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| Q | Scheme | Marks | AOs | Pearson Progression Step and Progress descriptor | |
| **1a** | *k*(16 – 9) + *k*(25 – 9) + *k*(36 – 9) (or 7*k* + 16*k* + 27*k*). | **M1** | 2.1 | 4th  Model simple discrete random variables as probability distributions. | |
| = 1 | **M1** | 1.1b |
| (answer given). | **A1\*** | 1.1b |
|  | **(3)** |  |  | |
| **1b** | |  |  |  |  | | --- | --- | --- | --- | | *x* | 4 | 5 | 6 | | P(*X* = *x*) |  |  |  |   Note: decimal values are 0.14, 0.32, 0.54 respectively. | **B1**  **B1** | 2.5  1.1b | 4th  Calculate probabilities from discrete distributions. |
|  | **(2)** |  |  |
| (5 marks) | | | | |
| Notes  1b  Ignore any extra columns with 0 probability. Otherwise –1 for each. If 4, 5 or 6 missing B0B0. | | | | |

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| Q | Scheme | Marks | AOs | Pearson Progression Step and Progress descriptor |
| **2a** | 0.15 + 0.15 + ** + ** + 0.1 + 0.1 = 2** + 0.5 = 1 | **M1** | 1.1b | 4th  Calculate probabilities from discrete distributions. |
| ** = 0.25 | **A1** | 1.1b |
|  | **(2)** |  |  |
| **2b** | P(–1 ⩽*X* < 2) = P(–1) + P(0) + P(1) = 0.6 | **B1** | 1.1b | 4th  Calculate probabilities from discrete distributions. |
|  | **(1)** |  |  |
| **2c** | P(*X*  > −2.3) = P(−2) + P(−1) + P(0) + P(1) + P(2) = 0.85 | **B1** | 1.1b | 4th  Calculate probabilities from discrete distributions. |
|  | **(1)** |  |  |
| (4 marks) | | | | |
| **Notes** | | | | |

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| **Q** | **Scheme** | **Marks** | **AOs** | **Pearson Progression Step and Progress descriptor** |
| **3a** | 2*k* + *k* + 0 + *k* = 1 | **M1** | 2.1 | 4th  Calculate probabilities from discrete distributions. |
| 4*k* = 1, so *k* = 0.25 (answer given). | **A1\*** | 1.1b |
|  | **(2)** |  |  |
| **3b** | P(*X*1 + *X*2 = 5) = P(*X*1 = 3 and *X*2 = 2) + P(*X*1 = 2 and *X*2 = 3)  = 0 + 0 = 0 (answer given). | **B1\*** | 2.4 | 4th  Calculate probabilities from discrete distributions. |
|  | **(1)** |  |  |
| **3c** | |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | | *x*1 + *x*2 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | | P(*X*1 + *X*2) | 0.25 | 0.25 | 0.0625 | 0.25 | 0.125 | 0 | 0.0625 | | **M1**  **A1**  **A1** | 2.5  1.1b  1.1b | 4th  Calculate probabilities from discrete distributions. |
|  | **(3)** |  |  |
| **3d** | P(1.3 ⩽ *X*1 + *X*2 ⩽ 3.2) = P(*X*1 + *X*2 = 2) + P(*X*1 + *X*2 = 3) | **M1** | 3.4 | 4th  Calculate probabilities from discrete distributions. |
| = 0.0625 + 0.25 = 0.3125 or | **A1ft** | 1.1b |
|  | **(2)** |  |  |
| **(8 marks)** | | | | |
| **Notes**  **3b**  Must show that 5 can only be obtained from 2 and 3 or 3 and 2, and so must use P(*X* = 2) = 0 but condone explanation in words.  **3c**  M1 for correct set of values for *X*1 + *X*2. Condone omission of 5 column.  A1 for correct probabilities for 0, 2 and 6. A1 for others. Equivalent fractions are | | | | |

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| **Q** | **Scheme** | **Marks** | **AOs** | **Pearson Progression Step and Progress descriptor** |
| **4a** | Let *X* be the random variable the number of games Amir loses.  *X* ~ B(9, 0.2)  P(*X* = 3) = 0.17616… = 0.176 to 3 sf from calculator | **B1**  **B1** | 3.3  1.1b | 5th  Calculate binomial probabilities. |
|  | **(2)** |  |  |
| **4b** |  | **M1** | 3.4 | 6th  Use statistical tables and calculators to find cumulative binomial probabilities. |
| = awrt 0.980 from calculator | **A1** | 1.1b |
|  | **(2)** |  |  |
| **(4 marks)** | | | | |
| **Notes**  **4a**  = 0.9144 – 0.7382  or  or  or  **4b**  0.98 is M1A0 | | | | |

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| **Q** | **Scheme** | **Marks** | **AOs** | **Pearson Progression Step and Progress descriptor** |
| **5a** | *X* ~ *B*(20, 0.05)  B1 for binomial  B1 for 20 and 0.05 | **B1**  **B1** | 3.1b  3.1b | 5th  Understand the binomial distribution (and its notation) and its use as a model. |
|  | **(2)** |  |  |
| **5b** | P(*X* = 0) = 0.358 (awrt) | **B1**  **A1** | 3.4  1.1b | 5th  Calculate binomial probabilities. |
|  | **(2)** |  |  |
| **5c** | P(*X* > 4) = 1 –  = 1 – 0.9974 | **M1** | 3.4 | 6th  Use statistical tables and calculators to find cumulative binomial probabilities. |
| = 0.0026 (2 s.f.) (answer given) | **A1\*** | 1.1b |
|  | **(2)** |  |  |
| **(6 marks)** | | | | |
| **Notes**  **5b**  P(*X* = 0) = 0.9520 | | | | |

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| **Q** | **Scheme** | **Marks** | **AOs** | **Pearson Progression Step and Progress descriptor** |
| **6a** | *X* ~ B(15, 0.5)  B1 for binomial  B1 for 15 and 0.5 | **B1**  **B1** | 3.1b  3.1b | 5th  Understand the binomial distribution (and its notation) and its use as a model. |
|  | **(2)** |  |  |
| **6bi** | from calculator P(*X* = 8) = 0.19638… | **M1**  **A1** | 3.4  1.1b | 5th  Calculate binomial probabilities. |
|  | **(2)** |  |  |
| **6bii** | P(*X* 4) = 1 – P(*X* 3)  = 1 – 0.0176 | **M1** | 3.4 | 6th  Use statistical tables and calculators to find cumulative binomial probabilities. |
| = awrt 0.982 or | **A1** | 1.1b |
|  | **(2)** |  |  |
| **(6 marks)** | | | | |
| **Notes**  **6bi**  P(*X* = 8) = P(*X*  8) – P(*X*  7) = 0.6964 – 0.5  or  or  or  = awrt 0.196 or | | | | |

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| **Q** | **Scheme** | **Marks** | **AOs** | **Pearson Progression Step and Progress descriptor** |
| **7a** | Binomial (distribution). | **B1** | 1.2 | 5th  Understand the binomial distribution (and its notation) and its use as a model. |
| Each plate is either blue or not blue, independently of each other, with constant probability and there is a fixed number of them. | **B1** | 2.4 |
|  | **(2)** |  |  |
| **7b** | *X* ~ B(10, 0.06) (could be seen in part a) | **B1** | 2.5 | 5th  Calculate binomial probabilities. |
| P(*X* > 2) = 1 – P(*X*   = 1 – 0.981162163… from calculator | **M1** | 3.4 |
| = awrt0.0188378… | **A1** | 1.1b |
|  | **(3)** |  |  |
| **(5 marks)** | | | | |
| **Notes**  **7a**  Ignore any parameter values given for the first B1. For second B1 all four points must be made with some context. | | | | |

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| **Q** | **Scheme** | **Marks** | **AOs** | **Pearson Progression Step and Progress descriptor** |
| **8a** | There is a fixed number of trials. | **B1** | 1.2 | 5th  Understand the binomial distribution (and its notation) and its use as a model. |
| Each trial results in 1 of 2 outcomes, ‘success’ and ‘failure’. | **B1** | 1.2 |
| Probability of success on each trial is the same. | **B1** | 1.2 |
| The trials are independent. | **B1** | 1.2 |
|  | **(4)** |  |  |
| **8bi** | P(*X* = 5) =; P(*X*  5) =  (either may be implied in either part) | **B1**  **B1** | 3.3  1.1b | 5th  Calculate binomial probabilities. |
| Idea of five failures followed by a success (or 0 successes out of five and then a success) seen or implied. | **M1** | 3.4 |
| P(5 on sixth throw) = | **M1** | 1.1b |
| = awrt 0.0531 | **A1** | 1.1b |
|  | **(5)** |  |  |
| **8bii** | – or – seen or implied. | **M1** | 3.3 | 5th  Calculate binomial probabilities. |
| P(*X* = 3) = 0.24285… from calculator | **M1**  **A1** | 1.1b  1.1b |
|  | **(3)** |  |  |
| **(12 marks)** | | | | |
| **Notes**  **8bii**  P(exactly 3 fives in first eight throws) =  o.e. | | | | |