**Networks - Roads**

**Extended investigation Part 2:** **In-class validation**

**Solutions and marking key**

**Question 1(a)**

|  |  |
| --- | --- |
| Solution | |
| RTNRMHSLEPTR or RTNRMHSLEPT  Any route could be given as no limitations are provided | |
| Mathematical behaviours | Marks |
| * identifies series of edges in network | 1 |

**Question 1(b)**

|  |  |
| --- | --- |
| Solution | |
| 47 or 44 | |
| Mathematical behaviours | Marks |
| * calculates distance | 1 |

**Question 1(c)**

|  |  |
| --- | --- |
| Solution | |
| No  Vertex R was re-visited | |
| Mathematical behaviours | Marks |
| * identifies network is not Hamiltonian * explains conclusion | 1  1 |

**Question 1(d)**

|  |  |
| --- | --- |
| Solution | |
| |  |  |  |  | | --- | --- | --- | --- | | **Route** | **Starting intersection** | **Route – order of roads travelled** | **Distance** | | 1 | R | RMHSLEPTNR | 41 km | | 2 | M | MHSLEPTNRM | 41 km | | 3 | L | LSHMRNTPEL | 41 km | | 4 | E | ELSHMRNTPE | 41 km | | |
| Mathematical behaviours | Marks |
| * calculates distance * identifies four routes each with a different starting point | 1  4 |

**Question 1(e)**

|  |  |
| --- | --- |
| Solution | |
| The driver should not travel on any route from R to H, S, E or T | |
| Mathematical behaviours | Marks |
| * identifies one route other than RT on which not to travel * identifies two further routes on which not to travel | 1  1 |

**Question 1(f)**

|  |  |
| --- | --- |
| Solution | |
| MHRSLEPTN (35 km)  MHSLEPTNR (29 km)  MHSLERNTP (28 km) Other possibilities exist. Routes can start at any vertex. | |
| Mathematical behaviours | Marks |
| * identifies 3 paths of different lengths | 3 |

**Question 1(g)**

|  |  |
| --- | --- |
| Solution | |
| MHSLERNTP  It is the shortest route so less petrol used and lowest cost | |
| Mathematical behaviours | Marks |
| * identifies shortest route * links answer to context of question. | 1  1 |

**Question 2(a)**

|  |  |
| --- | --- |
| Solution | |
| 11 km | |
| Mathematical behaviours | Marks |
| * interprets network | 1 |

**Question 2(b)(i)**

|  |  |
| --- | --- |
| Solution | |
| TNRH (12)  TNRMH (24)  TNRELSH (19)  TPERMH (28)  TPELSRMH (38) | |
| Mathematical behaviours | Marks |
| * identifies 5 different routes | 5 |

**Question 2(b)(ii)**

|  |  |
| --- | --- |
| Solution | |
| 26 | |
| Mathematical behaviours | Marks |
| * identifies shortest and longest routes * calculates difference | 1  1 |

**Question 3(a)**

|  |  |
| --- | --- |
| Solution | |
| Eulerian | |
| Mathematical behaviours | Marks |
| * demonstrates knowledge of terminology | 1 |

**Question 3(b)**

|  |  |
| --- | --- |
| Solution | |
| From M to H and then R, you need to get back to M to go over RM and this means repeating the edge MH or MR to get back to the other edges. | |
| Mathematical behaviours | Marks |
| * describes an attempted route * explains need to repeat edge | 1  1 |

**Question 3(c)**

|  |  |
| --- | --- |
| Solution | |
| The number of odd nodes in the network is not 0 or 2 | |
| Mathematical behaviours | Marks |
| * demonstrates knowledge of odd nodes for Eulerian trail * identifies number of odd nodes | 1  1 |

**Question 3(d)**

|  |  |
| --- | --- |
| Solution | |
| Make roads ET or HS (connecting any two odd vertices) | |
| Mathematical behaviours | Marks |
| * identifies one pair of odd vertices to connect * identifies a second pair of odd vertices to connect | 1  1 |

**Question 3(e)**

|  |  |
| --- | --- |
| Solution | |
| ELS**HS**RHMRTNREPT  SLEP**TE**RTNRSHRMH | |
| Mathematical behaviours | Marks |
| * uses first new road to make a route with no edges repeated * uses second new road to make a route with no edges repeated | 2  2 |

**Question 3(f)**

|  |  |
| --- | --- |
| Solution | |
| Neither route is shorter  Every edge is travelled each time | |
| Mathematical behaviours | Marks |
| * identifies every edge is used * identifies the same distance | 1  1 |

**Question 4(a)**

|  |  |
| --- | --- |
| Solution | |
| Add a loop at any intersection  Add an extra edge between any two vertices | |
| Mathematical behaviours | Marks |
| * identifies first feature of a network that is not simple * identifies second feature of a network that is not simple | 1  1 |

**Question 4(b)**

|  |  |
| --- | --- |
| Solution | |
| It can be draw in the plane (2-D) without edges crossing | |
| Mathematical behaviours | Marks |
| * describes planarity | 1 |

**Question 4(c)**

|  |  |
| --- | --- |
| Solution | |
| *v + f – e* = 2  9 + 6 – 13 = 2 | |
| Mathematical behaviours | Marks |
| * identifies number of edges * identifies number of faces * identifies number of vertices * substitutes using Euler’s formula | 1  1  1  1 |

**Question 4(d)**

|  |  |
| --- | --- |
| Solution | |
|  | |
| Mathematical behaviours | Marks |
| * all edges maintained * all vertices maintained * two edges cross | 1  1  1 |

**Question 4(e)**

|  |  |
| --- | --- |
| Solution | |
| (i) flyover, tunnel  (ii) occupies less space on the ground  (iii) costs more to build, pollution confined to smaller area | |
| Mathematical behaviours | Marks |
| * relates theory to context in three specific ways. | 3 |