Q	Scheme	Marks	AOs	Pearson Progression Step and Progress Descriptor
1a	A (finite) sequence of step-by-step instructions given to solve a problem o.e.	**B1**	1.2	1st Understand what an algorithm is
		(1)		
1b	Examples of an algorithm used in everyday life include a recipe, directions, assembling furniture	**B1**	3.1b	1st Understand what an algorithm is
		(1)		
1c	A = instruction (box) B = decision (box)	**B1** **B1**	1.2 1.2	1st Understand what an algorithm is
		(2)		
				(4 marks)
Notes				

<table>
<tr><th>Q</th><th>Scheme</th><th>Marks</th><th>AOs</th><th>Pearson Progression Step and Progress Descriptor</th></tr>
<tr><td>2a</td><td>
<table>
<tr><th>A</th><th>B</th><th>n</th><th>C</th><th>D</th><th>E</th><th>is n > 3?</th></tr>
<tr><td>2.236</td><td>–2.236</td><td>1</td><td>2.236</td><td>–2.236</td><td>4</td><td>no</td></tr>
<tr><td></td><td></td><td>2</td><td>5.000</td><td>5.000</td><td>0</td><td>no</td></tr>
<tr><td></td><td></td><td>3</td><td>11.179</td><td>–11.179</td><td>20</td><td>no</td></tr>
<tr><td></td><td></td><td>4</td><td>24.997</td><td>24.997</td><td>0</td><td>yes</td></tr>
</table>
</td><td>M1
A1
A1</td><td>1.1b
1.1b
1.1b</td><td>2nd
Be able to trace an algorithm in a flow chart</td></tr>
<tr><td></td><td></td><td>(3)</td><td></td><td></td></tr>
<tr><td>2b</td><td>0</td><td>B1</td><td>2.2a</td><td>3rd
Know how to determine the output of an algorithm for a given input</td></tr>
<tr><td></td><td></td><td>(1)</td><td></td><td></td></tr>
<tr><td colspan="5">(4 marks)</td></tr>
<tr><td colspan="5">Notes
2a Award M1 A1 for first row correct. Award A1 for next three rows correct.</td></tr>
</table>

<table>
<tr><th>Q</th><th>Scheme</th><th>Marks</th><th>AOs</th><th>Pearson Progression Step and Progress Descriptor</th></tr>
<tr><td>3a</td><td>
<table>
<tr><th>S</th><th>T</th><th>S = T to 2 dp?</th></tr>
<tr><td>3.5</td><td>2.75</td><td>no</td></tr>
<tr><td>2.75</td><td>2.648</td><td>no</td></tr>
<tr><td>2.648</td><td>2.646</td><td>yes</td></tr>
</table>
</td><td>M1
A1
A1</td><td>1.1b
1.1b
1.1b</td><td rowspan="2">3rd
Be able to trace an algorithm given as text instructions</td></tr>
<tr><td></td><td>(3)</td><td></td><td></td></tr>
<tr><td>3b</td><td>
<table>
<tr><th>S</th><th>T</th></tr>
<tr><td>–2</td><td>0</td></tr>
<tr><td>0</td><td>undefined/error</td></tr>
</table>
Square root of a negative number has no (real) answer</td><td>M1
A1

B1</td><td>2.1
2.1

3.2a</td><td rowspan="2">3rd
Know how to determine the output of an algorithm for a given input</td></tr>
<tr><td></td><td>(3)</td><td></td><td></td></tr>
<tr><td colspan="5">(6 marks)</td></tr>
</table>

Notes

3a Award **M1** for some recording in order (may not be in a table), **A2** for all values correct, **A1** for one row correct.

3b Stops when $S = 0$ with no further working for **M1.** Should comment on the failure of the next step or show a fraction with zero denominator for **A1.**

Also accept that the algorithm fails as it is impossible to divide by zero.

Q	Scheme	Marks	AOs	Pearson Progression Step and Progress Descriptor
4a	(7 5) 4 6 8 — 1st comparison: leave 7 (5 4) 6 8 — 2nd comparison: leave 7 5 (4 6) 8 — 3rd comparison: swap 7 5 6 (4 8) — 4th comparison: swap 7 5 6 8 4 — end of first pass	**M1** **A1**	1.1b 1.1b	4th Know how to apply a bubble sort algorithm
		(2)		
4b	comparisons = 4, swaps = 2	**B1**	1.1b	4th Know how to apply a bubble sort algorithm
		(1)		
4c	The smallest number (accept 4)	**B1**	2.2a	4th Know how to apply a bubble sort algorithm
		(1)		
				(4 marks)

Notes

4a Award **M1** for showing each individual pass, **A1** for correct order at end of first pass.

Q	Scheme	Marks	AOs	Pearson Progression Step and Progress Descriptor
5	65 43 24 64 (46) 13 71 23 16 45 43 24 13 (23) 16 45 [46] 65 (64) 71 13 (16) [23] 43 (24) 45 [46] [64] 65 (71) (13) [16] [23] [24] 43 (45) [46] [64] (65) [71] [13] [16] [23] [24] 43 [45] [46] [64] [65] [71] STOP	**M1** **A1** **A1 ft** **A1 cso**	1.1b 1.1b 1.1b 1.1b	5th Know how to apply a quick sort algorithm
				(4 marks)

Notes

M1: Quick sort, pivot p chosen middle right or middle left. After first pass values < p to the left and those > p to the right. (If only one pivot per iteration throughout scores **M1** only.)

A1: First two passes correct and pivots chosen correctly for third pass.

A1 ft: Third and fourth passes correct (ft from second pass and choice of pivots for third).

A1 cso: With sort complete, either stated or indicated by final pass written identical to previous row.

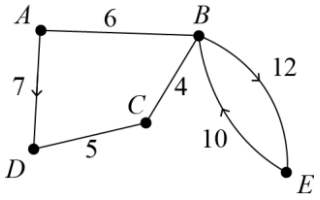
65 43 24 64 46 (13) 71 23 16 45
[13] 65 43 24 64 (46) 71 23 16 45
[13] 43 24 (23) 16 45 [46] 65 (64) 71
[13] [16] [23] [43] (24) 45 [46] [64] 65 (71)
[13] [16] [23] [24] 43 (45) [46] [64] [65] [71]
[13] [16] [23] [24] [43] [45] [46] [64] [65] [71]

<table>
<tr><th>Q</th><th>Scheme</th><th>Marks</th><th>AOs</th><th>Pearson Progression Step and Progress Descriptor</th></tr>
<tr><td rowspan="2">6a</td><td>Vertex Y is visited twice o.e.</td><td>B1</td><td>2.4</td><td>2nd
Understand the vocabulary used in graph theory</td></tr>
<tr><td></td><td>(1)</td><td></td><td></td></tr>
<tr><td rowspan="2">6b</td><td>There are six vertices. The first arc joins two vertices and each extra vertex needs an extra arc so five arcs needed.</td><td>B1</td><td>2.4</td><td>4th
Understand the definition of a tree</td></tr>
<tr><td></td><td>(1)</td><td></td><td></td></tr>
<tr><td rowspan="2">6c</td><td><table><tr><th>Vertex</th><th>Valency</th></tr><tr><td>U</td><td>3</td></tr><tr><td>V</td><td>4</td></tr><tr><td>W</td><td>2</td></tr><tr><td>X</td><td>2</td></tr><tr><td>Y</td><td>4</td></tr><tr><td>Z</td><td>3</td></tr><tr><td>TOTAL</td><td>18</td></tr></table>(does not need to be tabulated; list of vertices and valencies and the total is acceptable)

The graph has 9 edges; $9 \times 2 = 18$ = sum of valencies</td><td>M1

A1</td><td>3.1a

3.2a</td><td>2nd
Understand the vocabulary used in graph theory</td></tr>
<tr><td></td><td>(2)</td><td></td><td></td></tr>
<tr><td rowspan="2">6d</td><td>Z and U have odd valency, so the graph is not Eulerian</td><td>B1</td><td>2.2a</td><td>2nd
Understand the vocabulary used in graph theory</td></tr>
<tr><td></td><td>(1)</td><td></td><td></td></tr>
<tr><td colspan="5">(5 marks)</td></tr>
<tr><td colspan="5">Notes
6c A1: both $9 \times 2 = 18$ and conclusion needed.</td></tr>
</table>

<table>
<tr><th>Q</th><th>Scheme</th><th>Marks</th><th>AOs</th><th>Pearson Progression Step and Progress Descriptor</th></tr>
<tr><td rowspan="2">7a</td><td>
<table>
<tr><th></th><th>A</th><th>B</th><th>C</th><th>D</th><th>E</th></tr>
<tr><td>A</td><td>0</td><td>1</td><td>1</td><td>1</td><td>0</td></tr>
<tr><td>B</td><td>1</td><td>0</td><td>0</td><td>1</td><td>1</td></tr>
<tr><td>C</td><td>1</td><td>0</td><td>0</td><td>1</td><td>0</td></tr>
<tr><td>D</td><td>1</td><td>1</td><td>1</td><td>2</td><td>1</td></tr>
<tr><td>E</td><td>0</td><td>1</td><td>0</td><td>1</td><td>0</td></tr>
</table>
</td><td>M1
A1</td><td>1.1b
1.1b</td><td>4th
Understand graphs in matrix form</td></tr>
<tr><td></td><td>(2)</td><td></td><td></td></tr>
<tr><td rowspan="2">7b</td><td> 
</td><td>M1
A1</td><td>1.1b
1.1b</td><td>4th
Understand graphs in matrix form</td></tr>
<tr><td></td><td>(2)</td><td></td><td></td></tr>
<tr><td colspan="5">(4 marks)</td></tr>
</table>

Notes

7a M1 for no more than two errors, **A1** for all correct.

7b M1 for all edges OR all distances correct, **A1** for all edges, distances and direction arrows correct.

Q	Scheme	Marks	AOs	Pearson Progression Step and Progress Descriptor
8a	70 65 55 45 45 45 40 40 40 40 Strip 1 70, 55 (125 cm used) Strip 2 65, 45 (110 cm used) Strip 3 45, 45 (90 cm used) Strip 4 40, 40, 40 (120 cm used) Strip 5, 40 (40 cm used) 5 strips required Wasted = 0 + 15 + 35 + 5 + 85 = 140 cm	**M1** **A1** **A1** **A1 ft**	1.1b 1.1b 1.1b 2.2a	4th Solve bin packing problems using the first fit decreasing algorithm
		(4)		
8bi	40 + 40 + 45 = 125 40 + 40 + 45 = 125 70 + 55 = 125 65 + 45 = 110 4 strips required	**M1** **A1**	1.1b 1.1b	3rd Solve bin packing problems using the full bin algorithm
		(2)		
8bii	70 + 65 + 55 + 45 + 45 + 45 + 40 + 40 + 40 + 40= 485 485 ÷ 125 = 3.88 Any solution would require at least 4 strips, so the answer to part **bii** is optimal	**M1** **B1**	3.1b 2.4	5th Understand the strengths and weaknesses of bin packing algorithms
		(2)		
				(8 marks)

Notes

8a Award **A2** for all correct, **A1** for 70, 65, 55 and 45 in correct position.

8bi Award **M1** for any one correct strip, **A1** for all correct.