Question Number	Scheme	Marks
1.(a)	$\frac{131}{40} = 3.275$ so lower bound is 4	M1 A1 **(2)**
(b)	Container 1: 17 9 8 4 Container 2: 15 20 5 Container 3: 13 12 Container 4: 28	M1 A1 A1 **(3)**
(c)	middle right 17 9 15 8 20 **13** 28 4 12 5 — Pivots: 13 9 8 **4** 12 5 13 17 15 **20** 28 — Pivots: 4, 20 4 9 8 **12** 5 13 17 **15** 20 28 — Pivots: 12, 15, (28) 4 9 **8** 5 12 13 15 17 20 28 — Pivots: 8, (17) 4 5 8 9 12 13 15 17 20 28 — Sort complete	M1 A1 A1 **(3)**
	middle left 17 9 15 8 **20** 13 28 4 12 5 — Pivots: 20 17 9 15 **8** 13 4 12 5 20 28 — Pivots: 8, (28) **4** 5 8 17 9 **15** 13 12 20 28 — Pivots: 4, 15 4 5 8 9 **13** 12 15 17 20 28 — Pivots: (5), 13, (17) 4 5 8 **9** 12 13 15 17 20 28 — Pivots: 9 4 5 8 9 12 13 15 17 20 28 — (Sort Complete)	
(d)	$\left\lceil \frac{1+10}{2} \right\rceil = 6$ 13 – reject 13 – 28 $\left\lceil \frac{1+5}{2} \right\rceil = 3$ 8 – reject 4 – 8 $\left\lceil \frac{4+5}{2} \right\rceil = 5$ 12 – reject 12 $\lceil 4 \rceil = 4$ 9 – found	M1 A1 A1 **(3)**
		11 marks

Notes for Question 1

a1M1: Attempt to find the lower bound $(131 \pm 28)/40$. A value of 3.275 seen with no corresponding calculation can imply this mark. Allow this mark for a clear intention of adding **all** ten values and dividing by 40, for example,

$\frac{17+9+15+8+20+13+28+4+12+5}{40}$ scores M1

a1A1: cao - correct calculation seen followed by 4 **or** the correct value of 3.275 followed by 4. However, an answer of 4 with no working scores no marks in (a)

b1M1: First four values placed correctly and at least eight values placed in containers. The first four values are those that are boxed. Condone cumulative totals for M1 only (e.g. for Container 1: 17 26 34 38)

Question Number	Scheme	Marks
	b1A1: First eight values placed correctly (the boxed **and** underlined values). This mark cannot be awarded if you see **any** repeated values or more than ten values placed in containers (even if the first eight items have been placed correctly) **b2A1:** cso – no additional or repeated values (dependent on both previous marks)	
	c1M1: Quick sort, pivot, p, chosen (must be choosing middle left or right – choosing first/last item as the pivot is M0). After the first pass the list must read (values less than the pivot), pivot, (values greater than the pivot). If sorting into descending order then M1 only (even if the list is reversed at the end of the sort). This mark can be scored if one number only is either missing or incorrect or an additional number is added to the list **c1A1:** First two passes correct and next pivots chosen correctly for third pass (but third pass does not need to be attempted or correct) **c2A1:** cso (correct solution only – all previous marks in this part must have been awarded) – if middle right then either a fifth pass **or** a 'sort complete' statement (e.g. 'sorted', 'complete', etc. but not just underlining the fourth pass) is required after the fourth pass. If middle left then a fifth pass (with the value of 9) is required (but no 'sort complete' statement is required)	
	d1M1: Choosing middle right pivot (choosing middle left '12' is M0) **and** an attempt at discarding/retaining half the list (condone if retaining the wrong half of the list or if retaining 1 – 6) **d1A1:** First and second passes correct i.e. selecting the 6^{th} item in the first pass **and** using 1^{st} to 5^{th} items in the second pass (must not be using the 6^{th} item for the second pass) and then correctly selecting the 3^{rd} item (the 8) in the second pass and rejecting the 1^{st} to 3^{rd} items **d2A1:** cao - search completed correctly (so rejecting the 12 in the third pass) together with 'found'. Condone candidates who say that after the 12 in the third pass has been rejected the only value left is the 9 so it has been found. It must be clear that the 9 has been 'found' and not just stated as the final value	
	In (d) candidates must be using a correct ordered list (4 5 8 9 12 13 15 17 20 28) – if it is clear that the candidates are not using this list then M0. With regards to using the original (unsorted) list the 6^{th} value is 13 too so what the candidates do next will most likely indicate if the correct list is being used (e.g. if the next pivot is 15 then M0) Candidates who have sorted the list into descending order can earn full marks in (d) – scheme above applies in the same way for descending – must be choosing middle right (the 12) not middle left (the 13) for M1 28 20 17 15 13 12 9 8 5 4 $\left\lceil \frac{1+10}{2} \right\rceil = 6$ 12 – reject 28 – 12 $\left\lceil \frac{7+10}{2} \right\rceil = 9$ 5 – reject 5 – 4 $\left\lceil \frac{7+8}{2} \right\rceil = 8$ 8 – reject 8 $\lceil 7 \rceil = 7$ 9 – found	
2.(a)	e.g. A – B – F – H – J	B1 **(1)**
(b)	A – B – C – D – E – G – F – H – J is not an example of a tour on T as although it contains every vertex it does not return to A	B1 **(1)**