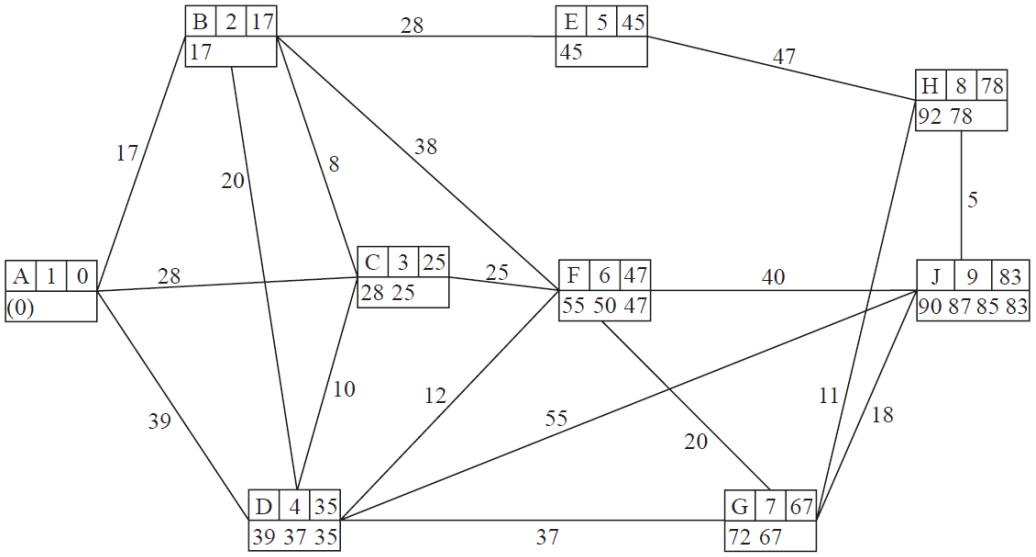
3.(a)(i)		M1 A1 (ABCDE) A1 (FG) A1ft (HJ)
	Shortest path from A to J is ABCDFGHJ	A1
(a)(ii)	Length of shortest path from A to J is 83 (km)	A1ft **(6)**
(b)	B(CD)F + HJ = 30 + 5 = 35* B(CDFG)H + F(GH)J = 61 + 36 = 97 B(CDFGH)J + F(G)H = 66 + 31 = 97	M1 A1 A1
	Repeat arcs: BC, CD, DF and HJ	A1
	Route length is 458 + 35 = 493 (km)	A1ft **(5)**
(c)	The shortest path between any of the pairs of the four odd nodes (A, B, F and H) is AB (17)	M1
	So start at F and finish at H (or vice-versa)	A1
	Length of route is 458 + 17 = 475 (km)	B1 **(3)**
		14 marks
	Special Case for Part B – using A B F H – Mark as Misread	
(b)	AB + F(G)H = 17 + 31 = 48* A(BCD)F + B(CDFG)H = 47 + 61 = 108 A(BCDFG)H + B(CD)F = 78 + 30 = 108	M1 A1 A1
	Repeat arcs: AB, FG and GH	A1
	Route length is 458 + 48 = 506 (km)	A1ft **(5)**
	Remove final two A marks earned in this section so max 3/5	

	Notes for Question 3	
	In (a) 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 D the working values must be 39 37 35 in that order (so 39 35 37 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**	
a1M1	A larger value replaced by a smaller value in the working values of at least two of the nodes C, D, F, G, H, J	
a1A1	All values at A, B, C, D and E correct and the working values in the correct order	
a2A1	All values at F and G correct and the working values in the correct order	
a3A1ft	All values in H and J correct on the follow through and the working values in the correct order. To follow through H check that the working values at H follow from the candidate's final values for the nodes that are directly attached to H (which are E and G). For example, **if** correct then the order of labelling of nodes E and G are 5 and 7 respectively so the working values at H should come from E and G in that order. The first working value at H should be their 45 (the Final value at E) + 47 (the weight of the arc EH), the second working value at H should be their 67 (the Final value at G) + 11 (the weight of the arc GH). Repeat the process for J (which will have working values from D, F, G and H with the order of these nodes determined by the candidate's order of labelling at D, F, G and H)	
a4A1	CAO (ABCDFGHJ)	
a5A1ft	Follow through their final value at J **only** – if answer is 83 but this is not the Final Value at J then A0	
b1M1	Three distinct pairings of the nodes B, F, H and J with one row correct (including total)	
b1A1	Any two rows correct including pairings **and** totals	
b2A1	All three rows correct including pairings **and** totals	
b3A1	CAO - correct arcs clearly stated and not just in their working as BC, CD, DF and HJ – must be these arcs. Do not accept BF or B(CD)F or BF via C and D	
b4A1ft	Correct route length (493) or follow through their least repeat + 458	
c1M1	Indicates the need to find the shortest path between any pair of the correct four odd nodes (A, B, F, H)	
c1A1	CAO (F, H)	
c1B1	CAO (475)	

	Special Case for Part B – using A B F H – Mark as Misread	
b1M1	Three distinct pairings of the nodes A, B, F and H with one row correct (including total)	
b1A1	Any two rows correct including pairings **and** totals	
b2A1	All three rows correct including pairings **and** totals	
b3A1	CAO - correct arcs clearly stated and not just in their working as AB, FG and GH – must be these arcs. Do not accept FH or F(G)H or FH via G	
b4A1ft	Correct route length (506) or follow through their least repeat + 458	
	Remove final two A marks earned in this section so max 3/5	