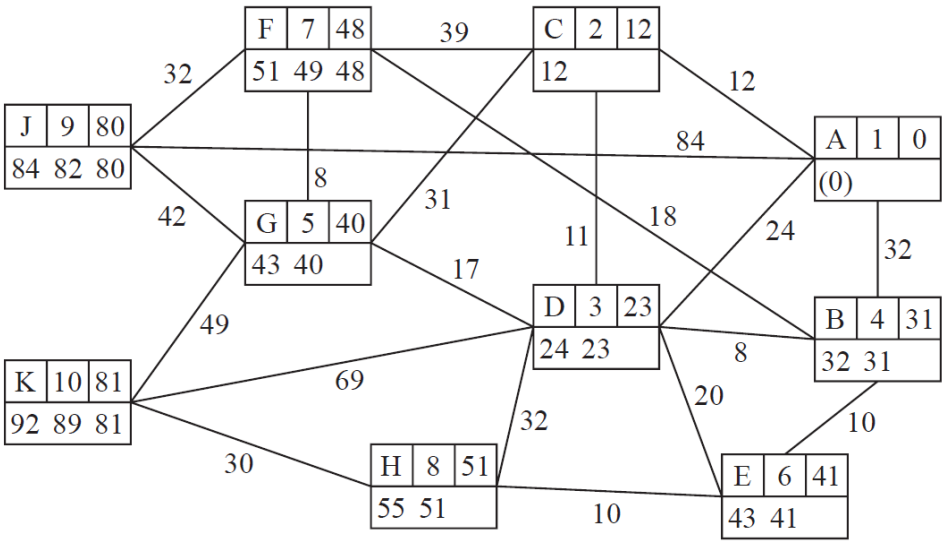
e4A1ft: Follow through their value of their smallest pairing total + 291

Question Number	Scheme	Marks
5.(a)	Start at A e.g. we would be able to find the shortest distance from A to every other vertex e.g. A appears in both required routes	B1 B1dep **(2)**
(b)	 Shortest path to J: A C D G F J Length: 80 (miles) Shortest path to K: A C D B E H K Length: 81 (miles)	M1 A1 (ACDBG) A1 (EFH) A1ft (JK) A1 A1 A1ft **(7)**
(c)	Route from F to H via A: F G D C A C D B E H	B1 **(1)**
		10 marks
Notes for Question 5		

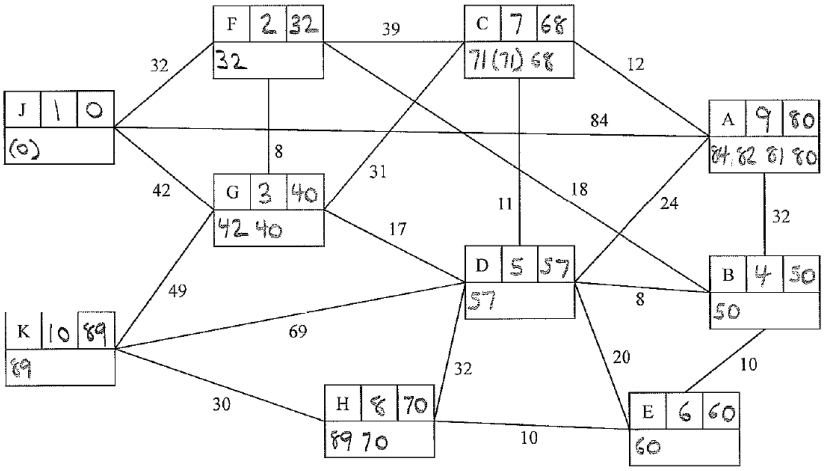
a1B1: CAO (A) – if more than (vertex) A stated then B0
a2B1dep: Correct reason for starting at A (dependent on first B mark) – either need to expicitly mention that A appears on both routes **or** if starting at A then the shortest route to all other vertices (or just to vertices J and K) can be found

In (b) it is important that all values at each node are checked very carefully – the order of the working values must be correct for the corresponding A mark to be awarded e.g. at F the working values must be 51 49 48 in that order (so 51 48 49 is incorrect)
It is also important that the order of labelling is checked carefully. The order of labelling must be a strictly increasing sequence – so 1, 2, 3, 3, 4, … will be penalised once (see notes below) but 1, 2, 3, 5, 6, … is fine. Errors in the final values and working values are penalised before errors in the order of labelling

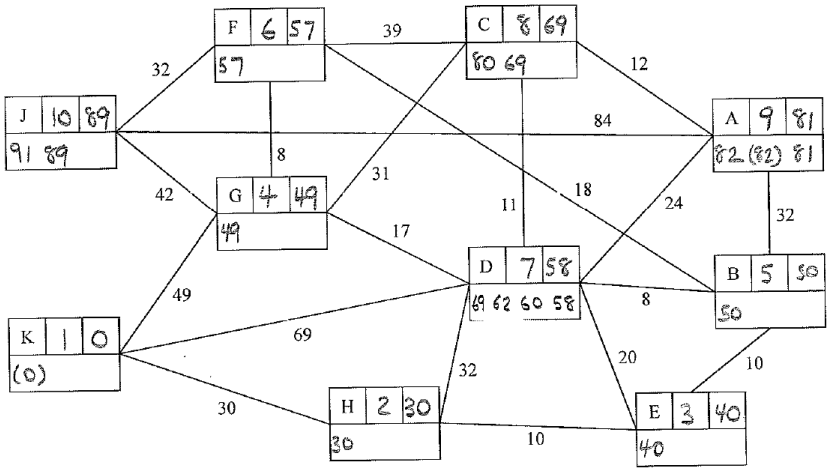
b1M1: Any larger working value replaced by any smaller working value at any two nodes except A and C (for example, **if** correct at B, 32 is replaced by 31 which is a larger value being replaced by a smaller value at one node – as this is a method mark the values do not need to be correct)
b1A1: All values at A, C, D, B and G correct and the working values in the correct order (including order of labelling so nodes must be labelled in the order A, then C, then D, then B, then G). Condone lack of a zero as a working value at A
b2A1: All values at E, F and H correct and the working values in the correct order. Penalise order of labelling only once per question (so E, F and H must be labelled in that order and E must be labelled after A, C, D, B and G)
b3A1ft: All values in J and K correct on the follow through and the working values in the correct order. Penalise order of labelling only once per question. To follow through J check that the working values at J follow from the candidate's final values for the nodes that are directly attached to J (which are A, F and G). For example, **if** correct then the order of labelling of nodes A, F and G is 1, 7 and 5 respectively so the working values at J should come from A, G and F in that order. The first working value at J should be 0 (the Final value at A) + 84 (the weight of the arc AJ), the second working value at J should be 40 (the Final value at G) + 42 (the weight of the arc GJ) and the final working value at J should be 48 (the Final value at F) + 32 (the weight of the arc FJ). Repeat the process for K (which will have working values from D, G and H with the order of these nodes determined by the candidate's order of labelling at D, G and H)
b4A1: One correct route (either ACDGFJ or ACDBEHK) – allow if reversed (e.g. JFGDCA) and allow if stated in terms of arcs (e.g. AC, CD, DG, GF, FJ)
b5A1: Both routes correct (as for **b4A1** – routes can be reversed and accept in terms of arcs)
b6A1ft: Both lengths correct following through **their** Final values at J and K. Condone correct answers or correct answers following through their diagram even if not explicitly clear which value refers to which path

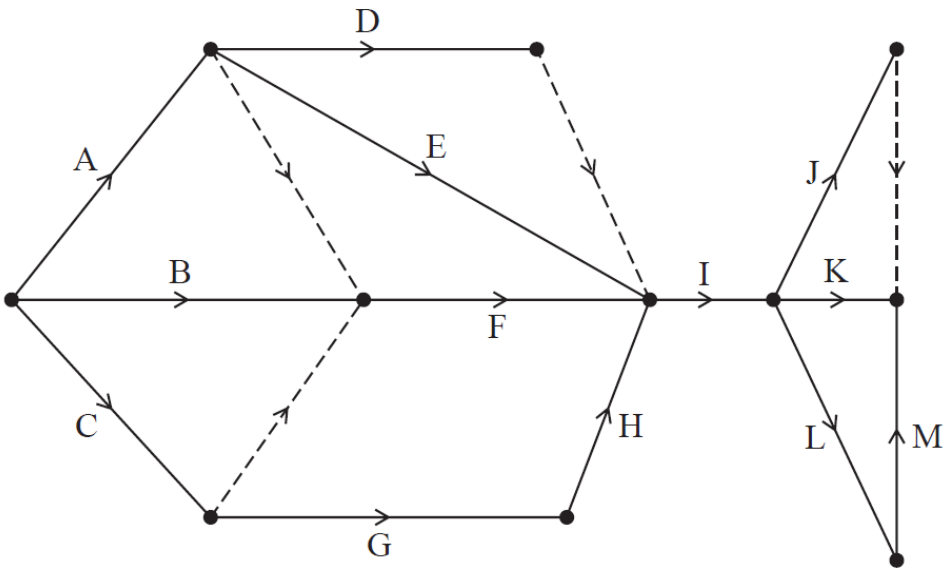
c1B1: Correct answer only (FGDCACDBEH or FG, GD, DC, CA, AC, CD, DB, BE, EH) – if stated in terms of arcs then arcs AC and CD must appear twice in their route

If Dijkstra is completed twice (from J **and** K) then full marks can be awarded. If the candidate uses **just** J or K as the starting vertex in **(b)** then this is not a misread. The candidate can score if starting at J: M1 (as above), A1 (for correct values at J, F, G, B, D), A0, A0, A1 (for route JFGDCA), A1 (for length 80), A0 so 4 out of 7 max.



If starting at K: M1 (as above), A1 (for correct values at K, H, E, G, B), A0, A0, A1 (for route KHEBDCA), A1 (for length 81), A0 so 4 out of 7 max.



Question Number	Scheme	Marks
6.(a)	e.g.  	M1 A1 A1 A1 A1 **(5)**