| **Question** | **Scheme** | **Marks** |
| --- | --- | --- |
| **1(a)** |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| *x* | 1 | 0 | 1 | 2 |
|  P(*X* = *x*) | 4*k* | *k* | 0 | *k* |

 | M1 |
| 4*k* + *k* + (0) + *k* = 1 (Allow verify approach) | A1 |
|   **(\*)** | A1cso |
|  |  | **(3)** |
| **1(b)** | [E(*X*)] = 4*k* (+ 0 + 0) + 2*k* or  2*k* or   | M1 |
| =  | A1 |
|  |  | **(2)** |
| **1(c)** | (o.e.) | M1 |
|  =  **(\*)** | A1cso |
|  |  |  | **(2)** |
| **1(d)** | [Var(*X*) ]=  | *Y* = 1 – 3*X* : 4 1 2 5Prob: 4*k* *k* 0 *k*   And E(*Y*) = 12*k* | M1 |
| VarVar(*X*) or 9Var(*X*) |  | M1 |
|  = 11 | A1 cao |
|  |  | **(3)** |
|  |  | **(10 marks)** |
| **2(a)** | *p* + *q* + 0.2 + 0.3 + *p* = 1 or 2*p* + *q* = 0.5 (oe) | B1 |
|  |  | **(1)** |
| **2(b)** | [E(*X*) = ] – 2*p* – *q* + × 0.2 + × 0.3 + 2*p* [= 0.4] or – *q* + 0.1 + 0.45 [= 0.4] | M1A1 |
| ***q* = 0.15** | A1 |
|  |  | **(3)** |
| **2(c)** | 2*p* + “0.15” = 0.5 (oe) | M1 |
| ***p* = 0.175** | A1 |
|  |  | **(2)** |
| **2(d)** | [Var(*X*) = ] 2.275 – (0.4)2 | M1 |
| **= 2.115** | A1 |
|  |  | **(2)** |
| **2(e)** |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| *r* |  | – 1 | 2 |  |  |
| P(*R* = *r*) | *p* | *q* | 0.2 | 0.3 | *p* |

 | M1 |
| E(*R*) =  *p* – *q*+ 0.4 + 0.2 + *p* | dM1 |
| = 0.6 – *q* = **0.45** (or ) | A1ft |
|  |  | **(3)** |
| **2f(i)** | *S* > *R* when *x* = 1.5 and 2 | M1 |
| P(Sarah wins) = 0.3 + *p* = **0.475** (or ) | A1ft |
| **2f(ii)** | *R* > *S* when *x* = – 2 and  | M1 |
| P(Rebecca wins) = 0.2 + *p* = **0.375** (or ) | A1ft |
|  |  | **(3)** |
|  |  | **(15 marks)** |
| **3(a)** | To score 15 points, 2 correct and 1 not correct or  = 0.432 **(\*)** | M1A1cso |
|  |  | **(2)** |
| **3(b)** | 1 – (0.216 + 0.432 + 0.064) = **0.288** or30.6(0.4)2 | B1 |
|  |  | **(1)** |
| **3(c)** | [(30, 0), (0, 30) or (15, 15)]   **awrt 0.311** | M1 A1ftA1 |
|  |  | **(3)** |
| **3(d)** | = 12 **12** (only) | M1A1 |
|  |  | **(2)** |
| **3(e)** | (= 306) **162** | M1M1 A1 |
|  |  | **(3)** |
| **3(f)** | Let *Y* = number of points scored in bonus round

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| [ *y* ] | 60 | 35 | 10 | –15  |
| [ P(*Y* = *y*) ] | 0.216 | 0.432 | 0.288 | 0.064 |

 | M1 |
|  |  = **30**  | dM1A1 |
|  |  | **(3)** |
|  |  | **(14 marks)** |
| **4(a)** | *k* + 2*k* + 3*k* + 4*k* = 1 or 10*k* = 1*k* = 0.1 (\*) [allow verification with a comment e.g. “so *k* = 0.1”] | B1cso |
|  |  | **(1)** |
| **4(b)** | E(*X*) = 1 × 0.1 + 2 × 0.2 + 3 × 0.3 + 4 × 0.4 = 3 | M1A1 |
|  |  | **(2)** |
| **4(c)** | E(*X*2) = 1 × 0.1 + 4 × 0.2 + 9 × 0.3 + 16 × 0.4 = 10 | M1A1 |
|  |  | **(2)** |
| **4(d)** | Var(*X*) = 10 – 9 (= 1) | M |
|  | Var(2 – 5*X*) = 52 Var(*X*) = 25 | M1A1 |
|  |  | **(3)** |
| **4(e)** | P(1, 3) + P(2, 2) = 2 × 0.1 × 0.3 + 0.2 × 0.2 = 0.1 (\*) | M1A1cso |
|  |  | **(2)** |
| **4(f)** |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| *X*1 + *X*2 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| *p* | 0.01 | 0.04 | 0.1 | **0.2** | 0.25 | 0.24 | **0.16** |

 | B1B1 |
|  |  | **(2)** |
| **4(g)** | P(2) + P(3) = 0.05 | M1A1 |
|  |  | **(2)** |
|  |  | **(14 marks)** |
| **5(a)** |

|  |  |  |  |
| --- | --- | --- | --- |
| *b* | 1 | 3 | 5Also allow *b* values 1,1,3,3,5,5 and probabilities all   |
| P(*B* = *b*) |  |  |  |

 | B1B1 |
|  |  | **(2)** |
| **5(b)** | Discrete Uniform {distribution} | B1 |
|  |  | **(1)** |
| **5(c)** | [E(*B*) =] 3 (by symmetry) | B1 |
|  |  | **(1)** |
| **5(d)** | [E(*R*) = ]  | M1 |
|  = **3** | A1 |
|  |  | **(2)** |
| **5(e)** |   | M1 |
| [Var( *R*) =] (or any exact equivalent. NB 2.33 is A0) | dM1A1 |
|  |  | **(3)** |
| **5(f)** | Coin lands on **2**, choose **blue** die; coin lands on **5** choose **red** die | B2/1/0 |
| P(Avisha wins) =  | M1 |
|  =  (allow awrt 0.417) | A1  |
|  |  | **(4)** |
|  |  | **(13 marks)** |
| **6(a)** | E(*S*) =  = [0.2 + 0.2 + 1.2 + 1.0] | M1 |
|   **2.6** | A1 |
|  |  | **(2)** |
| **6(b)** |  or 0.2 + 0.4 + 4.8 + 5 | M1 |
|  **10.4 (\*)** | A1cso |
|  |  | **(2)** |
| **6(c)** | Var(*S*) =  | M1 |
|  **3.64** or  (o.e.) | A1 |
|  |  | **(2)** |
| **6(d)(i)** | 5E(*S*) – 3 = 5”2.6” – 3 , = **10** | M1A1 |
| **6(d)(ii)** | = 253.64, = **91** | M1A1 |
|  |  | **(4)** |
| **6(e)** |  or *S* > 1.5, so need P(*S* > 2) | M1A1 |
|  P(*S* > 2) = **0.6** | A1 |
|  |  | **(3)** |
| **6(f)** | = 0.16 **(\*)** | M1A1cso |
|  |  | **(2)** |
| **6(g)** |  |  |
| Full method – all cases listed | M1 |
| all correct products | A1 |
|  |  = **0.57** | A1 |
|  |  | **(3)** |
|  |  | **(18 marks)** |
| **7(a)** |  =  or 0.1 | M1A1 |
|  |  | **(2)** |
| **7(b)** | E(*S*) = , (or equiv. in decimals) = 2.55 | M1A1 |
|  |  | **(2)** |
| **7(c)** | E  or 0.25 + 1 + 3.2 + 5 = 9.45 (\*) | M1A1cso |
|  |  | **(2)** |
| **7(d)** | Var(*S*) = 9.45 , = 2.9475 or  (accept awrt 2.95) | M1A1 |
|  |  | **(2)** |
| **7(e)** | P(5 and 5 ) = , =  | M1A1 |
|  |  | **(2)** |
| **7(f)** | P(4, 4, 2) =  ( = 0.03 or ) | M1M1 |
| P(4, 4, 4)  ( = 0.008 or ) | B1 |
|  | P(Tom wins in 3 spins) = 0.038 | A1 |
|  |  | **(4)** |
| **7(g)** | P  = 0.064 or  | M1M1A1 |
|  |  | **(3)** |
|  |  | **(17 marks)** |

|  |  |  |  |  |  |
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|  | **Source paper** | **Question number** | **New spec references** | **Question description** | **New AOs** |
| 1 | S1 2012 | 1 | FS1 1.1 | Discrete random variables | 1.1b, 2.1, 3.1a, 3.4 |
| 2 | S1 2016 | 2 | FS1 1.1 | Discrete random variables | 1.1b, 3.1b, 3.4 |
| 3 | S1 2015 | 5 | FS1 1.1 | Discrete random variables | 1.1b, 2.1, 3.3, 3.4 |
| 4 | S1 Jan 2011 | 6 | FS1 1.1 | Discrete random variables | 1.1b, 2.1, 3.1a |
| 5 | S1 Jan 2013 | 6 | FS1 1.1 | Discrete probability distributions | 1.1b, 1.2, 2.4, 3.1b, 3.4 |
| 6 | S1 2013R | 7 | FS1 1.1 | Discrete probability distributions | 1.1b, 1.2, 2.1, 3.1a, 3.4 |
| 7 | S1 2011 | 8 | FS1 1.1 | Discrete probability distributions | 1.1b, 1.2, 2.1, 3.4 |