

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) $E(X) = \frac{1}{30}(1 \times 1 + 2 \times 4 + 3 \times 9 + 4 \times 16)$ M1
 $= \frac{10}{3}$ A1
 $E(X^2) = \frac{1}{30}(1 \times 1 + 4 \times 4 + 9 \times 9 + 16 \times 16)$
 $= \frac{59}{5}$ B1
 $\text{Var}(X) = \frac{59}{5} - \left(\frac{10}{3}\right)^2$ M1
 $= \frac{31}{45} \quad (0.688) \quad \text{cao}$ A1
- (c) Possibilities are 1,3 ; 3,1 ; 2,2 si B1
[Accept 1,3 ; 2,2]
 $\text{Prob} = \frac{1}{30^2}(1 \times 9 + 9 \times 1 + 4 \times 4)$ M1A1
 $= 0.038$ A1
6. (a) If the fair coin is chosen, $P(3 \text{ heads} = 1/8)$ si B1
 $P(3 \text{ heads}) = \frac{1}{3} \times 1 + \frac{2}{3} \times \frac{1}{8}$ M1A1
 $= \frac{5}{12}$ A1
- (b) $\text{Reqd prob} = \frac{1/3}{5/12}$ (FT the denominator from (a)) B1B1
 $= \frac{4}{5} \quad \text{cao}$ B1
- (c) $P(\text{Head}) = \frac{4}{5} \times 1 + \frac{1}{5} \times \frac{1}{2} = \frac{9}{10}$ M1A1
[FT their probability from (b)]
7. (a) Independent trials. B1
Constant probability of success. B1
- (b)(i) $P(X = 8) = \binom{20}{8} \times 0.4^8 \times 0.6^{12}$ M1
 $= 0.180$ A1
[or $0.5956 - 0.4159$ or $0.5841 - 0.4044$]
- (ii) $P(6 \leq X \leq 10) = 0.8725 - 0.1256$ or $0.8744 - 0.1275$ B1B1
 $= 0.747 \quad \text{cao}$ 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) $E(X) = \int_0^1 12x \cdot x^2(1-x) dx$ (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
- $$P(0.2 \leq X \leq 0.5) = \int_{0.2}^{0.5} 12x^2(1-x) dx$$
- 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,
- $$a = -\frac{1}{2}, b = \frac{1}{2}$$
- A1A1