

Question Number	Scheme	Marks
6. (a)	$B(AD)E + F(J)H = 45 + 30 = 75^*$ $B(CK)F + E(DG)H = 50 + 35 = 85$ $B(CKJ)H + E(DGHJ)F = 60 + 65 = 125$ Arcs BA, AD, DE, FJ and JH will be traversed twice Route length = $384 + 75 = 459$ (metres)	M1 A1 (2 correct) A1 (3 correct) A1 A1ft (5)
(b)	e.g. if we start at an odd vertex we will finish at another odd vertex. This removes the need to repeat the route between them. So we just have to consider one repeated route rather than two	B2, 1, 0 (2)
(c)	We only have to repeat one pair of odd vertices which does not include F (BE = 45, EH = 35, BH = 60) EH is the smallest of the repeat so repeat EH (ED, DG, GH) and therefore the guard should finish at B	M1 A1 (2)
(d)	Route e.g. FJKFCKLJHGHEDGDECBDAB The length of the route is 419 (metres)	B1 B1ft (2) 11 marks

Notes for Question 6

a1M1: Three distinct pairings of the **correct** four odd nodes

a1A1: **Any** two rows correct including pairings **and** totals

a2A1: **All** three rows correct including pairings **and** totals

a3A1: CAO correct **arcs** clearly (not just in their working) stated: BA, AD, DE, FJ, JH. Accept BADE, FJH **or** BE via A and D, FH via J. Do not accept BE, FH

a4A1ft: Correct answer of 459, or $384 +$ their smallest repeat out of a choice of at least **two** totals seen

b1B1: One of (i) **finishing** at an odd vertex (ii) only having to **repeat one route/pairing/pair/path** (but not 'repeat only one arc') rather than two **or** having **one less route/pairing/pair/path to repeat** (but not an argument based only on arcs e.g. 'one less arc to repeat' or 'it reduces the number of arcs')

b2B1: Correct complete argument – including both (i) and (ii) from b1B1 (so B0B1 is not possible in (b))

c1M1: Identifies the need to repeat one route of BE(45), EH(35), BH(60), which does not include F (maybe implicit) or a general comment to repeat one route that does not include F

c1A1: Identifies EH (but not just 35) as the least of those paths not including F, **and** B as the position of the finishing vertex. Note that they must either explicitly state that EH is **the least not including F** (just stating that EH is the least is A0) **or** they list the three pairings (BE, EH, BH) **and** only these three pairings in this part and state that EH is the least

d1B1: Any correct route – checks: start at F and finishes at B, 21 vertices (repeats ED, DG, GH, and node A appears 1, B(2), C(2), D(3), E(2), F(2), G(2), H(2), J(2), K(2), L(1))

d2B1ft: Correct answer of 419 or $384 +$ their EH (i.e. the least route that does not include F – so their smallest of BE, EH, BH – must be their smallest value (usually from (a)) not what they state/think is their smallest value). **This mark is dependent on the M mark in (a)**

Question Number	Scheme	Marks
5. (a)	$A(FG)C + E(FI)J = 14.5 + 9.2 = 23.7$ $A(F)E + C(GFI)J = 10.2 + 13.5 = 23.7$ $A(FI)J + E(FG)C = 9.6 + 14.1 = 23.7$ So repeat tracks AF, EF, CG, FG, FI and IJ	M1 A1 A1 A1 A1 (5)
(b)	Any route e.g. AFAEFEHIFIKJIJGFGCGDCBA Length = $106.7 + 23.7 = 130.4$ (km)	B1 DB1ft (2)
(c)	The new track would make A and C even So only EJ would need to be repeated Extra distance would be $15 + 9.2 = 24.2 > 23.7$ So it would increase the total distance (by 0.5 (km))	B1 B1 (2) 9 marks

Notes for Question 5

a1M1: Three distinct pairings of the correct four odd nodes

a1A1: Any one row correct including pairing and total

a2A1: Any two rows correct including pairings and totals

a3A1: All three rows correct including pairings and totals

a4A1: Correct arcs explicitly identified and not just stated in their working. Accept e.g. AFGC but not AC

b1B1: Any correct route – checks: starts and finishes at A, 23 vertices, repeats AF, EF, CG, FG, FI and IJ and node A appears 3, B(1), C(2), D(1), E(2), F(4), G(3), H(1), I(3), J(2), K(1)

b2B1ft: 130.4 or $106.7 +$ ft their least from (a) – this mark is dependent on at least two totals seen in (a)

c1B1: Explicit mention of EJ or EFIJ (not just 9.2) – if any other pairing mentioned then B0

c2B1: $24.2 +$ ‘increase’ provided 23.7 found as least in (a) **or** $130.9 +$ ‘increase’ provided 130.4 found in (b) **or** 14.5 stated as the length of AC + increase **or** 14.5 compared with $15 +$ ‘increase’. This mark is not dependent on the previous B mark – so B0B1 can be awarded

SC for (c): If B0B0 awarded but ‘increase of 0.5’ stated then award B1B0

Question Number	Scheme	Marks
5.(a)	$A(BC)E + H(F)G = 15 + 13 = 28^*$ $A(BDF)H + E(F)G = 30 + 7 = 37$ $A(BDF)G + E(F)H = 21 + 16 = 37$ Repeat arcs: AB, BC, CE, HF, FG Length: $214 + 28 = 242$ (km)	M1 A1 A1 A1 A1 A1ft (6)
(b)	4	B1 (1)
(c)	EG (7) is the shortest link between two odd nodes excluding H Repeat EG (7) since this is the shortest path excluding H We finish at A Length of route = $214 + 7 = 221$ (km)	M1 A1 A1 (3) (10 marks)

Notes for Question 5

a1M1: Three distinct pairings of the correct four odd nodes
 a1A1: One row correct including pairings **and** totals
 a2A1: Two rows correct including pairings **and** totals
 a3A1: All three rows correct including pairings **and** totals
 a4A1: The smallest repeat **arcs** (accept ABCE, HFG but not AE, HG)
 a5A1ft: Correct answer of 242 **or** $214 +$ their least

 b1B1: CAO (4)

 c1M1: Identifies the need to repeat one path of the three (AE, EG, AG) which does not include H (maybe implicit) or listing of only these possible repeats – this mark is dependent on either scoring the M mark in (a) or stating all three possible paths
 c1A1: Identifies EG as the least **and** A as the finishing point. They have to explicitly state the EG is the least path (but they do not need to include that it is the least of those that do not include H as this is the least of all six possible paths)
 c2A1: CAO (221)