S1

Solutions and Mark Scheme

Final Version

1. (a) $P(2Y) = \frac{3}{10} \times \frac{2}{9}$ or $\frac{\binom{3}{2}}{\binom{10}{2}} = \frac{1}{15}$ M1A1

(b) $P(2B) = \frac{2}{10} \times \frac{1}{9}$ or $\frac{\binom{2}{2}}{\binom{10}{2}} = (\frac{1}{45})$ A1

$P(2G) = \frac{4}{10} \times \frac{3}{9}$ or $\frac{\binom{4}{2}}{\binom{10}{2}} = (\frac{2}{15})$ A1

P(Same colour) = Sum of above probabilities M1

$= \frac{2}{9}$ A1

[FT one arithmetic slip]

(c) $P(0G) = \frac{6}{10} \times \frac{5}{9}$ or $\frac{\binom{6}{2}}{\binom{10}{2}} = \frac{1}{3}$ M1A1

2. (a) $P(A \cap B) = P(A) + P(B) - P(A \cup B)$ M1
$= 0.2 + 0.4 - 0.52$ A1
$= 0.08$ A1
$P(A)P(B) = 0.08$ A1
Independent because $P(A \cap B) = P(A)P(B)$ A1

(b) P(Exactly one event) = $P(A \cup B) - P(A \cap B)$ or $P(A')P(B) + P(A)P(B')$ M1
$= 0.44$ A1

(c) Reqd prob = $\frac{0.2 \times 0.6}{0.44}$ B1B1
$= 3/11\ (0.273)$ B1
[FT their answer to (b)]

3. (a) Mean = $np = 10$, Variance = $npq = 9$ B1B1
Dividing, M1
$q = 0.9$ so $p = 0.1$ A1
$n = 10/0.1 = 100$ A1
[Sp case : Award B1B0M1A1A0 for taking variance equal to 3 and getting $p = 0.7$]

(b) Y is B(380,0.016) which is approx P(6.08) si B1
$P(Y < 3) = e^{-6.08}(1 + 6.08 + 6.08^2/2)$ M1A1
$= 0.058$ A1
[Award just M1 for $P(Y \leq 3)$; award M0 for using tables]

4. (a) [0,0.4] [Accept (0,0.4)] B1B1

(b) (i) $E(X) = 0.1 \times 2 + 0.2 \times 3 + 0.3 \times 4 + 5\lambda + 6(0.4 - \lambda)$ M1
$= 4.4 - \lambda$ A1
Putting this equal to 4.25 gives $\lambda = 0.15$ A1
[FT from their expression for E(X) if sensible value]

(ii) $E(X^2) = 0.1 \times 4 + 0.2 \times 9 + 0.3 \times 16 + 0.15 \times 25 + 0.25 \times 36$ (19.75)
M1A1
$\text{Var}(X) = 19.75 - 4.25^2 = 1.6875$ A1
[FT their value of λ if sensible answer]

5. (a) Number of seeds germinating, X, is B(20,0.8) si B1

(i) Prob = $\binom{20}{15} \times 0.8^{15} \times 0.2^5 = 0.1746$ M1A1

(ii) Number of seeds failing to germinate, Y, is B(20,0.2) si B1
We require $P(X \geq 15) = P(Y \leq 5) = 0.8042$ or $1 - 0.1958$ M1A1

(b) Prob that they all germinate = 0.8^n B1
Solving $0.8^n = 0.10737$ by any valid method M1
$n = 10$ A1
[Award 3 marks for $n = 10$ using tables]

6. (a) P(No heads) = $\frac{1}{3} \times \frac{1}{2} + \frac{1}{3} \times \frac{1}{4} + \frac{1}{3} \times \frac{1}{8}$ M1A1A1A1

$= \frac{7}{24}$ A1

(b) P(2 | no heads) = $\frac{1/12}{7/24}$ B1B1
[FT their denominator from (a)]
$= \frac{2}{7}$ cao B1

7. (a) (i) Prob = 0.1205 or $1 - 0.8795$ M1A1
[Award M1A0 for use of adjacent row or column]

(ii) Prob = $e^{-1.2} = 0.301$ M1A1
[For candidates using tables award M0 for wrong row,M1A0 if adjacent column used]

(b) Required prob = $\frac{0.1205}{1 - 0.301}$ B1B1
$= 0.172$ cao B1
[FT numerator and denominator from (a)]

(c) Reqd prob = $0.301 \times 0.301 \times (1 - 0.301) = 0.063$ M1A1
[FT from (a)(ii) ; Award M1A0 for $0.301 \times 0.301 \times 1.2e^{-1.2}(0.361)$]

8. (a) (i) Prob = F(2.5) – F(2) M1

$= \frac{1}{10}\left(2.5^2 + 2.5 - 2 - 2^2 - 2 + 2\right)$ A1

= 0.275 A1

(ii) $F(m) = 0.5$ leading to M1

$m^2 + m - 7 = 0$ A1

$m = \frac{-1 \pm \sqrt{29}}{2}$ m1

= 2.19 A1

(b) (i) $f(x) = F'(x)$ M1

$= \frac{1}{10}(2x + 1)$ A1

(ii) $f(4) = 0$ B1

(iii) $E(X) = \frac{1}{10}\int_1^3 x(2x+1)\mathrm{d}x$ M1

$= \frac{1}{10}\int_1^3 (2x^2 + x)\mathrm{d}x$ A1

$= \frac{1}{10}\left[\frac{2x^3}{3} + \frac{x^2}{2}\right]_1^3$ A1

[Limits need not be seen until line 3 ; FT their $f(x)$ as far as possible]

= 2.13 cao A1