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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 | 5thCalculate 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 |  | M1M1A1 | 1.1a1.1b1.1b | 6thUnderstand exponential models in bivariate data. |
|  | (3) |  |  |
| b | *b* is the proportional rate at which the temperature changes per minute. | A1 | 3.2a | 6thUnderstand exponential models in bivariate data. |
|  | (1) |  |  |
| c | Extrapolation/out of the range of the data. | A1 | 2.4 | 4thUnderstand the concepts of interpolation and extrapolation. |
|  | (1) |  |  |
| (5 marks) |
| **Notes** |
| H3 | Scheme | Marks | AOs | Pearson Progression Step and Progress descriptor |
| a | = | M1 | 1.1b | 2ndCalculate probabilities from relative frequency tables and real data. |
|  = 0.4 | A1 | 1.1b |
|  | (2) |  |  |
| b | = | M1 | 3.1a | 4thUnderstand set notation. |
|  = 0.864 | A1 | 1.1b |
|  | (2) |  |  |
| c | P(*S**A*) == 0.136 ≠ P(*S*) × P(*A*) ==0.163… | **M1** | 2.1 | 4thUnderstand 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 | 3rdUnderstand 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 | 5thCalculate 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 | 5thCalculate 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 | 5thCalculate 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 : $ρ$ = 0, H1 : $ρ$ < 0Critical 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** | 2.51.1a2.2b | 6thCarry 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 | 7thInterpret 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 | 5thUnderstand 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 | 5thUnderstand 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 | 5thSelect and critique a sampling technique in a given context. |
|  | **(1)** |  |  |
| **d** | H0: *p* = 0.55 H1: *p* > 0.55 | **B1** | 2.5 | 5thCarry 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= 0.0159Reject H0, it is in the critical region.There is evidence to support the manufacturer's claim. | **B1****M1****M1****A1****A1****M1****A1** | 3.33.41.1b1.1b1.1b1.1b2.2b | 7thInterpret 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 | 5thCalculate 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 | 8thSolve 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 | 5thUnderstand the language of hypothesis testing. |
|  | **(1)** |  |  |
| **b** | H0 : $ρ$ = 0, H1 : $ρ$ ≠ 0*p-*value < 0.05There is evidence to reject H0There is evidence (at 5% level) of a correlation between the daily mean temperature and daily mean pressure. | **B1****M1****A1** | 2.51.1b2.2b | 6thCarry out a hypothesis test for zero correlation. |
|  | **(3)** |  |  |
| **c** | Two sensible interpretations or observations. For example,Two distinct distributionsSimilar 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 | 4thUse 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 | 8thUnderstand general kinematics problems with vectors. |
|  | **M1** | 1.1b |
| (m s−2) | **A1** | 1.1b |
|  | **(3)** |  |  |
| **b** | Integrate **a** | **M1** | 1.1a | 8thSolve 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 | 6thUnderstand 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 | 5thFind 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 | 5thSolve 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 | 5thSolve 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 | 8thDerive 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 | 8thSolve 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 | 5thUse integration to determine functions for velocity and/or displacement. |
|  | **A1** | 1.1b |
|  | **(2)** |  |  |
| **b** |  | **M1** | 3.1a | 7thSolve 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 | 5thUse 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 |