Question Number	Scheme	Marks
4.(a)	Prim: AC, AB, AE; DE, DF, BJ; HJ, GH **or** AC, AE, DE; AB, DF, BJ; HJ, GH	M1 A1 A1 **(3)**
(b)	127 (km)	B1 **(1)**
(c)	If starting at E and finishing at F then the shortest path between C and H needs to be traversed twice. So the length of the route is 58 + 494 = 552 (km)	M1 A1 **(2)**
(d)	Route must start at C and finish at A therefore need to consider pairings of the nodes A, E, F and H	M1
	AE + FH = 15 + 53 = 68 AF + EH = 42 + 66 = 108 AH + EF = 51 + 27 = 78	A1 A1
	Repeat roads: AE, FG, GH	A1 **(4)**
ALT	**Special Case – considers C, E, F and H – mark as misread removing final 2 A marks earned in this section**	M1
	CE + FH = 22 + 53 = 75 CF + EH = 49 + 66 = 115 CH + EF = 58 + 27 = 85	A1 A1
	Repeat roads: CA, AE, FG, GH	A1 **(4)**
(e)	B – A – C – E – D – F – G – H – J – B 15 + 7 + 22 + 10 + 17 + 40 + 13 + 19 + 31 = 174 (km)	M1 A1 **(2)**
(f)	(127 – 7) + 7 + 22 = 149 (km)	M1 A1 **(2)**
		14 marks

	Notes for Question 4
a1M1:	Prim's – first three arcs correctly chosen in order (AC, AB, AE, … or AC, AE, DE) **or** first four nodes {A, C, B, E, … or A, C, E, D,…} 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, 3, 2, - , 4 , -, -, -, - or 1, -, 2, 4, 3, -, -, -, -}. Starting at any other node can score M1 only for first three arcs chosen correctly
a1A1:	First six arcs correctly chosen in order {AC, AB, AE, DE, DF, BJ, …} **or** all nine nodes {A, C, B, E, D, F, J, H, G} correctly chosen in order. Order of nodes may be seen at the top of a matrix so for the first two marks accept {1, 3, 2, 5, 4, 6, 9, 8, 7} (**no** missing numbers). **Or** the alternative six arcs {AC, AE, DE, AB, DF, BJ,…}, nine nodes {A, C, E, D, B, F, J, H, G} or numbers {1, 5, 2, 4, 3, 6, 9, 8, 7}
a2A1:	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)
b1B1:	CAO (127)
c1M1:	Indication that the shortest path between C and H needs to be traversed twice (correct answer can imply this mark)
c1A1:	CAO (552)
d1M1:	The correct three pairings of the correct four nodes (A, E, F and H)
d1A1:	Two rows correct including pairings **and** totals
d2A1:	All three rows correct including pairings **and** totals
d3A1:	CAO (AE, FG, GH only but in any order) – must be stated as edges so **A0** for AE, FH or AE F(G)H
	Special Case – considers C, E, F and H – mark as misread removing last two A marks earned in this section, so max 2/4
d1M1:	The correct three pairings of the four nodes (C, E, F and H)
d1A1:	Two rows correct including pairings **and** totals
d2A1:	All three rows correct including pairings **and** totals
d3A1:	CAO (CA, AE, FG, GH only but in any order) – must be stated as edges so **A0** for CE, FH or C(A)E F(G)H
e1M1:	Nearest neighbour starting at B with first five nodes correct (B – A – C – E – D –) Accept arcs so BA, AC, CE, ED,
e1A1:	Correct nearest neighbour route (must return to B) and correct length (174) Accept arcs so BA, AC, CE, ED, DF, FG, GH, HJ, JB
f1M1:	(weight of their MST from (b) **or** 127 **only**) – 7 + 7(AC) + 22(CE or CB) (oe so may not see the –7 + 7). A correct answer of 149 with no working can imply this (and the next) mark. If (b) is incorrect a value of their "127" from (b) plus 22 scores M1 (Note new calculation to find RMST 120 + 7 + 22 = 149 may be seen)
f1A1:	CAO (149)