Question Number	Scheme	Marks
6.(a)	**Classical** problem must visit **every vertex exactly once** and **returns to start** but **practical** problem must visit **every vertex at least once** and **returns to start**	B1 B1
		(2)
(b)	Either AB, BC, CK, HK, JK, CD, GJ, FG, EG or AB, BC, CK, HK, JK, GJ, FG, EG, CD	M1 A1 A1
		(3)
(c)	$89 \times 2 = 178$ (miles)	B1
		(1)
(d)	ABCKHJGFEDA 140 (miles)	M1 A1 A1
		(3)
(e)	Route from A as it is the smaller value or 140 because $140 < 145$	B1ft
		(1)
(f)	Lower Bound = 89 – 16 + (16 + 19) = 108 (miles)	M1 A1
		(2)
(g)	$108 \leqslant L \leqslant 140$	B1ft
		(1)
		13 marks

Notes for Question 6		
a1B1	General idea that Classical visits vertices once but practical is at least once. Any mention of travelling along every arc is B0	
a2B1	Need to see all the words in bold (accept equivalent technical language e.g. node instead of vertex) – must include return to start	
b1M1	Prim's – first three arcs correctly chosen in order (AB, BC, CK, …) **or** first four nodes {A, B, C, K, … } correctly chosen in order. If any explicit rejections seen at some point then M1 (max) only. Order of nodes may be seen at the top of a matrix/table {1, 2, 3, - , - , -, -, -, -, 4 }. Starting at any other node can score M1 only for first three arcs chosen correctly	
b1A1	First six arcs correctly chosen in order {AB, BC, CK, HK, JK, CD, …} or {AB, BC, CK, HK, JK, GJ, …}**or** all 10 nodes {A, B, C, K, H, J, D, G, F, E} or {A, B, C, K, H, J, G, F, E, D}correctly chosen in order. Order of nodes may be seen at the top of a matrix so for the first two marks accept {1, 2, 3, 7, 10, 9, 8, 5, 6, 4} or {1, 2, 3, 10, 9, 8, 7, 5, 6, 4} (**no** missing numbers).	
b2A1	CSO – all **arcs** correctly **stated** and chosen in the correct order (with no additional arcs). They must be considering arcs for this final mark (do not accept a list of nodes or numbers across the top of the matrix unless the correct list of arcs (in the correct order) is also seen)	
c1B1	CAO	
d1M1	NN route attempted – first seven nodes correct ABCKHJG (accept arcs for this mark AB, BC, CK, KH, HJ, JG or complete numbering on table {1, 2, 3, 10, 9, 8, 7, 5, 6, 4} which is clearly a separate calculation from part (b))	
d1A1	CAO – route correct including return to A (accept arcs AB, BC, CK, KH, HJ, JG, GF, FE, ED, DA) (condone if arcs stated alphabetically instead of in route order)	
d2A1	CAO – distance 140	
e1B1ft	States A or 140 **and** reason correct (smaller value) but ft their answer to (d) dependent on M1 in (d)	
f1M1	Their "89" – 16 + two shortest from A (a new calculation to find the RMST may be seen e.g. new table with A deleted and a new MST calculation, with the correct 8 arcs circled BC CD CK EG FG GJ JK KH plus two shortest from A)	
f1A1	CAO – an answer of 108 implies both of these marks	
g1B1ft	FT their answers to (e) and (f) but dep on B1 in (e) and M1 in (f) and their (f) < their (e) (accept $108 < L \leqslant 140$ or interval notation [108, 140] or (108, 140])	