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A-LEVEL MATHEMATICS • DECISION 1

Route Inspection

Worked Solutions

Pearson Edexcel International A Level (WDM11) • Calculator allowed: show every step

Full worked solutions for the free Route Inspection worksheet, A-Level and International A-Level Maths

A **Examples** & Your turn page 2

B **Fluency** core skills page 2

C **Reasoning** explain it page 3

D **Problem** solving page 4

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Tap a section to jump straight to it

Full worked solutions for every question on the Decision 1 Route Inspection worksheet, in the same order and with the same question numbers.

How to mark your work. Tick each step you got right, not just the final answer. At A-level most marks are for method, so a wrong final answer can still earn most of the marks. If you lost marks, find the *first* line where your working is different from ours. That is the thing to fix.

In Section E: **M** = method mark, **dM** = method mark that depends on the previous M mark, **A** = accuracy mark (needs the M mark before it), **B** = independent mark.

Question sheet | Exam questions by topic | Decision 1 exam questions | More worksheets

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A Your turn answers

Compare each line of your working with the solution.

CORE

A1 Every degree is even: **Eulerian**

A2 64 + 11: **75**

A3 PQ + RS = 13, PR + QS = 8, PS + QR = 17: **PR + QS = 8**

STRETCH

A4 95 + 8: **103**

A5 The shortest single path is PR 3; start and finish at the other two: **Q and S, 98**

A6 Finish P: repeat RS 6; R: PS 9; S: PR 3: **finish at S**

A7 **2**

B Fluency solutions

One mark for each correct part. The notes in italics explain why each sequence was chosen.

CORE

B1 **(a)** **A2, B3, C4, D3, E2** **(b)** **B and D** **(c)** **semi-Eulerian** **(d)** **45**

Count the odd vertices first.

B2 **(a)** B–C–D: **11** **(b)** **BC and CD** **(c)** 45 + 11: **56** **(d)** BD is 12, longer than B–C–D

The repeat is the shortest path, not the direct arc.

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B3 **(a)** **P, Q, S, T** **(b)** PQ 6, PS 4, PT 14, QS 10, QT 8, ST 10 **(c)** PQ+ST 16, PS+QT 12, PT+QS 24 **(d)** 54 + 12: **66**

Every pairing, every total.

B4 **(a)** **A and C** **(b)** start at A, finish at C (or the reverse) **(c)** **31** **(d)** 31 + 9: **40**

Semi-Eulerian: no repeats if you start at an odd vertex.

B5 **(a)** PQ: repeat ST 10; PS: QT 8; PT: QS 10; QS: PT 14; QT: PS 4; ST: PQ 6 **(b)** **start Q, finish T** **(c)** 54 + 4: **58**

Repeat the shortest path between the other two.

B6 **(a)** **Q, S, T** **(b)** Q: ST 10; S: QT 8; T: QS 10 **(c)** **finish at S** **(d)** 54 + 8: **62**

The finish must be another odd vertex.

STRETCH

B7 **(a)** degrees A2, B2, C4, D2, E2, all even **(b)** e.g. **A–C–E–D–C–B–A** **(c)** **2** **(d)** **33**

Each pass enters and leaves: two arcs.

B8 **(a)** **none** **(b)** **yes** **(c)** 45 + 10: **55** **(d)** the new road (10) replaces a repeat of 11

A road between the odd vertices makes them even.

B9 **(a)** $22 + x$ **(b)** A–D–C: **10** **(c)** $x < 10$ **(d)** 29 + 7: **36**

The direct arc is repeated only if it is the shortest path.

B10 **(a)** PQ 6, PS 4, PT 14 **(b)** QS 10, QT 8, ST 10 **(c)** it gives distances from P only **(d)** PS + QT = 4 + 8 = 12

Reuse Dijkstra values where they fit.

C Reasoning solutions

Your wording can be different. Check that your reason makes the same point.

CORE

C1 Every pairing must be totalled and the least chosen: PQ+ST is 16, but PS+QT is **12**.

C2 11 is only the repeated distance; the route is the total weight plus it: **56**

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C3 The repeat is the shortest path B–C–D (11), not the arc BD (12): **56**

C4 An open route must start and finish at odd vertices; R has even degree. The best is **Q to T**.

STRETCH

C5 She must state where the route finishes, “finish at S”, with the reason that the repeated distance QT 8 is the least of the three.

C6 Each pass through C uses two arcs, so degree 4 gives **2** passes.

C7 The degree sum is twice the number of arcs, so it is even; three odd degrees would make it odd.

C8 **(a)** each time the route passes through a vertex it uses one arc in and one arc out, and the start and finish pair up, so every vertex uses an even number of arcs

(b) every arc is used once, plus repeats that make every degree even; the cheapest way to pair the odd vertices is the least pairing total

D Problem solving solutions

There is often more than one correct method. Any complete, correct method scores full marks.

CORE

D1 Odd vertices B and E; shortest path B–D–E (25); repeat BD and DE: **$145 + 25 = 170$ m**

D2 **(a)** odd A, B, D, E: AB+DE = 10 + 21 = 31; AD+BE = 28 + 8 = 36; AE+BD = 18 + 27 = 45; repeat **AB, DC, CE**

(b) 148 + 31: **179 km**

D3 **(a)** every vertex has even degree; **115 m**

(b) e.g. **A–C–F–E–D–B–E–C–B–A**

(c) **2**

D4 Odd A, B, G, H. Leaving out GH repeats AB (4), the least of the six options: **start at G and finish at H (or the reverse),** $185 + 4 = 189$ **m**

STRETCH

D5 **(a)** repeat the shortest path G–E–H (23): $150 + 23 = 173$ **km**

(b) repeat A–B–G–E–F (29): **179 km**, an increase of **6 km**

D6 **(a)** odd O, Q, R, S: OQ+RS 35, OR+QS 47, OS+QR 28: $144 + 28 = 172$ **m**

(b) Q and S become even, leaving O and R (16): $157 + 16 = 173$: **an increase of 1 m**

D7 **(a)** odd A, D, E, F: AD+EF 26, AE+DF 35, AF+DE 35: $150 + 26 = 176$

(b) finish D: repeat EF 15; E: DF 18; F: DE 6: **finish at F**, $150 + 6 = 156$, a saving of **20**

D8 **(a)** **A and B**; A–F–B has length $x + 5$, AB has 10: AF repeated when $x < 5$

(b) $x \leqslant 4$**:** $122 + 2x$; $x \geqslant 5$**:** $127 + x$

(c) $x = 1$: **124 km**

E Exam practice solutions

Mark-scheme notes are shown on the right of each line.

CORE *Exam questions for everyone*

E1 **(a)** odd vertices C, D, F, G *B1*

CD+FG = 16 + 25 = 41; CF+DG = 21 + 14 = 35; CG+DF = 12 + 37 = 49 *M1 A1*

repeat **CB, BF, DH, HG**: 190 + 35 = **225 minutes** *A1*

(b) e.g. **A–E–F–B–C–G–H–D–G–B–F–G–H–D–C–B–A** *M1 A1*

(c) finish D: repeat FG 25; F: repeat DG 14; G: repeat DF 37 *M1*

finish at F, the least repeat, D–H–G *A1*

190 + 14 = **204 minutes** *A1*

(d) **3** *B1*

E2 **(a)** order B, A, F, D, C, H, G, E, J *M1*

final values B 0, A 22, F 25, D 26, C 33, H 42, G 45, E 48, J 49 *A1 A1*

working values at J: 66, 49 *A1*

B–D–G–J, 49 m *A1*

(b) odd B, F, H, J; BF 25, BH 42, BJ 49 from (a); HJ 14, FJ 31, FH 17 *M1*

BF+HJ 39; BH+FJ 73; BJ+FH 66 *A1 A1*

206 + 39 = **245 m** *A1*

(c) finish F: repeat HJ 14; H: FJ 31; J: FH 17 *M1*

finish at F *A1*

206 + 14 = **220 m** *A1*

STRETCH

E3 **(a)** order A, B, H, G, F, C, E, D *M1*

final values A 0, B 7, H 17, G 18, F 24, C 28, E 32, D 37 *A1 A1*

working values F 26, 24; D 55, 37 *A1*

A–H–E, 32 km *A1*

(b) odd A, C, E, F: AC+EF = 28 + 11 = 39; AE+CF = 32 + 32 = 64; AF+CE = 24 + 32 = 56 *M1 A1 A1*

repeat **AB, BC, EF**: 159 + 39 = **198 km** *A1*

(c) EF is repeated only if it is the shortest E–F path (E–H–F is 24) and AC+EF stays the least pairing: $28 + x < 56$ *M1 A1*

$x < 24$ *A1*

(d) C and F become even, leaving A and E (32) *M1*

159 + 9 + 32 = **200 km** *A1*

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