**Varying speeds**

**In-class investigation**

**Solutions**

**Question 1**

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|  | Solution | Marking key/mathematical behaviours | Marks |
| (a) | (i) Speed = 20 ÷ 10 = 2 km/min  (ii) Speed = 10 ÷ 5 = 2 km/min  (iii) Speed = 2 ÷ 1 = 2 km/min | * Determines the speed for each interval given | 3 |
| (b) |  | * Identifies *y*-intercept * States linear rule with correct gradient | 1  1 |
| (c) | The speed would remain constant at 2 km/min because the relationship is linear and the gradient = 2 | * Identifies continuing constant speed * Justifies conclusion | 1  1 |

**Question 2**

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|  | Solution | Marking key/mathematical behaviours | Marks |
| (a) | Speed = 70.19 ÷ 48 = 1.462 km/min | * Selects correct distance and time * Calculates average speed | 1  1 |
| (b) | No relationship  As distance from the city increases, the average speed over each section does not have any pattern of increasing, decreasing or remaining constant. | * Concludes lack of relationship * Justifies conclusion | 1  1 |
| (c) | No information is given about the change in speed during each section so we cannot conclude that the speed is constant throughout the section and hence cannot call it the *speed* and imply that is that speed throughout the section.  We can determine the average speed as the total distance travelled and the time taken are known. | * Justifies using “average” * Explains lack of information about constancy of speed | 1  1 |

**Question 3**

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|  | Solution | Marking key/mathematical behaviours | Marks |
| (a) | (i) linear  (ii) *s* = 4*n* – 2  (iii) Average speed increases by 4 m/sec for every second increase | * Identifies type of relationship * Identifies *y*-intercept * Identifies gradient * Describes increasing average speed relative to time | 1  1  1  1 |
| (b) | (i)   |  |  | | --- | --- | | Time  (secs) | Distance reached  (m) | | 0 | 0 | | 1 | 16 | | 2 | 64 | | 3 | 144 | | 4 | 256 |  |  |  | | --- | --- | | *n* | speed ( *s* )  (m / sec) | | 1 | 16 | | 2 | 48 | | 3 | 80 | | 4 | 112 |   (ii) 144 m/sec  (iii) linear  (iv) *s* = 32*n* – 16  (v) average speed increases by 32 m/sec for every second increase | * Calculates distance for each value of *t* * Calculates average speed over each second * Predicts speed * Identifies linear relationship * Identifies gradient * Identifies *y* –intercept * Describes increasing average speed relative to time | 2  2  1  1  1  1  1 |

**Question 3 (cont’d)**

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|  | Solution | Marking key/mathematical behaviours | Marks |
| (c) | (i)   |  |  | | --- | --- | | Time  (secs) | Height reached  (m) | | 0 | 0 | | 1 | 7 | | 2 | 12 | | 3 | 15 | | 4 | 16 |  |  |  | | --- | --- | | *n* | speed ( *s* )  (m / sec) | | 1 | 7 | | 2 | 5 | | 3 | 3 | | 4 | 1 |   (ii) *s* = - 2*n* + 9  (iii) Average speed decreases by 2 m/sec for every second increase  (iv) *speed =*  = = 4 m/s | * Calculates height for each value of *t* * Calculates average speed over each second * Identifies linear relationship * Identifies gradient * Identifies *y* –intercept * Describes decreasing average speed relative to time * Calculates speed over first 4 seconds | 2  2  1  1  1  1  1 |

**Question 4**

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|  | Solution | Marking key/mathematical behaviours | Marks |
| (a) | 1 quadratic  2 cubic  3 cubic  4 cubic  5 polynomial of degree 4 (quartic)  6 polynomial of degree 4 (quartic)  7 linear | * Identifies each of the four types of relationships | 4 |
| (b) | For each distance function, the associated function for speed has a degree one less than its distance function. Examples  The cubic distance functions for objects 2, 3 & 4 have quadratic speed functions | * Identifies degrees of related functions * Applies principle in each case | 2  1 |

**Question 5**

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|  | Solution | Marking key/mathematical behaviours | Marks | |
| (a) | 9 m/sec | * Uses calculation model provided | 1 | |
| (b) | Yes  The calculation is closer to the time considered | * Identifies greater accuracy of the model * Justifies choice | 1  1 | |
| (c) | Solution   |  |  |  |  | | --- | --- | --- | --- | | From | To | Calculation for average speed | Speed  (m/sec) | | *t* = 2.0 | *t* = 2.5 |  | 9 | | *t* = 2.0 | *t* = 2.1 |  | 8.2 | | *t* = 2.0 | *t* = 2.01 |  | 8.02 | | *t* = 2.0 | *t* = 2.001 |  | 8.002 | | *t* = 2.0 | *t* = 2.0001 |  | 8.0002 | | | | |
| Marking key/mathematical behaviours   * Uses calculation models to determine two given speeds * Continues pattern to provide calculation models * Uses created models to determine speeds | | | 1  1  1 |
| (d) | Solution  The smaller the interval chosen at *t* = 2, the closer the speed is to 8 m/sec. This value is a more accurate reflection of the speed at *t* = 2 and is quite different to the speed of the object during the second following *t* = 2. | | | |
| Marking key/mathematical behaviours   * Identifies the approaching value of 8 and * Identifies the greater accuracy. | | | 1  1 |