S1

1. (a) Prob = $\frac{5}{9}\times\frac{3}{8}\times\frac{1}{7}\times 6$ or $\binom{5}{1}\times\binom{3}{1}\times\binom{1}{1}\div\binom{9}{3}$ M1A1

$= \frac{5}{28}$ (0.179) A1

(b) Prob = $\frac{6}{9}\times\frac{5}{8}\times\frac{4}{7}$ or $\binom{6}{3}\div\binom{9}{3} = \frac{5}{21}$ (0.238) M1A1

(c) P(All red) = $\frac{5}{9}\times\frac{4}{8}\times\frac{3}{7}$ or $\binom{5}{3}\div\binom{9}{3}\left(\frac{5}{42}\right)$ B1

P(All green) = $\frac{3}{9}\times\frac{2}{8}\times\frac{1}{7}$ or $\binom{3}{3}\div\binom{9}{3}\left(\frac{1}{84}\right)$ B1

P(Same colour) = $\frac{5}{42}+\frac{1}{84} = \frac{11}{84}$ (0.131) B1

[FT their two probs found in (c)]

2. (a) $E(Y) = 4a + b = 16$ M1A1

$\text{Var}(Y) = 4a^2 = 16$ M1A1

$a = 2$ cao A1

$b = 8$ cao A1

(b) Because Y cannot take all appropriate values, eg 0. B1

3. (a) $P(A \cup B) = 1 - P(A' \cap B')$ M1

$= 0.55$ A1

Not mutually exclusive because $P(A) + P(B) \neq P(A \cup B)$ A1

(b) EITHER $P(A \cap B) = P(A) + P(B) - P(A \cup B)$ M1

$= 0.1$ A1

Use of $P(A \cap B) = P(A) \times P(B) = 0.1$ m1

A and B are independent. A1

OR

$P(A') = 0.75, P(B') = 0.6$ M1A1

Use of $P(A' \cap B') = P(A') \times P(B') = 0.45$ m1

A and B are independent. A1

[Accept correct use of these arguments in reverse]

4. (a)(i) X is Poi(12). si B1

$P(X = 10) = e^{-12} \times \frac{12^{10}}{10!}$ M1

$= 0.105$ (FT their mean] A1

[Award M0 if answer only given]

(ii) Y is Poi(6). si B1

$P(Y > 5) = 1 - 0.4457$ M1

$= 0.5543$ (FT their mean] A1

(b) $p_0 = e^{-0.2t} = 0.03$ M1A1

$-0.2t \log e = \log 0.03$ m1

$t = 17.5$ cao A1

5. (a) $k(1+4+9+16)=1$ M1A1

$k = 1/30$

(b) $E(X)=\frac{1}{30}(1\times1+2\times4+3\times9+4\times16)$ M1

$= \frac{10}{3}$ A1

$E(X^2)=\frac{1}{30}(1\times1+4\times4+9\times9+16\times16)$

$= \frac{59}{5}$ B1

$\text{Var}(X) = \frac{59}{5}-\left(\frac{10}{3}\right)^2$ M1

$= \frac{31}{45}$ (0.688) cao A1

(c) Possibilities are 1,3 ; 3,1 ; 2,2 si B1

[Accept 1,3 ; 2,2]

Prob = $\frac{1}{30^2}(1\times9+9\times1+4\times4)$ M1A1

= 0.038 A1

6. (a) If the fair coin is chosen, P(3 heads = 1/8) si B1

P(3 heads) = $\frac{1}{3}\times1+\frac{2}{3}\times\frac{1}{8}$ M1A1

$= \frac{5}{12}$ A1

(b) Reqd prob = $\frac{1/3}{5/12}$ (FT the denominator from (a)) B1B1

$= \frac{4}{5}$ cao B1

(c) P(Head) = $\frac{4}{5}\times1+\frac{1}{5}\times\frac{1}{2}=\frac{9}{10}$ M1A1

[FT their probability from (b)]

7. (a) Independent trials. B1

Constant probability of success. B1

(b)(i) $P(X = 8) = \binom{20}{8}\times0.4^8\times0.6^{12}$ M1

= 0.180 A1

[or 0.5956 – 0.4159 or 0.5841 – 0.4044]

(ii) $P(6\le X\le10) = 0.8725 - 0.1256$ or $0.8744 - 0.1275$ B1B1

= 0.747 cao B1

[Award M0 if answer only given in (i) or (ii)]

(c) The number of hits, *Y*, is approx Poi(4). si B1

$P(Y<5) = 0.6288$ M1A1

8. (a)(i) $E(X) = \int_0^1 12x.x^2(1-x)\,dx$ (No limits required here) M1

$= \left[\frac{12x^4}{4} - \frac{12x^5}{5}\right]_0^1$ A1

$= 0.6$ A1

(ii) $E(1/X) = \int_0^1 \frac{12}{x}x^2(1-x)\,dx$ (No limits required here) M1

$= \left[\frac{12x^2}{2} - \frac{12x^3}{3}\right]_0^1$ A1

$= 2$ A1

(iii) EITHER

$P(0.2 \le X \le 0.5) = \int_{0.2}^{0.5} 12x^2(1-x)dx$ M1

$= \left[\frac{12x^3}{3} - \frac{12x^4}{4}\right]_{0.2}^{0.5}$ A1

$= 0.285$ A1

OR

$F(x) = 4x^3 - 3x^4$ B1

Required prob = $F(0.5) - F(0.2)$ M1

$= 0.285$ A1

(b) $a + b = 0$ M1

$2a + 4b = 1$ A1

[Award M1A0 for 1 correct equation]

Solving,

$a = -½$, $b = ½$ A1A1