Discrete probability function As level Edexcel Statistics Maths Past Papers Answers

01.

Qu	Scheme	Marks	AO
a	$P(X=4)=P(X=2)$ so $P(X=4)=0.35$ $P(X=1)=P(X=3)$ and $P(X=1)+P(X=3)=1-0.7$ So x: 1, 2, 3, 4 $P(X=x)$: 0.15, 0.35, 0.15, [0.35]	M1 A1 (2)	2.1 1.1b
(b)	Let A = number of spins that land on 4 $A \sim B(60, "0.35")$	B1ft	3.3
	$[P(A>30)=]\ 1-P(A \leqslant 30)$ $= 1-0.99411\ldots$ = **awrt 0.00589**	M1 A1 (3)	3.4 1.1b
(c)	$Y-X \leqslant 4 \Rightarrow \frac{12}{X}-X \leqslant 4$ <u>or</u> $12-X^2 \leqslant 4X$ (since $X>0$) o.e.	M1	3.1a
	i.e. $0 \leqslant X^2+4X-12 \Rightarrow 0 \leqslant (X+6)(X-2)$ so $X \geqslant 2$	M1	1.1b
	$P(Y-X \leqslant 4)=P(X \geqslant 2)=0.35+0.15+0.35$ = **<u>0.85</u>**	A1 (3)	3.2a
		(8 marks)	

	Notes
(a)	M1 for using the given information to obtain $P(X=4)$ Award for statement $P(X=4)=P(X=2)$ <u>or</u> writing $P(X=4)=0.35$
	A1 for getting fully correct distribution (any form that clearly identifies probs) e.g. can be list $P(X=1)=0.15$, $P(X=3)=\ldots$etc or as a probability function $P(X=x)=\begin{cases}0.15 & x=1,3\\0.35 & x=2,4\end{cases}$ [Condone missing $P(X=2)$ as this is given in QP]
(b)	B1 for selecting a suitable model, sight of B(60, their 0.35) o.e. in words f.t. their $P(X=4)$ from part (a). Can be implied by $P(A \leqslant 30)$ = awrt 0.9941 or final answer = awrt 0.00589
	M1 for using their model and interpreting "more than half" Need to see $1-P(A \leqslant 30)$. Can be implied by awrt 0.00589 Can ignore incorrect LHS such as $P(A \geqslant 30)$
	A1 for awrt 0.00589
(c)	1st M1 for translating the prob. problem into a <u>correct</u> mathematical inequality Just an inequality in 1 variable. May be inside a probability statement.
ALT	**Table of values:** X: 1, 2, 3, 4 Y: 12, 6, 4, 3 <u>or</u> values of $Y-X = 11, 4, 1, -1$
	2nd M1 for solving the inequality leading to a range of values, allow 1 or 2 slips May be a quadratic or cubic but must lead to a set of values of X or $Y-X$
ALT	**Table or values:** They must state clearly which values are required **Both Ms can be implied by a correct answer (or correct ft of their distb'n)**
	A1 for interpreting the inequality and solving the problem i.e. 0.85 cao

02.

Question	Scheme	Marks	AOs
a	(Discrete) uniform (distribution)	B1	1.2
		(1)	
(b)	B(28, 0.2)	B1	3.3
(i)	$P(X \geq 7) = 1 - P(X \leq 6)$ [= 1 – 0.6784…]	M1	3.4
	awrt **0.322**	A1	1.1b
(ii)	$P(4 \leq X < 8) = P(X \leq 7) - P(X \leq 3)$ [= 0.818… – 0.160…]	M1	3.1b
	awrt **0.658**	A1	1.1b
		(5)	
			(6 marks)

Notes	
(a)	Continuous uniform is B0
(b)	**B1:** for identifying correct model, B(28, 0.2) allow B, bin or binomial may be implied by one correct answer or sight one correct probability i.e. awrt 0.678, awrt 0.818 or awrt 0.160 B(0.2, 28) is B0 unless it is used correctly
(i)	**M1:** Writing or using $1 - P(X \leq 6)$ or $1 - P(X < 7)$ **A1:** awrt 0.322 (correct answer only scores M1A1)
(ii)	**M1:** Writing or using $P(X \leq 7) - P(X \leq 3)$ or $P(X < 8) - P(X < 4)$ or $P(X = 4) + P(X = 5) + P(X = 6) + P(X = 7)$ Condone P(4) as $P(X = 4)$, etc. **A1:** awrt 0.658 (correct answer only scores M1A1)

03.

Question	Scheme	Marks	AOs
3	Overall method	M1	2.1
	$a+b=2c+0.5$ oe **or** $a+b=2(1-a-b)$	B1	2.2a
	$a+b+c=0.75$ oe	B1	1.1b
	$3c=0.25$ $\left[c=0.0833...\text{ or }\frac{1}{12}\right]$	M1	1.1b
	P(scoring 2,4 or 4,2 or 3,3) = $2\times"\frac{1}{12}"\times0.15+0.1^2$	M1	3.1b
	= 0.035 oe	A1cso	1.1b
		(6)	
			(6 marks)

Notes		
3	**M1:**	A fully correct method with all the required steps. For gaining 2 correct equations with at least one correct(allow if unsimplified). Attempting to solve to find a value of c followed by **correct method** to find the probability
	B1:	Forming a correct equation from the information given in the question
	B1:	A correct equation using the sum of the probabilities equals 1
	M1:	Correct method for solving 2 equations to find c Implied by $c=\frac{1}{12}$
	M1:	Recognising the ways to get a total of 6. Condone missing arrangments or repeats. Do not ignore extras written unless ignored in the calculation. May be implied by $m\times"\frac{1}{12}"\times0.15+n\times0.1^2$ where m and n are positive integers
	A1cso:	Cao 0.035, $\frac{7}{200}$ oe

04.

Qu	Scheme	Marks	AO
	Must end up with 3 of each colour or 4 of each colour	M1	3.1b
	$\underline{n=2}$ requires 1st red and 2nd green or red from **A** and green from **B**	M1	2.2a
	P(1st red and 2nd green) $= \frac{4}{9}\times\frac{1}{10}=\frac{4}{90}$ or $\frac{2}{45}$ $\quad p=\underline{\underline{\frac{2}{45}}}$	A1	1.1b
	$\underline{n=5}$ requires 1st green and 2nd yellow or green from **A** and yellow from **B**	M1	2.2a
	P(1st green and 2nd yellow) $= \frac{5}{12}\times\frac{3}{10}=\frac{15}{120}$ or $\frac{1}{8}$ $\quad p=\underline{\underline{\frac{1}{8}}}$	A1	1.1b
		(5)	
		(5 marks)	

	Notes
	1st M1 for an overall strategy realising there are 2 options. Award when evidence of both cases (3 of each colour or 4 of each colour) seen.
	2nd M1 for $n=2$ and attempt at 1st red and 2nd green May be implied by e.g. $\frac{4}{9}\times\frac{1}{9}$
	1st A1 for $p=\underline{\underline{\frac{2}{45}}}$ or exact equivalent
	3rd M1 for $n=5$ and attempt at 1st green and 2nd yellow May be implied by e.g. $\frac{5}{12}\times\frac{3}{9}$
	2nd A1 for $p=\underline{\underline{\frac{1}{8}}}$ or exact equivalent
NB	If both correct values of p are found and then added (get $\frac{61}{360}$) , deduct final A1 only (i.e. 4/5)

05.

Qu	Scheme	Mark	AO
5. (a)(i)	Require $R = 3$ and $G = 4$ so probability is $\frac{3}{4}\times\frac{1}{3}$	M1	2.1
	$= \underline{\frac{1}{4}}$ or $\underline{0.25}$	A1	1.1b
(ii)	[R must be 2 and $G = 1$ so $\frac{1}{4}\times\frac{2}{3}$] $= \underline{\frac{1}{6}}$	A1	1.1b
		(3)	
(b)	$P(X = 50) = 0.25$ must mean $R = 3$ and $G = 4$	M1	3.1a
	so $3m + 4n = 50$	A1	1.1b
	$P(X = 20) = \frac{1}{6} \Rightarrow R = 2, G = 1$ so $2m + n = 20$	A1	2.1
	Solving: $3m + 4(20 - 2m) = 50$ (o.e.)	M1	1.1b
	$\underline{\boldsymbol{m = 6}}$ and $\underline{\boldsymbol{n = 8}}$	A1	3.2a
		(5)	
		(8 marks)	

Notes

(a)(i) M1 for sight of $\frac{3}{4}\times\frac{1}{3}$ or $\frac{1}{4}\times\frac{2}{3}$ as a single product BUT allow e.g. $\frac{3}{4}\times\frac{1}{3}+\frac{1}{3}\times\frac{3}{4}$ to score M1

However if the products are later added e.g. $\frac{3}{4}\times\frac{1}{3}+\frac{1}{4}\times\frac{2}{3}$ it is M0

May be implied by one correct answer to (i) or (ii)

A1 for $\frac{1}{4}$ or 0.25 or exact equivalent (allow 25%)

(ii) A1 for $\frac{1}{6}$ or exact equivalent

(b) **For the 1st 4 marks condone incorrect labelling e.g. *R* for *m* or *G* for *n* if intention is clear**

1st M1 for identifying either set of cases ($R = 2, G = 1, X = 20$) or ($R = 3, G = 4, X = 50$)

Allow 1st M1 for $P(X = 20) = \frac{1}{4}\times\frac{2}{3}$ **or** $P(X = 50) = \frac{3}{4}\times\frac{1}{3}$ **NOT** just $P(X = 20) = \frac{1}{6}$ etc

or $\frac{1}{4}m + \frac{2}{3}n = 20$ **or** $\frac{3}{4}m + \frac{1}{3}n = 50$ and might score 2nd M1 (answer is $m = 64, n = 6$)

or $\frac{1}{4}m + \frac{2}{3}n = \frac{1}{6}$ **or** $\frac{3}{4}m + \frac{1}{3}n = \frac{1}{4}$ and might score 2nd M1 (answer is $m = \frac{4}{15}, n = \frac{3}{20}$)

or $2m + n = \frac{1}{6}$ **or** $3m + 4n = \frac{1}{4}$ and might score 2nd M1 (answer is $m = \frac{1}{12}, n = 0$)

or $2m + n = 50$ **and** $3m + 4n = 20$ and might score 2nd M1 (answer is $m = 36, n = -22$)

1st A1 for one correct equation

2nd A1 for **both** correct equations and no incorrect equations, unless they attempt to solve the correct 2 equations only

2nd M1 for attempt to solve their two linear equations in m and n (reduce to an equation in one variable, condone one sign error). May be implied by $m = 6$ and $n = 8$.

Calc If they use one of the 4 sets of equations for 1st M1 and use a calculator to write down the answer, we will allow this mark for sight of the correct answers to those equations as given above.

3rd A1 $m = 6$ and $n = 8$ only (no incorrect labelling here)

Correct answer by trial can score 5/5 if no incorrect working seen.

06.

Que.	Scheme	Marks	AOs
a	$X = 0, 1, 2$ only	B1	3.1b
	$[\mathrm{P}(X=0)=]\frac{6}{8}\times\frac{5}{7}\times\frac{4}{6}$	M1	1.1b
	$[\mathrm{P}(X=1)=]3\times\frac{2}{8}\times\frac{6}{7}\times\frac{5}{6}$ or $[\mathrm{P}(X=2)=]3\times\frac{2}{8}\times\frac{1}{7}\times\frac{6}{6}$	M1	2.1
	x: 0 | 1 | 2 $\mathrm{P}(X=x)$: $\frac{5}{14}$ | $\frac{15}{28}$ | $\frac{3}{28}$	A1 A1	1.1b 1.1b
		(5)	
(b)	$J \sim \mathrm{B}(10, \frac{1}{9})$	M1	3.1b
	$\mathrm{P}(J\geqslant 4)=1-\mathrm{P}(J\leqslant 3)$ or $\mathrm{P}(J\geqslant 4)=\mathrm{P}(J=4)+\mathrm{P}(J=5)+\ldots+\mathrm{P}(J=10)$ or $1-0.981(57\ldots)$	M1	3.4
	= awrt 0.0184	A1	1.1b
		(3)	
			(8 marks)

Notes

(a)	**B1:** identifying that X can only take on the values 0, 1 and 2 (may be seen at end of tree diagram). If other values stated, they must be associated with a probability of 0. **M1:** correct expression for $\mathrm{P}(X=0)$ **M1:** correct expression for either $\mathrm{P}(X=1)$ or $\mathrm{P}(X=2)$ **A1:** one correct probability Watch out for $\frac{6}{8}\times\frac{5}{7}=\frac{15}{28}$ which is an incorrect attempt at $\mathrm{P}(X=0)$ and scores M0A0 **A1:** complete probability distribution, need not be in a table, but each value of x must be associated with its probability. Allow awrt 0.357, awrt 0.536, awrt 0.107
(b)	**M1:** identifying that the B(inomial) distribution with $n = 10$ is appropriate here. If distribution not stated, may be implied by use of $(10Cr)p^r(1-p)^{10-r}$ or $0.981(57\ldots)$ **M1:** writing or using a correct probability statement **A1:** awrt 0.0184 Correct answer scores 3 out of 3