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| I1 | Scheme | Marks | AOs | Pearson Progression Step and Progress descriptor |
| a |  | M1  M1  A1 | 1.1a  1.1b  1.1b | 6th  Understand exponential models in bivariate data. |
|  | (3) |  |  |
| b | *a* is a constant of proportionality. | A1 | 3.2a | 6th  Understand exponential models in bivariate data. |
|  | (1) |  |  |
| c | Extrapolation/out of the range of the data. | A1 | 2.4 | 4th  Understand the concepts of interpolation and extrapolation. |
|  | (1) |  |  |
| (5 marks) | | | | |
| **Notes** | | | | |

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| I2 | | Scheme | | Marks | | AOs | | Pearson Progression Step and Progress descriptor | |
| **a** | | **\\192.168.0.251\Pearson\A Level Maths\WIP files\Unit tests\Stats 2\Artwork\2. Files from YPS\alevel_ut_s2_u2_markscheme_aw3.png**  Let *F* ~ faulty | | **B1**  **B1**  **B1** | | 2.5  1.1b  1.1b | | 3rd  Draw and use tree diagrams with three branches and/or three levels. | |
|  | | **(3)** | |  | |  | |
| **b** | | P(*B**F*') = 0.35 × 0.98 | | **M1** | | 1.1b | | 5th  Understand and calculate conditional probabilities in the context of tree diagrams. | |
| = 0.343 | | **A1** | | 1.1b | |
|  | | **(2)** | |  | |  | |
| **c** | | P(*F*) = 0.4 × 0.05 + 0.35 × 0.02 + 0.25 × 0.03 | | **M1** | | 1.1b | | 5th  Understand and calculate conditional probabilities in the context of tree diagrams. | |
| = 0.0345 | | **A1** | | 1.1b | |
|  | | **(2)** | |  | |  | |
| **d** | | P(*C*'|*F*) === | | **M1**  **A1ft** | | 3.1b  1.2 | | 5th  Calculate conditional probabilities using formulae. | |
| 0.7826... or (accept awrt 0.783) | | **A1** | | 1.1b | |
|  | | **(3)** | |  | |  | |
| (10 marks) | | | | | | | | | |
| Notes | | | | | | | | | |
| I3 | | Scheme | | Marks | | AOs | | Pearson Progression Step and Progress descriptor | |
| **a** | | bell shaped | | **B1** | | 1.2 | | 5th  Understand the basic features of the normal distribution including parameters, shape and notation. | |
| 170, 180 on axis | | **B1** | | 1.1b | |
| 5% and 20% | | **B1** | | 1.1b | |
|  | | **(3)** | |  | |  | |
| **b** | | P(*X* < 170) = 0.05    *μ* = 170 + 1.6449*σ*  P(*X* > 180) = 0.2  *μ* = 180 − 0.8416*σ*  Solving simultaneously gives:  *μ* = 176.615… (awrt 176.6) and *σ* = 4.021…(awrt 4.02) | | **M1**  **B1**  **B1**  **B1**  **M1**  **A1**  **A1** | | 3.3  3.4  1.1b  3.4  1.1b  1.1b  1.1b | | 7th  Find unknown means and/or standard deviations for normal distributions. | |
|  | | **(7)** | |  | |  | |
| **c** | | P(All three are taller than 175 cm) = 0.656…3 | | **M1** | | 1.1b | | 5th  Understand informally the link to probability distributions. | |
| = 0.282… (using calculator) awrt 0.282 | | **A1** | | 1.1b | |
|  | | **(2)** | |  | |  | |
| (12 marks) | | | | | | | | | |
| Notes | | | | | | | | | |

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| I4 | Scheme | Marks | AOs | Pearson Progression Step and Progress descriptor |
| a | The data seems to follow an exponential distribution. | B1 | 2.4 | 6th  Understand exponential models in bivariate data. |
|  | (1) |  |  |
| b |  | B1 | 2.2a | 2nd  Know and understand the language of correlation and regression. |
| which gives a strong positive correlation. | B1 | 2.4 |
|  | (2) |  |  |
| c | Model is a good fit with a reason. For example,  Very strong positive linear correlation between *t* and log10 *p.*  The transformed data points lie close (enough) to a straight line. | B2 | 3.2a | 6th  Understand exponential models in bivariate data. |
|  | (2) |  |  |
| (5 marks) | | | | |
| Notes  **c**  B0 for just stating the model is a good fit with no reason. | | | | |

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| I5 | Scheme | Marks | AOs | Pearson Progression Step and Progress descriptor |
| a | \\192.168.0.251\Pearson\A Level Maths\WIP files\Unit tests\Stats 2\Artwork\2. Files from YPS\alevel_ut_s2_u2_markscheme_aw4.png  *T* = hand assignments in on time, *D* = start assignments on the day they are issued | **B1**  **B1**  **B1** | 2.5  1.1b  1.1b | 2nd  Draw and use simple tree diagrams with two branches and two levels. |
|  | (3) |  |  |
| **b i** | P(*T**D*) = P(*T*|*D*) × P(*D*) | **M1** | 3.1b | 5th  Understand and calculate conditional probabilities in the context of tree diagrams. |
| =  =or 0.33 | **A1** | 1.1b |
|  | **(2)** |  |  |
| **b ii** |  | **M1** | 3.1b | 5th  Understand and calculate conditional probabilities in the context of tree diagrams. |
|  | or 0.841… | **A1** | 1.1b |  |
|  | P(*T*''*D*') = | **M1** | 1.1b |  |
|  | or 0.0633… (accept awrt 0.0633) | **A1** | 1.1b |  |
|  |  | **(4)** |  |  |
| **c** | P(*T**D*) =≠ P(*T*) × P(*D*) = | **M1** | 2.1 | 4th  Understand and use the definition of independence in probability calculations. |
| So, *T* and *D* are not statistically independent. | **A1** | 2.4 |
|  | **(2)** |  |  |
| (11 marks) | | | | |
| Notes  **b ii** Alternative solution  P(*T*''*D*') = 1 − P(*T**D*)  P(*T**D*) =  =  P(*T*''*D*') = 1 −= | | | | |

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| I6 | Scheme | Marks | AOs | Pearson Progression Step and Progress descriptor |
| **a** | A critical value is the point (or points) on the scale of the test statistic beyond which we reject the null hypothesis. | **B1** | 1.2 | 5th  Understand the language of hypothesis testing. |
|  | **(1)** |  |  |
| **b** | H0 : = 0, H1 : > 0  Critical value = 0.5494  0.714 > 0.5494 (test statistic in critical region)  There is evidence to reject H0  There is evidence that there is a positive correlation between the number of vehicles and road traffic accidents. | **B1**  **M1**  **A1** | 2.5  1.1b  2.2b | 6th  Carry out a hypothesis test for zero correlation. |
|  | **(3)** |  |  |
| **c** | *r* = −7.0 + 0.02*v* | **B1** | 1.2 | 4th  Make predictions using the regression line within the range of the data. |
|  | **(1)** |  |  |
| **d** | Road fatalities per 100 000 population. | **B1** | 1.2 | 2nd  Know and understand the language of correlation and regression. |
|  | **(1)** |  |  |
| **e** | Outside the range of the data used in the model.  or  This would require extrapolation. | **B1** | 3.5b | 4th  Understand the concepts of interpolation and extrapolation. |
|  | **(1)** |  |  |
| (7 marks) | | | | |
| Notes | | | | |

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| I7 | Scheme | Marks | AOs | Pearson Progression Step and Progress descriptor |

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| **a** | Moment from bus = 5000 × 2 × *g* | **M1** | 3.1a | 5th  Find resultant moments by considering direction. |
| = 10 000*g* (N m) | **A1** | 1.1b |
| Moment from gold = 1000 × 12 × *g* | **M1** | 3.1b |
| = 12 000*g* (N m) | **A1** | 1.1b |
| Moment from people = 70 × 8 × *n* × *g* | **M1** | 3.1a |
| = 560*ng* (N m) | **A1** | 1.1b |
| Total moment = (22 000 − 560*n*)*g* (N m) | **A1** | 1.1b |
|  | **(7)** |  |  |
| **b** | Forming an equation or inequality for *n* and solving to find (*n* = 39.28…) | **M1** | 1.1b | 5th  Solve equilibrium problems involving horizontal bars. |
| Need 40 people. | **A1** | 3.2a |
|  | **(2)** |  |  |
| **c** | New moment from gold and extra person is 1070 × 12 × *g* (N) | **M1** | 3.1a | 5th  Solve equilibrium problems involving horizontal bars. |
| New total moment = (22840 − 560*n*)*g* (N m) | **M1** | 1.1b |
| *n* = 40.78… | **A1** | 3.2a |
| 42 people (including the extra) | **A1** | 2.4 |
|  | **(4)** |  |  |
|  |  |  |  | **(13 marks)** |

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| I8 | Scheme | Marks | AOs | Pearson Progression Step and Progress descriptor |
| **a** | Net force is **C** + **W** | **M1** | 3.1b | 4th  Calculate resultant forces using vectors. |
|  | **A1** | 1.1b |
|  | **(2)** |  |  |
| **b** | Use of Newton’s 2nd Law. | **M1** | 3.1b | 5th  Use Newton's second law to model motion in two directions. |
|  | **M1** | 1.1b |
|  | **A1** | 1.1b |
|  | **(3)** |  |  |
| **c** |  | **M1** | 1.1a | 5th  Use the equations of motion to solve problems in familiar contexts. |
|  | **M1** | 1.1b |
| *x* = *t* + 25*t*2 | **A1** | 1.1b |
| *y* = *t* − 5*t*2 | **A1** | 1.1b |
|  | **(4)** |  |  |
| **d** | Substitute *t* = 10 | **M1** | 3.1b | 5th  Use the equations of motion to solve problems in familiar contexts. |
| *x* *=* 2510 | **A1** | 1.1b |
| *y* = −490 | **A1** | 1.1b |
| Distance travelled | **M1** | 1.1a |
| 2557.38…(m) (Accept awrt 2560) | **A1** | 3.2a |
|  | **(5)** |  |  |
| (14 marks) | | | | |
| Notes | | | | |

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| I9 | Scheme | Marks | AOs | Pearson Progression Step and Progress descriptor |

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| **a** | **Figure 1**  Force labels one mark each  Allow explicit evaluation with *g.* | **B2** | 2.5 | 4th  Calculate moments. |
|  | **(2)** |  |  |
| **b** | Alice: Moment = 2 × 50 × *g* | **M1** | 1.1b | 5th  Calculate sums of moments. |
| = 100*g* (N m) | **A1** | 1.1b |
| Bob: Moment = (2 − *x*) × 80 × *g* | **M1** | 3.4 |
| = 80(2 − *x*)*g* (N m) | **A1** | 1.1b |
| Total clockwise moment = 20*g*(4*x* − 3) (N m) | **A1** | 1.1b |
|  | **(5)** |  |  |
| **c** | Equating to 0 and solving | **M1** | 3.4 | 5th  Solve equilibrium problems involving horizontal bars. |
| *x* = 0.75 (m) | **A1** | 1.1b |
|  | **(2)** |  |  |
| **d** | Identifying 2 as a limit | **M1** | 2.4 | 7th  Solve problems involving bodies on the point of tilting. |
| So tilts towards Alice when 0.75 < *x* ⩽ 2 | **A1** | 2.2a |
|  | **(2)** |  |  |
| **e** | Any valid limitation. For example,  Pivot not a point.  Alice can’t sit exactly on the end.  The see-saw might bend. | **A1** | 3.5 | 3rd  Understand assumptions common in mathematical modelling. |
|  | **(1)** |  |  |

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| I10 | Scheme | Marks | AOs | Pearson Progression Step and Progress descriptor |
| **a** | Use of | **M1** | 1.1a | 6th  Resolve velocity into horizontal and vertical components. |
| Initial velocity is | **A1** | 3.4 |
|  | **A1** | 1.1b |
|  | **B1** | 1.1b |
|  | **(4)** |  |  |
| **b** | Solve *y* = 0 for *t* | **M1** | 3.4 | 5th  Model horizontal projection under gravity. |
|  | **A1** | 1.1b |
| *t* = 0 or | **A1** | 1.1b |
| *t* = 0 is initial position so | **M1** | 2.4 |
|  | **A1** | 1.1b |
|  | **(5)** |  |  |
| **c** | Sketch of sin 2*θ* or other legitimate method. | **M1** | 2.2a | 6th  Resolve velocity into horizontal and vertical components. |
| Maximum is at *θ* = 45° | **A1** | 2.4 |
|  | **(2)** |  |  |
| **d** | Correct limitation. For example, air resistance. | **B1** | 3.5b | 3rd  Understand assumptions common in mathematical modelling. |
|  | **(1)** |  |  |
| (12 marks) | | | | |
| Notes | | | | |

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| I11 | Scheme | Marks | AOs | Pearson Progression Step and Progress descriptor |

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| **a** | One correct force with correct label.  Two more correct forces with correct labels. | **B1**  **B1** | 2.5  2.5 | 3rd  Draw force diagrams. |
|  | **(2)** |  |  |
| **b** | Resolve vertically. | **M1** | 1.1b | 5th  Calculate resultant forces in perpendicular directions. |
| Weight = 8*g* | **M1** | 1.1b |
| = 78.4 | **M1** | 1.1b |
| Vertical part of normal reaction is 2*R* cos 40 | **A1** | 1.1b |
| 2*R* cos 40 = 78.4 | **M1** | 1.1b |
| Solve for *R* | **M1** | 1.1b |
| *R* = 51.171… (N) accept awrt 51 | **A1** | 1.1b |
|  | **(7)** |  |  |
|  |  |  |  | **(9 marks)** |