National
Qualifications

CS(H)20BMS

Computing Science
Marking Instructions

perfectpapers

General Marking Principles for Higher Computing Science

Always apply these general principles. Use them in conjunction with the detailed marking instructions, which identify the key features required in candidates' responses.

(a) Always use positive marking. This means candidates accumulate marks for the demonstration of relevant skills, knowledge and understanding; marks are not deducted for errors or omissions.

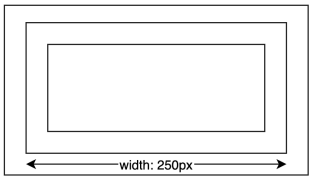
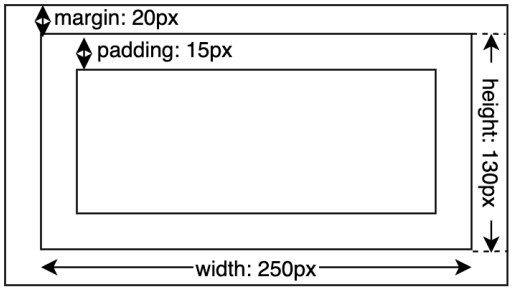
(b) If a candidate response does not seem to be covered by either the principles or detailed marking instructions, and you are uncertain how to assess it, you must seek guidance from your team leader.

(c) Award marks regardless of spelling, as long as the meaning is unambiguous

(d) Candidates may answer programming questions in any appropriate programming language or pseudocode. Award marks regardless of minor syntax errors, as long as the intention of the coding is clear.

(e) For a describe question, candidates must provide a statement or structure of characteristics and/or features. This will be more than an outline or a list. It may refer to, for example, a concept, process, experiment, situation, or facts, in the context of and appropriate to the question. Candidates must make the same number of factual/appropriate points as there are marks available in the question.

(f) For an explain question, candidates must relate cause and effect and/or make relationships between things clear, in the context of the question or a specific area within the question.

Number			Question	Instructions	Marks
1			Convert the denary number -120 to binary using 8 bits.	10010010 **(1 mark)**	**1**
2			A Cascading Style Sheet contains the following rule. (see paper) Label this diagram to show how the rule above would be applied. The width property is already shown.  	 **1 mark for margin (outside of width/height)** **1 mark for padding (within width and height)** **1 mark for height correctly shown** **Maximum 3 marks**	**3**
3			When analysing a project, boundaries are defined. Describe what is meant by boundaries in software development.	• the limits that help to define what is in the project and what is not. • can also clarify any assumptions made by the software developers regarding the client's requirements. **1 mark each bullet, max 2 marks**	**2**
4			A website is experiences a DOS attack.		
	a		State two symptoms users experience when this happens.	• Slow performance • Inability to access data/services **1 mark each bullet, max 2 marks**	**2**
	b		State two costs that the website owners will have as a result of the DOS attack.	• Costs due to lost business from downtime. • Costs to remedy / make site **1 mark each bullet, max 2 marks**	**2**
5			Describe the purpose of registers within a processor.	Registers are used to hold values within the processor **(1 mark)** while they are being processed or as a result of their processing **(1 mark)**	**2**
6.			Describe one problem that can occur when using global variables in a program.	It is possible that global variables may be altered inadvertently because they are not restricted in their scope **(1 mark)**	**1**
7			Explain how the range and precision of floating-point numbers can be decreased.	The range can be reduced by reducing the number of bits for the exponent **(1 mark)** The precision can be decreased by reducing the number of bits for the mantissa **(1 mark)**	**2**

<table>
<tr><th colspan="3">Number</th><th>Question</th><th>Instructions</th><th>Marks</th></tr>
<tr><td>8</td><td></td><td></td><td>A database table is shown below. (see paper)

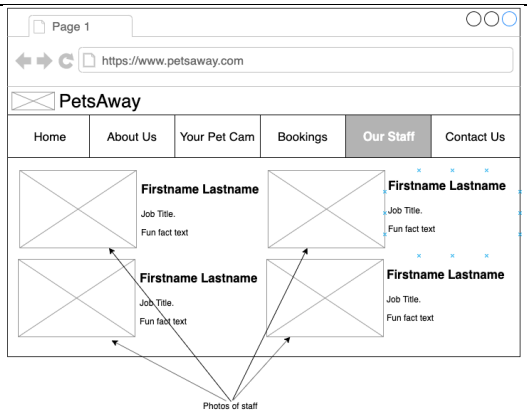
Complete the table below showing the output from the following SQL statement. (see paper)</td><td><table><tr><td>Name</td><td>Lowest</td></tr><tr><td>Creag Mhor
Coire a’Chairn</td><td>981
981</td></tr></table>1 mark for “Lowest” as missing column title
1 mark for each correct row

Maximum 3 marks</td><td>3</td></tr>
<tr><td>9</td><td></td><td></td><td>An intelligent thermostat for a heating system is shown below. (see paper)

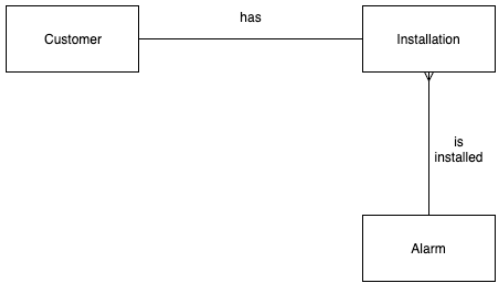
Describe one environmental benefit of using a heating system which is intelligent.</td><td>Pro-active decision making by software/apps to reduce usage e.g.
automatically switch heating off/on when within range
monitoring/responding to external weather conditions
adjust heating based on historical patterns of data
zoned heating
Any one bullet for 1 mark</td><td>1</td></tr>
<tr><td>10</td><td></td><td></td><td>A section of code has been written which examines an array of one hundred values. (see paper)</td><td></td><td></td></tr>
<tr><td></td><td>a</td><td></td><td>State the name of the standard algorithm which is shown above.</td><td>Finding Minimum (1 mark)</td><td>1</td></tr>
<tr><td></td><td>b</td><td></td><td>Explain what will be held in <code>requiredIndex</code> when the FOR loop terminates.</td><td>requiredIndex will hold the location (1 mark)
in the array of the minimum value (1 mark).</td><td>2</td></tr>
<tr><td>11</td><td></td><td></td><td>The content of a web page is correctly structured using HTML tags. A part of the site is shown below. (see paper)

State the HTML tag that would be used to contain each of the items of content above.</td><td>Section (1 mark)</td><td>1</td></tr>
<tr><td>12</td><td></td><td></td><td>A ticket agency sells tickets for events. Customers can purchase up to six tickets for each event but repeat purchases, for the same event, are not allowed. (see paper)

State the primary key of the TicketSale entity.</td><td>CustomerID and EventID
1 mark for each part of the compound primary key</td><td>2</td></tr>
</table>

Number			Question	Instructions	Marks
13			PetsAway is a new startup business which combines technology and care for pets while their owners are away on holiday. Pets are cared for in a multi-room pet "hotel". The company places tags on the collars of each animal it cares for. When an animal enters different rooms in the hotel, their presence is detected by sensors and video footage is recorded of the detected animal and the date, time and location in the hotel recorded. This footage can be viewed online by the owner, using a special code to access the footage.		
	a		State two functional requirements of the system above.	• Record video on detection of pet • Record data, time and room on detection of pet • Allow access to footage based on code **1 mark each bullet, max 2 marks**	**2**
	b		During the development process a wireframe is created. Describe how this wireframe could be used in usability testing.	Useability testing would focus on • Access to menus – are these clear enough • Video elements are in the correct position to allow them to viewed. • How users interact with the content • Any other valid response. **Award 1 mark each for any two relevant uses.**	**2**
	c		The "Our Staff" web page shows the details of four members of staff. It shows their first and last names, jobs titles, an image of each of them and a fun fact. Using this information, draw a wireframe design for the "Our Staff" web page. This should be consistent with the design for the site.	 **1 mark for four photos,** **1 mark for text information** **1 mark for consistent with previous layout**	**3**

Number			Question	Instructions	Marks
	d		The site wireframes are developed into low-fidelity prototypes. Describe the key features of low-fidelity prototypes.	• Is an interactive version the site • Implements navigation • Contains menu elements as shown in wireframe • Quickly amended/changed to reflect feedback from users/client • Allows users to "play" with design, to discover how it works. • Other valid **1 mark each bullet, max 2 marks**	**2**
	e		When the website is created, the following CSS rules are coded. (see paper) Using grouping selectors to remove any repetition, re-write this code to make it more efficient.	.menutext, .videobox, .videoheading, .video-text { padding: 10px} .menutext, .videoheading, .video-text, #logo { margin-top: 10px} .menutext { margin-top: 5px } #logo { padding: 5px} **1 mark for each correct CSS rule, max 4 marks**	**4**
	f		Some code from the "Your Booking" page is shown below.		
		i	State the type of validation used for "Pet Name".	Presence **(1 mark)**	**1**
		ii	A drop-down has been used to selected details of "Pet vacinations". Describe two reasons for using a dropdown list rather than radio buttons on the form.	Reduces the amount of space required on the page **(1 mark)** Allows the selection from any number of options without needing to know the number available **(1 mark)**	**2**
		iii	A user selects the radio button for "Dog" but then changes their selection to "Guinea Pig". When this happens the "Dog" radio button is deselected. Explain, with reference to the HTML, why this happens.	This is because the radio buttons are part of a group **(1 mark)** because they have the same name ("type") applied to them. **(1 mark)**	**2**
		iv	The pet hotel accepts bookings for between 1 and 21 nights. Amend the HTML for "duration" so that the number of days is restricted as required.	`<input type="number" name="duration" min="1" max="21" />` **1 mark for the addition of min and max with correct values to the HTML statement.** *Accept without ""*	**1**
14			A security company has a record of customers and the alarm system that each customer has installed. A sample from the company database is shown below. This shows the alarm systems currently installed for each customer. (see paper)		

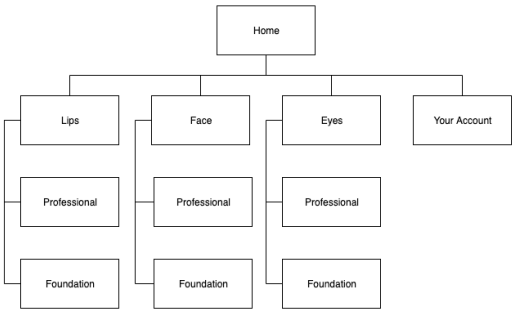
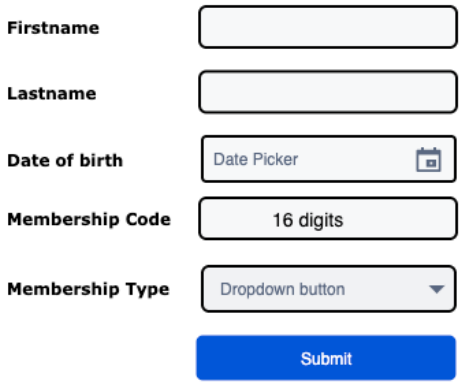
Number			Question	Instructions		Marks
	a		Draw an entity relationship diagram to represent the relationships that exist in this database. Your answer should show the entity names and cardinality. Attributes are not required on the diagram.	 **1 mark for correct 1-to-1 relationship (Customer to Installation)** **1 mark for correct 1-to-many relationship (Alarm to Installation)** **1 mark for suitable names given to both relationships.**		**3**
	b		A partially complete data dictionary for the database is shown below. (see paper)			
		i	Complete the entries for the data dictionary from A to D below.	A. PK/FK B. FK C. Lookup from Customer.CustomerID D. Boolean **1 mark each, max four marks**		**4**
		ii	A change is required which means that the system will now store information about the alarm systems that customers had previously installed as well as the ones they currently have installed. Describe how the keys for the entity "Installation" would be changed to allow this to happen.	A compound key **(1 mark)** of customer and alarmsystem will be required **(1 mark)** *Accept answers that makes use of installation date as part of the primary key.*		**2**
	c		A query is required to show the total spent by customers from 01/10/2018 to 31/10/2018, for each different alarm system. Design this query using the layout below which has been partially completed for you.	Fields(s) and calculation(s)	AlarmSystem, SUM(RRP)	**3**
				Table(s)	Installation, Alarm	
				Search criteria	WHERE InstalledOn ≥ '01/10/2018' AND Installed On ≤ '31/10/2018'	
				Grouping	Alarm	
				Sort Order		
				1 mark for fields/calculation **1 mark for tables** **1 mark for grouping**		
	d		State the part of the processor that that would calculate the total spend for each alarm system.	ALU **(1 mark)**		**1**

Number			Question	Instructions	Marks
	e		The customer "Zang, H" has changed address. She has a new address of 42 Robertson St, Otley, OT19 8UW. Write the SQL statement to make these changes.	UPDATE customer **(1 mark)** SET Address="42 Robertson St, Otley", Postcode ="OT19 8UW" **(1 mark)** WHERE CustomerName = "Zang, H" **(1 mark)** **OR** UPDATE customer **(1 mark)** SET Address="42 Robertson St, Otley", Postcode ="OT19 8UW" **(1 mark)** WHERE CustomerID = "1901" **(1 mark)**	**3**
	f		The text data in the database is stored using Unicode. Describe an advantage of using Unicode over extended ASCII.	• Able to represent more characters • Can store characters from more than one language • Can storage characters for languages with more than 250 characters • Can include user-defined characters **1 mark**	**1**
15			A program is being developed to store contacts on a mobile phone. It is proposed that a record structure is used to represent a contact. (see paper)		
	a		Using pseudocode, or a programming language of your choice, declare a variable, called contactData, that can store up to 500 contacts.	ARRAY contactData OF contact INITIALLY [] * 500 **1 mark for use of record structure** **1 mark for number of records in array**	**2**
	b		Explain the purpose of the line BOOLEAN spam INITIALLY false in the record code.	When a record is initially set **(1 mark)** the value of the spam field will be false. **(1 mark)**	**2**
	c		Explain why a record structure is proposed rather than separate arrays.	Using a record allows the data to be treated as one group rather than processed as a number of separate arrays **(1 mark)** The components of the array can be referred to using this record structure which is more efficient than using separate arrays **(1 mark)**	**2**
	d		A function is developed to be used when searching for a particular contact. The function code is shown below. (see paper)		
		i	State two parameters used by this programme.	• valueToCheck • valueToFind **1 mark each bullet, max 2 marks**	**2**

Number			Question	Instructions	Marks
		ii	Using a recognised design technique, design an efficient solution, using this function function, which: • allows search text to be entered • finds email addresses or names entered matching this text • displays the name, email and mobile name for matches.	**1 mark for entering search text** **1 mark for loop for each value in array of records** **1 mark for matching function with name** **1 mark for matching function with email** **1 mark for displaying results.** *Accept solutions that make use of nested IF statements or use of logical operator (OR).* *Only 1 mark possible for solutions which use two separate IF statements.*	**5**

			`DECLARE textToFind AS STRING INITIALLY FROM KEYBOARD`
			`FOR EACH contact FROM contactData DO`
			`  IF MatchContact(contact.name, textToFind) OR`
			`  MatchContact(contact.email, textToFind) THEN`
			`  SEND Contact.name, contact.email, contact.mobileNumber TO DISPLAY`
			`  END IF`
			`END FOR`		

		iii	Explain the purpose of lines 205 and 206 in the function.	205 stores the length of the string valueToFInd **(1 mark)** 206 changes the length of the text to check so that it is the same as the valueToFind string **(1 mark)** OR This code allows a match to be made if the search text is found at the beginning **(1 mark)** of the value being checked **(1 mark)**	**2**
	e		All the images used with the program are bit-mapped rather than vector graphics. Describe an advantage of bit-mapped graphics over vector graphics for this purpose.	As the program is for contact details of people, bit-mapped graphics are more suitable for storing photographs of contacts because: • they use individual pixels to represent the elements of the image • each element can have a specific colour, making them more lifelike **1 mark each bullet, max 2 marks**	**2**
16			A professional makeup company is developing a web site. A horizontal navigation bar will include links to pages for Lips, Face, Eyes, and Your Account. Each makeup page links to a "professional" and a "foundation" range of make-up for sale.		

Number			Question	Instructions	Marks
	a		Design a multi-level structure for the makeup company web site.	 • **First level with box for each item from the navigation: Lips, Face, Eyes** • **First level: Your Account page** • **Second level: linked from each page (Lips, Face, Eyes) Professional and Foundation pages.**	**3**
	b		The "Your Account" page should include a form to allow users to update their account details. A user's account has the following information. Firstname Lastname Date of Birth Membership Code (16-characters) Membership Type (Silver, Gold or Professional) Using this information, draw a wireframe design for the form on the Your Account page.	 **1 mark for suitable control for Date of Birth** **1 mark for Dropdown/Radio buttons for Membership Type** **1 mark for indicating 16 digits for Membership Code** **1 mark for including Firstname/Lastname**	**4**

<table>
<tr><th colspan="3">Number</th><th>Question</th><th colspan="3">Instructions</th><th>Marks</th></tr>
<tr><td></td><td>c</td><td></td><td>A program is used to identify which customer, with a “professional” membership type, has spent the most on the company web site. The program imports data from a text file containing:

• membership type
• firstname
• lastname
• total spent

A sample of the data in the text file is shown below.

Silver, Kiera, Long, 467.25
Professional, Helen, Budge, 289.00
…

The top-level algorithm for the program is:

1. Import customer data
2. Find the highest spending customer
3. Display customer details</td><td colspan="3"></td><td></td></tr>
<tr><td></td><td></td><td>i</td><td>The table below has the data flow completed for steps 1 and 3 of the algorithm.

Complete the missing data flow for step 2.</td><td colspan="3"><table><tr><th>Step</th><th>IN/OUT</th><th>Data flow</th></tr><tr><td rowspan="2">1</td><td>IN</td><td></td></tr><tr><td>OUT</td><td>membershiptype[], firstname[], lastname[], totalspent[]</td></tr><tr><td rowspan="2">2</td><td>IN</td><td>membershiptype[], totalspent[]</td></tr><tr><td>OUT</td><td>location</td></tr><tr><td rowspan="2">3</td><td>IN</td><td>location, membershiptype[], firstname[], lastname[], totalspent[]</td></tr><tr><td>OUT</td><td></td></tr></table>1 mark for correct IN
1 mark for correct OUT</td><td>2</td></tr>
<tr><td></td><td></td><td>ii</td><td>Step 2 finds the position of the highest spending customer with a professional membership type.

Using a recognised design technique, design this step.</td><td colspan="3">• Initialisation of location and highest to first position in arrays
• Loop for remaining items in arrays
• Condition membership type = professional used in conditional structure
• Condition totalspend > highest
• Assignment of new value for location and Assignment of new value for highest

1 mark each bullet, max 5 marks</td><td>5</td></tr>
</table>

<table>
<tr><th colspan="3">Number</th><th>Question</th><th>Instructions</th><th>Marks</th></tr>
<tr><td colspan="3"></td><td>

```
SET highest TO totalspent[1]
SET location TO 1
SET end TO length(totalspent[])
FOR position = 2 TO end
  IF membershiptype[position] = "Professional" AND
     totalspent[position] > highest THEN
     SET location TO position
     SET highest TO totalspent[position]
  END IF
END FOR
```

</td><td></td><td></td></tr>
<tr><td></td><td>d</td><td></td><td>As part of the execution of the program, an instruction in memory location 37612 is to be fetched and executed. Complete the missing steps of the fetch-execute cycle shown below.</td><td>1. The processor sets up the address bus with the address 37612.

3. The instruction is fetched from memory location 37612 using the data bus and stored in the instruction register.

1 mark for each item, max 2 marks</td><td>2</td></tr>
<tr><td></td><td>e</td><td></td><td>The company discover that an employee has accessed the system and modified information to get products for free.

State two different offences the employee has committed under the Computer Misuse Act 1990.</td><td>• unauthorised access to computer material
• unauthorised access with intent to commit a further offence
• unauthorised modification of data on a computer

1 mark for each bullet, max 2 marks</td><td>2</td></tr>
<tr><td>17</td><td></td><td></td><td>Arbitrary Letter Substitution is a simple encryption method that takes each letter in a message and substitutes it for another, based on a cipher alphabet.

For example, using the table below, the letter F, which has an ASCII code of 70, is replaced with the letter P, which is in the same position as F (6) in the cipherAlphabet.
(see paper)

The program below asks the user to enter a message which is then encrypted. (see paper)</td><td></td><td></td></tr>
<tr><td></td><td>a</td><td></td><td>A breakpoint is set at line 060.

The function is tested by entering the following message.

Message: CAT

Complete the table below to show the values of cipherIndex and cipherText each time execution is stopped.</td><td>
<table>
<tr><th>Break in execution</th><th>cipherIndex</th><th>cipherText</th></tr>
<tr><td>First</td><td>3</td><td>R</td></tr>
<tr><td>Second</td><td>1</td><td>RT</td></tr>
<tr><td>Third</td><td>20</td><td>RTK</td></tr>
</table>
1 mark for each correct row, max 3 marks
</td><td></td></tr>
</table>

Number			Question	Instructions	Marks
	b		The program was initially tested using a "dry run". Describe what is meant by a dry run when testing a program.	A dry run involves manually stepping through the code line by line **(1 mark)** Recording the values of variables in a trace table **(1 mark)**	**2**
	c		Using a programming language of your choice, state the pre-defined function used to convert.		
		i	A text character to ASCII	1 mark for suitable predefined function e.g. JavaScript: CharCodeAt(x) Python: Ord(x)	**1**
		ii	ASCII to a text character	1 mark for suitable predefined function e.g. JavaScript: fromCharCode(x) Python: chr(x)	**1**
	d		An error occurs if the message is not typed in uppercase letters.		
		i	Explain why this error occurs.	If characters not in the cipherAlphabet are used these will generate numbers which are either below or above **(1 mark)** the range of index for cipherAlphabet and will generate an associated error **(1 mark)**	**2**
		ii	State which type of error this is.	Execution error (detected at runtime and generates a runtime error on range) **1 mark**	**1**
	e		An evaluation of the program is carried out. It finds that the code is not maintainable. Describe two ways of improving the maintainability of the program.	• Using internal commentary to describe the operation of the code • Using modular design to clearly define the different functions of sections of the code • Carefully scoping variables and reducing global variables to effectively manage data flow • Other valid **1 mark each bullet, max 2 marks**	**2**

Number			Question	Instructions	Marks
	f		The encryption program was developed for a client, using an agile development approach. Describe the role of the client when developing software using agile methodologies.	The role of the client in agile development is to: • Outlines scope and boundaries for development • Evaluates prototype/suggest changes • Provides information to priorities backlog/development priorities • Provides feedback/liaising with development team throughout process **1 mark each bullet, max 2 marks**	**2**

Detail of Sources / Mark Allocations and Balance

Question	Mark	Skills	Detail	Unit
1	1	Application of CS Knowledge	Two's compliment	CS
2	3	Implementation	CSS - margin, padding, height, width	WDD
3	2	Application of CS Knowledge	Development methodologies	SDD
4a	2	Application of CS Knowledge	DOS attacks - Symptoms	CS
4b	2	Application of CS Knowledge	DOS attacks - cost	CS
5	2	Application of CS Knowledge	Processor - registers	CS
6	1	Implementation	Scope - Global Variables	SDD
7	2	Application of CS Knowledge	Floating point representation	CS
8	3	Implementation	SQL - SELECT, MIN, GROUPING	DDD
9	1	Application of CS Knowledge	Environmental - heating systems	CS
10a	1	Implementation	Standard algorithm - find minimum	SDD
10b	2	Implementation	Read and explain code	SDD
11	1	Implementation	HTML - Section Tag	WDD
12	2	Design	Primary Key	DDD
	25			

Question	Mark	Skills	Detail	Unit
13a	2	Analysis	Website system requirements	WDD
13b	2	Testing	Useability Testing	WDD
13c	3	Design	effective design using wireframe	WDD
13d	2	Design	low-fidelity prototypes	WDD
13e	4	Implementation	CSS - grouping selectors	WDD
13fi	1	Implementation	HTML - validation - presence	WDD
13fii	2	Implementation	HTML - use of SELECT	WDD
13fiii	2	Implementation	HTML - use of Input - radio - grouping	WDD
13fiv	1	Implementation	HTML validation - range	WDD
14a	3	Design	Entity Relationship Diagram	DDD
14bi	4	Design	Data Dictionary	DDD
14bii	2	Design	Primary / Foreign keys	DDD
14c	3	Design	Query - SUM. Grouping	DDD
14d	1	Application of CS Knowledge	ALU	CS
14e	3	Implementation	SQL - UPDATE	DDD
14f	1	Application of CS Knowledge	Unicode	CS
15a	2	Design	Array of Records	SDD
15b	2	Design	Record structure	SDD
15c	2	Evaluation	Efficient use of coding constructs	SDD

15di	2	Implementation	Parameter passing	SDD
15dii	5	Implementation	Linear Search	SDD
15diii	2	Implementation	Create substrings / string length	SDD
15e	2	Application of CS Knowledge	Advantages of bitmapped over vector graphics	CS
16a	3	Design	Multi-level web site	WDD
16b	4	Design	Wireframe	WDD
16ci	2	Design	Data flow	SDD
16cii	5	Design	Finding maximum	SDD
16d	2	Application of CS Knowledge	Fetch-excute cycle	CS
16e	2	Application of CS Knowledge	Computer misuse act	CS
17a	3	Testing	Tracetable	SDD
17b	2	Testing	Dryrun	SDD
17ci	1	Implementation	String to ASCII	SDD
17cii	1	Implementation	ASCII to String	SDD
17di	2	Implementation	Read and explain code	SDD
17dii	1	Testing	Execution error	SDD
17e	2	Evaluation	Maintainability	SDD
17f	2	Analysis	Agile development	SDD
	85			

Content	% of course assessment	Range of QP marks	Allocated
SDD	40%	34–44	42
WDD	25%	20–35	30
DDD	25%	20–35	20
CS	10%	12–20	18

Skills	% of course assessment	Range of QP marks	Allocated
Analysis	5%	0–6	4
Design	30%	35–51	37
Implementation	40%	26–42	37
Testing	10%	7–15	8
Evaluation	5%	0–6	4
Application of CS knowledge	10%	12–20	20