decimal notation.
			
			Accept the following:
			  8 bits required to 250 different hosts (254 different addresses)
			  the binary subnet mask is therefore 11111111.11111111.11111111.00000000
			  the decimal subnet mask is therefore 255.255.255.0
			
			1 mark for each point
			award full marks for correct final answer without working
				3PS	

[END OF MARKING INSTRUCTIONS]