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| H1 | Scheme | Marks | AOs | Pearson Progression Step and Progress descriptor |
|  | *X* ~ females *X* ~ N(165, 92), *Y* ~ males *Y* ~ N(178, 102) | M1 | 3.3 | 5th  Calculate probabilities for the standard normal distribution using a calculator. |
| P(*X* >177) = P(*Z* >1.33) (or = 0.0912) | M1 | 1.1b |
| P(*Y* >190) = P(*Z* > 1.20) (or = 0.1151) | A1 | 1.1b |
| Therefore the females are relatively taller. | A1 | 2.2a |
| (4 marks) | | | | |

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| H2 | 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 | *b* is the proportional rate at which the temperature changes per minute. | 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** | | | | |
| H3 | Scheme | Marks | AOs | Pearson Progression Step and Progress descriptor |
| a | = | M1 | 1.1b | 2nd  Calculate probabilities from relative frequency tables and real data. |
| = 0.4 | A1 | 1.1b |
|  | (2) |  |  |
| b | = | M1 | 3.1a | 4th  Understand set notation. |
| = 0.864 | A1 | 1.1b |
|  | (2) |  |  |
| c | P(*S**A*) == 0.136 ≠ P(*S*) × P(*A*) ==0.163… | **M1** | 2.1 | 4th  Understand and use the definition of independence in probability calculations. |
| So, *S* and *A* are not statistically independent. | **A1** | 2.4 |
|  | **(2)** |  |  |
| d | *B* and *C* are not mutally exclusive | B1 | 2.2a | 3rd  Understand and use the definition of mutually exclusive in probability calculations. |
| Being in team *C* does not exclude the possibility of winning a bronze medal | B1 | 2.4 |
|  | (2) |  |  |
| e | = | M1 | 3.1b | 5th  Calculate conditional probabilities using formulae. |
| = 0.424 | A1 | 1.1b |
|  | (2) |  |  |
| (10 marks) | | | | |
| Notes | | | | |

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| H4 | Scheme | Marks | AOs | Pearson Progression Step and Progress descriptor |
| **a** | P(*M* < 850) = 0.3085 (using calculator) | **B1** | 1.1b | 5th  Calculate probabilities for the standard normal distribution using a calculator. |
|  | **(1)** |  |  |
| **b** | P(*M* < *a*) = 0.1 and P(*M* < *b*) = 0.9 | **M1** | 3.1b | 5th  Calculate probabilities for the standard normal distribution using a calculator. |
| (using calculator) *a* = 772 g | **A1** | 1.1b |
| *b* = 1028 g | **A1** | 1.1b |
|  | **(3)** |  |  |
| (4 marks) | | | | |
| Notes | | | | |

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| H5 | Scheme | Marks | AOs | Pearson Progression Step and Progress descriptor |
| **a** | H0 : = 0, H1 : < 0  Critical value = −0.6319  −0.6319 < −0.136 no evidence to reject H0 (test statistic not in critical region)  There is insufficient evidence to suggest that the weight of chickens and average weight of eggs are negatively correlated. | **B1**  **M1**  **A1** | 2.5  1.1a  2.2b | 6th  Carry out a hypothesis test for zero correlation. |
|  | **(3)** |  |  |
| **b** | Sensible explanation. For example, correlation shows there is no (or extremely weak) linear realtionship between the two variables. | **B1** | 1.2 | 7th  Interpret the results of a hypothesis test for zero correlation. |
| For example, there could be a non-linear relationship between the two variables. | **B1** | 3.5b |
|  | **(2)** |  |  |
| (5 marks) | | | | |
| Notes | | | | |

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| H6 | | Scheme | | Marks | | AOs | | Pearson Progression Step and Progress descriptor | |
| **a** | | *n* is large | | **B1** | | 1.2 | | 5th  Understand the binomial distribution (and its notation) and its use as a model. | |
| *p* is close to 0.5 | | **B1** | | 1.2 | |
|  | | **(2)** | |  | |  | |
| **b** | | Mean = *np* | | **B1** | | 1.2 | | 5th  Understand the binomial distribution (and its notation) and its use as a model. | |
| Variance = *np*(1 − *p*) | | **B1** | | 1.2 | |
|  | | **(2)** | |  | |  | |
| **c** | | There would be no batteries left. | | **B1** | | 2.4 | | 5th  Select and critique a sampling technique in a given context. | |
|  | | **(1)** | |  | |  | |
| **d** | | H0: *p* = 0.55 H1: *p* > 0.55 | | **B1** | | 2.5 | | 5th  Carry out 1-tail tests for the binomial distribution. | |
|  | | **(1)** | |  | |  | |
| **e** | | *X* ~ N(165, 74.25)  P(*X* ⩾ 183.5)  = P  = P(*Z* ⩾ 2.146...)  =1 − 0.9838  = 0.0159  Reject H0, it is in the critical region.  There is evidence to support the manufacturer's claim. | | **B1**  **M1**  **M1**  **A1**  **A1**  **M1**  **A1** | | 3.3  3.4  1.1b  1.1b  1.1b  1.1b  2.2b | | 7th  Interpret the results of a hypothesis test for the mean of a normal distribution. | |
|  | | **(7)** | |  | |  | |
| (13 marks) | | | | | | | | | |
| Notes | | | | | | | | | |
| H7 | | Scheme | | Marks | | AOs | | Pearson Progression Step and Progress descriptor | |
| **a** | | *X* ~ women’s body temperature *X* ~ N(36.73, 0.1482) | | **M1** | | 3.3 | | 5th  Calculate probabilities for the standard normal distribution using a calculator. | |
| P(*X* > 38.1) = 0.000186 | | **B1** | | 1.1b | |
|  | | **(2)** | |  | |  | |
| **b** | | Sensible reason. For example,  Call the doctor as very unlikely the temperature would be so high. | | **B1** | | 2.2a | | 8th  Solve real-life problems in context using probability distributions. | |
|  | | **(1)** | |  | |  | |
| (3 marks) | | | | | | | | | |
| Notes | | | | | | | | | |

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| H8 | Scheme | Marks | AOs | Pearson Progression Step and Progress descriptor |
| **a** | A statistic that is calculated from sample data in order to test a hypothesis about a population. | **B1** | 1.2 | 5th  Understand the language of hypothesis testing. |
|  | **(1)** |  |  |
| **b** | H0 : = 0, H1 : ≠ 0  *p-*value < 0.05  There is evidence to reject H0  There is evidence (at 5% level) of a correlation between the daily mean temperature and daily mean pressure. | **B1**  **M1**  **A1** | 2.5  1.1b  2.2b | 6th  Carry out a hypothesis test for zero correlation. |
|  | **(3)** |  |  |
| **c** | Two sensible interpretations or observations. For example,  Two distinct distributions  Similar gradients of regression line.  Similar correlations for each season.  Lower temperaure in autumn.  More spread for the daily mean pressure in autumn. | **B2** | 3.2a | 4th  Use the principles of bivariate data analysis in the context of the large data set. |
|  | **(2)** |  |  |
| (6 marks) | | | | |
| **Notes** | | | | |

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| H9 | Scheme | Marks | AOs | Pearson Progression Step and Progress descriptor |
| **a** | Use of Newton’s second law. | **M1** | 3.1b | 8th  Understand general kinematics problems with vectors. |
|  | **M1** | 1.1b |
| (m s−2) | **A1** | 1.1b |
|  | **(3)** |  |  |
| **b** | Integrate **a** | **M1** | 1.1a | 8th  Solve general kinematics problems using calculus of vectors. |
| (m s−1) | **A1** | 1.1b |
| because initially at rest. | **A1** | 2.4 |
| Integrate **v** | **M1** | 1.1a |
| (m) | **A1** | 1.1b |
| **c** = 0 because initially at origin. | **A1** | 2.4 |
|  | **(6)** |  |  |
| **c** | Subsititute *t* = 1 | **M1** | 1.1a | 6th  Understand general kinematics problems with vectors. |
|  | **M1** | 1.1b |
| (m s−1) | **A1** | 1.1b |
|  |  | **(3)** |  |
| (12 marks) | | | | |
| Notes | | | | |

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| H11 | 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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| H10 | Scheme | Marks | AOs | Pearson Progression Step and Progress descriptor |
| **a** | Use of suvat equations | **M1** | 1.1a | 8th  Derive formulae for projectile motion. |
|  | **A1** | 1.1b |
|  | **M1** | 1.1b |
|  | **A1** | 1.1b |
| Substitute *x* = 10 and *y* = −5 | **M1** | 1.1a |
| Solve *x* equation for *t* | **M1** | 1.1b |
|  | **A1** | 1.1b |
| Substitute into *y* equation | **M1** | 1.1a |
|  | **A1** | 2.1 |
| Use of | **M1** | 2.1 |
| legitimately obtained | **A1** | 2.1 |
|  | **(11)** |  |  |
| **b** | Solve for tan *θ* | **M1** | 1.1a | 8th  Solve problems in unfamiliar contexts using the concepts of friction and motion. |
| tan *θ* = 0 or tan *θ* = 2 | **A1** | 1.1b |
| *θ* = 0 or 63.43…(°) (accept awrt 63) | **A1** | 1.1b |
|  | **(3)** |  |  |
| (14 marks) | | | | |
| **Notes** | | | | |

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| H12 | Scheme | Marks | AOs | Pearson Progression Step and Progress descriptor |
| **a** | Integrate *a* w.r.t. *t* | **M1** | 1.1a | 5th  Use integration to determine functions for velocity and/or displacement. |
|  | **A1** | 1.1b |
|  | **(2)** |  |  |
| **b** |  | **M1** | 3.1a | 7th  Solve general kinematics problems in less familiar contexts. |
|  | **A1** | 1.1b |
|  | **A1** | 2.4 |
| Breaking the speed limit between 20 and 40 minutes. | **A1** | 3.2a |
|  | **(4)** |  |  |
| **c** | Integrate *v* w.r.t. *t* | **M1** | 1.1a | 5th  Use integration to determine functions for velocity and/or displacement. |
|  | **A1** | 1.1b |
| When | **A1** | 3.1b |
| Average speed = | **M1** | 1.1b |
| 30 km h−1 | **A1** | 1.1b |
|  | **(5)** |  |  |
| (11 marks) | | | | |
| Notes | | | | |