3.(a)	Kruskal: AB(6), BP(10), CW(11), CP(12), HM(14), AH(15), reject CH(17), reject AC(18), reject AP(20), reject MW(21), LY(21), AS(26), LS(28) (not BS, LM, HL, SY, AL)	M1 A1 A1 **(3)**
(b)	Prim: AB, BP, CP, CW, AH, HM, AS, LS, LY	M1 A1 A1 **(3)**
(c)	143 (miles)	B1 **(1)**
(d)	286 (miles)	B1ft **(1)**
(e)	NNA starting at W: W – C – P – B – A – H – M – L – Y – S – W 11 + 12 + 10 + 6 + 15 + 14 + 40 + 21 + 48 + 55 = 232	M1 A1 **(2)**
(f)	The best upper bound is the one starting at Y as 212 is less than both 232 and 286	B1 **(1)**
(g)	(143 – 11) + 11 + 21 = 164 (miles)	M1 A1 **(2)**
(h)	WCPBAHMLYS**AC**W	B1 **(1)**
		14 marks

Notes for Question 3

a1M1: First four arcs (AB, BP, CW, CP) correctly chosen and at least one rejection seen at some point
a1A1: All arcs in tree selected correctly and in the correct order (AB, BP, CW, CP, HM, AH, LY, AS, LS) – no other arcs in MST
a2A1: cso including all rejections correct and at the correct time – **note that LY can be accepted before MW is rejected**. We do not need to see the explicit rejection of arcs BS to AL but if these are explicitly rejected then they must be in the correct order. Note that a list of all the arcs in the correct order followed by a list of the arcs in the MST can score full marks
b1M1: First three arcs correctly chosen in order (AB, BP, CP,…) **or** first four nodes {A, B, P, C, …} 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, 4, - , - , -, 3, -, -, -} so do check carefully for this. Starting at any other node can score M1 only for first three arcs chosen correctly
b1A1: First six arcs correctly chosen in order (AB, BP, CP, CW, AH, HM,…) **or** all ten nodes {A, B, P, C, W, H, M, S, L, Y} 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, 4, 6, 9, 7, 3, 8, 5, 10} (**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 (143) – this mark can be awarded if seen in (b) (although if answered in (c) too then mark according to the answer given in (c))
d1B1ft: Follow through double their answer from (c)
e1M1: Nearest neighbour route starting at W – must have at least W – C – P – B – A – H – … allow if stated in terms of arcs
e1A1: CAO on length (232) **and** route (must return to W and can be stated in terms of arcs)
f1B1: An indication that 212 is the minimum (of 212 and the answers to (d) and (e)) – this mark is dependent on the correct values in (d) and (e) so accept an answer of the form 'the one starting at Y (or the route with weight 212) as it is the least' – we do not need to see explicit mention of the values in (d) and (e) provided they are correct in (d) and (e)
g1M1: (weight of their MST from (c) **or** (b) **or** 132 **only**) – 11 + 11(WC) + 21(MW) (oe so may not see the –11 + 11). A correct answer of 164 can imply this (and the next) mark
g1A1: 164
h1B1: cao – either the route must be written out in full (in terms of nodes or arcs) **or** they must make it absolutely clear that the route begins exactly as in (e) (which must therefore be correct) but after S, towns A and C are visited before (returning to) W. Just stating that A, C, W are visited twice (or similar) is B0