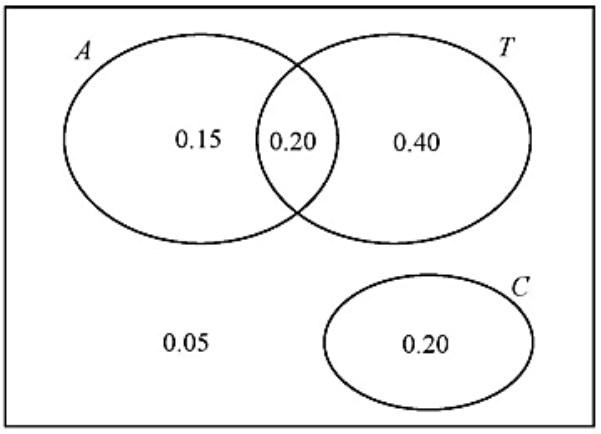
Probability and venn Diagram As level Edexcel statistics Maths Past Papers Answers

01.

Question	Scheme	Marks	AOs
a	$p = [1 - 0.75 - 0.05 =]$ **0.20**	B1	1.1b
		(1)	
(b)	$q =$ **0.15**	B1ft	1.1b
	P(A) = 0.35 P(T) = 0.6 P(A and T) = 0.20 P(A)×P(T) = 0.21	M1	2.1
	Since 0.20 ≠ 0.21 therefore A and T are **not** independent	A1	2.4
		(3)	
			
(c)	P(not [A or C]) = **0.45**	B1	1.1b
		(1)	
			(5 marks)

Part	Notes
(a)	B1cao for $p = 0.20$
(b)	B1ft for use of their p and P(A or T) to find q i.e. 0.75 – "p" – 0.40 or $q = 0.15$
	M1 for the statement of all probabilities required for a suitable test and sight of any appropriate calculations required.
	A1 All probabilities correct, correct comparison and suitable comment.
(c)	B1cao for 0.45

02.

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	M1	2.1
	$\begin{array}{\|c\|c\|c\|c\|c\|}\hline x & 1 & 2 & 3 & 4 \\ \hline P(X=x) & 0.15 & 0.35 & 0.15 & [0.35] \\ \hline \end{array}$	A1	1.1b
		(2)	
(b)	Let A = number of spins that land on 4 $A \sim B(60, "0.35")$	B1ft	3.3
	$[P(A>30)=]\ 1-P(A \leqslant 30)$	M1	3.4
	$=1-0.99411\ldots$ = **awrt 0.00589**	A1	1.1b
		(3)	
(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	3.2a
		(3)	
		(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

03.

Question	Scheme	Marks	AOs
a	Label **each** year group	B1	1.1b
	Use random numbers to select a ...	B1	1.1b
	Simple random sample of 24 Year 12s and 16 Year 13s.	B1	1.1b
		(3)	
(b)	Increase by 2.8 marks	B1	3.4
		(1)	
(c)	e.g. 'the best performance is predicted for the students who never wake up'	B1	3.5b
		(1)	
			(5 marks)

Notes	
(a)	**B1:** for a suitable numbered/labelled/ordered(o.e.) list/database/register(o.e.) for **each** year group. Condone poor numbering but if just one list, then the Year 12s must be distinguishable from the Year 13s
	B1: for use of random numbers/sample/selection to choose students
	B1: for 24 Year 12s, and 16 Year 13s
Note:	A description of a systematic sample: only allow access to the first mark and therefore may score maximum B1B0B0
(b)	**B1:** Using the gradient of the regression equation must include increase(o.e.) and 2.8 'Increase by approximately 3 marks' is B0 but isw if 2.8 is seen $5.6 \div 2$ is not sufficient
(c)	**B1:** for any suitable limitation of the model e.g. the idea that the longer you sleep the better performance in the test or only valid between 0 and 24 hours (within range of the data) or only applicable to the amount of sleep the night before the test or only takes sleep into consideration/does not include other variables (factors) or cannot score below 26.1 marks on the test or the model might not be linear over the entire range or the model might predict more than the maximum mark B0: e.g. might not be correlation between s and p or individual student performance may vary

04.

Question	Scheme	Marks	AOs
a	$x = 0$	B1	2.2a
	$P(A) = 0.1 + z + y \quad P(C) = 0.39 + z[+x] \quad P(A \text{ and } C) = z$	M1	2.1
	$P(A \text{ and } C) = P(A) \times P(C) \rightarrow z = (0.1 + z + y) \times (0.39 + z[+x])$	M1	1.1b
	$\left[\sum p = 1\right]$ $0.06 + 0.3 + 0.39 + 0.1 + z + y[+x] = 1 \rightarrow \quad [z + y[+x] = 0.15]$	M1	1.1b
	Solving (simultaneously) leading to $\underline{z = 0.13} \quad \underline{y = 0.02}$	A1	1.1b
			(5 marks)

Notes

B1: for $x = 0$, may be seen on Venn diagram

M1: Identifying the probabilities required for independence and at least 2 correct
These must be labelled
If there are no labels, then this may be implied by $z = (0.1 + z + y)(0.39 + z\ [+x])$, allow one numerical slip

Allow e.g.
$P(A') = 0.39 + 0.30 + 0.06[+x] \quad P(C) = 0.39 + z[+x] \quad P(A' \text{ and } C) = 0.39$
[Not on spec. but you may see use of conditional probabilities]

M1: Use of independence equation with their labelled probabilities in terms y, z [and x]
All their probabilities must be substituted into a correct formula
Sight of a correct equation e.g. $z = (0.1 + z + y)(0.39 + z\ [+x])$ scores M1M1

M1: Using $\Sigma p = 1$
Implied by $[x +]\ y + z = 0.15$
or their $x + y + z = 0.15$ where x, y, and z are all probabilities
or e.g. $P(A) = 0.25$

A1: both $y = 0.02$ and $z = 0.13$

05.

Question	Scheme	Marks	AOs
	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		
	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

06.

Qu	Scheme	Marks	AO
(a)	$[p = 1 - (0.2 + 0.2 + 0.1 + 0.2)] =$ **0.3**	B1 **(1)**	1.1b
(b)	A and C are mutually exclusive. [NOT P(A) and P(C)]	B1 **(1)**	1.2
		(2 marks)	

	Notes
(a)	B1 for
(b)	B1 for A and C [NB $A \cap C$ or $A \cap C = \varnothing$ is B0] If more than one case given they must all be correct e.g. $A \cap B$ and C

07.

Qu	Scheme	Marks	AO
a	Systematic (sampling)	B1 (1)	1.2
(b)(i)	[Daily Mean] Wind Speed	B1	2.2a
(ii)	Light	B1 (2)	1.2
(c)	Variable *A* occurs most (around 80~90%) of the time	B1 (1) (4 marks)	2.2b

	Notes
(a)	B1 for identifying the correct sampling technique Allow slight misspelling e.g. "sysmatic", "sytmatic" Do NOT allow "systemic"
(b)(i)	B1 for identifying appropriate qualitative variable. {LDS mark} Allow "Wind speed" or "Wind strength" but NOT just "wind" or "wind direction"
(ii)	B1 for realising that modal wind speed is "Light" {LDS mark} Allow just "light" or "most light"
NB	These two B marks are independent so can score B0B1 for e.g. "rainfall" and "light"
(c)	B1 for inferring that frequency of *A* can be estimated fairly reliably: {underestimates *B* and over estimates *C*} e.g. "*A* is the most frequent" [can then ignore comments about *B* and *C*]

08.

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 $\frac{1}{8}$ $\quad p=\underline{\frac{1}{8}}$	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 $p=\underline{\frac{1}{8}}$ 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)

09.

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 $\underline{\mathbf{0.25}}$	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.

10.

Question	Scheme	Marks	AOs
a	$61\times(2\times3),\quad 63\times(2\times12),\quad 65\times(2\times8),\quad 67\times(2\times2)$	M1	2.1
	$\dfrac{61\times(2\times3)+63\times(2\times12)+65\times(2\times8)+67\times(2\times2)}{50}=63.72*$	A1*cso	1.1b
		(2)	
(b)	$\sqrt{\dfrac{61^2\times6+63^2\times24+65^2\times16+67^2\times4}{50}-63.72^2}$	M1	1.1b
	$=\sqrt{2.5216}=1.58795...$ = awrt **1.59**	A1	1.1b
		(2)	
(c)	No effect (oe) since…e.g. • since addition/subtraction does not affect the standard deviation (only multiplication and division do) • the weights will have the same spread • the distance of each weight from the mean will not have changed • they all change by the same amount	B1	2.4
		(1)	
			(5 marks)

Notes	
(a)	**M1:** at least 3 correct products seen (oe) Allow any 3 from 366, 1512, 1040, 268 **A1*cso:** correct expression for mean (which may be seen in stages) and given answer. $\frac{3186}{50}=63.72$ on its own is M0A0, but $\frac{3186}{50}=63.72$ following all 4 correct products seen can score M1A1
SC:	**B2:** $\dfrac{61\times3+63\times12+65\times8+67\times2}{25}=63.72*$ scores M1A1 on epen
(b)	**M1:** correct expression for the standard deviation including root Allow equivalent complete methods e.g. $\sqrt{\dfrac{6(61-63.72)^2+24(63-63.72)^2+16(65-63.72)^2+4(67-63.72)^2}{50}}$ NB: $\sum fx^2=203138$ **A1:** awrt 1.59 (allow s = awrt 1.60) Correct answer with no incorrect working scores 2 out of 2
SC:	**B2:** $\sqrt{\dfrac{61^2\times3+63^2\times12+65^2\times8+67^2\times2}{25}-63.72^2}$ = awrt 1.59 scores M1A1 on epen
(c)	**B1:** correct statement and correct explanation