

Topic Test

Summer 2022

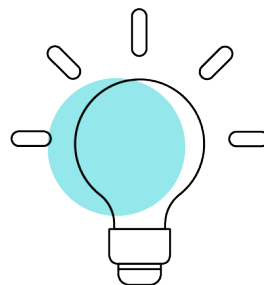
Pearson Edexcel GCE Mathematics (9MA0)

Paper 3 – Statistics

Topic 3: Probability and Venn diagrams

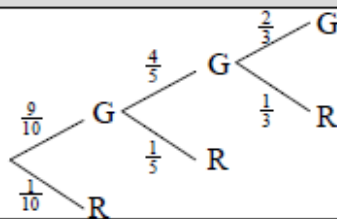
Contents

<u>General guidance to Topic Tests</u>	<u>3</u>
<u>Revise Revision Guide content coverage</u>	<u>4</u>
<u>Questions</u>	<u>5</u>
<u>Mark Scheme</u>	<u>19</u>



Mark Scheme

Question T3_Q1

Question	Scheme	Marks	AOs
1(a)		B1 dB1 (2)	1.1b 1.1b
(b)	$\frac{9}{10} \times \frac{4}{5} \times \frac{2}{3}$ $= \frac{12}{25} (= 0.48)$	M1 A1 (2)	1.1b 1.1b
(c)	$\frac{9}{10} \times \frac{1}{5} + \frac{9}{10} \times \frac{4}{5} \times \frac{1}{3} \quad \text{or} \quad 1 - \left(\frac{1}{10} + \frac{9}{10} \times \frac{4}{5} \times \frac{2}{3} \right)$ $= \frac{21}{50} (= 0.42)$	M1 A1 (2)	3.1b 1.1b
(d)	$[P(\text{Red from } B \text{Red selected})] = \frac{\frac{9}{10} \times \frac{1}{5}}{\frac{1}{10} + \frac{9}{10} \times \frac{1}{5} + \frac{9}{10} \times \frac{4}{5} \times \frac{1}{3}} \left[= \frac{9}{13} \right]$ $= \frac{9}{26}$	M1 A1 (2)	3.1b 1.1b
(8 marks)			
Notes			
	Allow decimals or percentages throughout this question.		
(a)	B1: for correct shape (3 pairs) and at least one label on at least two pairs G(reen) and R(ed) allow G and G' or R and R' as labels, etc. condone 'extra' pairs if they are labelled with a probability of 0 dB1: (dep on previous B1) all correct i.e. for all 6 correct probabilities on the correct branches with at least one label on each pair		
(b)	M1: Multiplication of 3 correct probabilities (allow ft from their tree diagram) A1: $\frac{12}{25}$ oe		
(c)	M1: Either addition of only two correct products (product of two probs + product of three probs) which may ft from their tree diagram or for $1 - (' \frac{1}{10} ' + '(b) ')$ A1: $\frac{21}{50}$ oe		
(d)	M1: Correct ratio of probabilities or correct ft ratio of probabilities e.g. $\frac{' \frac{9}{10} ' \times ' \frac{1}{5} '}{1 - '(b) '}$ or $\frac{' \frac{9}{10} ' \times ' \frac{1}{5} '}{' \frac{1}{10} ' + '(c) '}$ with num < den A1: $\frac{9}{26}$ (allow awrt 0.346)		

Question T3_Q2

Qu 1	Scheme	Marks	AO
(a)	A, C <u>or</u> D, B <u>or</u> D, C	B1 (1)	1.2
(b)	$[p = 0.4 - 0.07 - 0.24 =]$ <u>0.09</u>	B1 (1)	1.1b
(c)	A and B independent implies $P(A) \times 0.4 = 0.24$ <u>or</u> $(q + 0.16 + 0.24) \times 0.4 = 0.24$ so $P(A) = 0.6$ and $q =$ <u>0.20</u>	M1 A1cso (2)	1.1b
(d)(i)	$P(B' C) = 0.64$ gives $\frac{r}{r+p} = 0.64$ <u>or</u> $\frac{r}{r+"0.09"} = 0.64$ $r = 0.64r + 0.64 "p"$ so $0.36r = 0.0576$ so $r =$ <u>0.16</u>	M1 A1	3.1a 1.1b
(ii)	Using sum of probabilities = 1 e.g. $"0.6" + 0.07 + "0.25" + s = 1$ so $s =$ <u>0.08</u>	M1 A1 (4)	1.1b 1.1b
(8 marks)			
Notes			
(a)	B1 for one correct pair. If more than one pair they must all be correct. Condone in a correct probability statement such as $P(A \cap C) = 0$ or correct use of set notation e.g. $A \cap C = \emptyset$ BUT e.g. " $P(A)$ and $P(C)$ are mutually exclusive" alone is B0		
(b)	B1 for $p = 0.09$ (Maybe stated in Venn Diagram [VD]) [If values in VD and text conflict, take text or a value <u>used</u> in a later part]		
(c)	M1 for a correct equation in one variable for $P(A)$ or q using independence <u>or</u> for seeing both $P(A \cap B) = P(A) \times P(B)$ <u>and</u> $0.24 = 0.6 \times 0.4$ A1cso for $q = 0.20$ or exact equivalent (dep on correct use of independence) Use of $P(A) = 1 - P(B) = 0.6$ leading to $q = 0.2$ scores M0A0		
Beware			
(d)(i)	1 st M1 for use of $P(B' C) = 0.64$ leading to a correct equation in r and possibly p . Can fit their p provided $0 < p < 1$ 1 st A1 for $r = 0.16$ or exact equivalent		
(ii)	2 nd M1 for use of total probability = 1 to form a linear equation in s . Allow p, q, r etc Can follow through their values provided each of p, q, r are in $[0, 1)$ 2 nd A1 for $s = 0.08$ or exact equivalent		

Question T3_Q3

Qu 4	Scheme	Marks	AO
(a)	$\frac{k}{10} + \frac{k}{20} + \frac{k}{30} + \frac{k}{40} + \frac{k}{50} = 1$ or $\frac{1}{600}(60k + 30k + 20k + 15k + 12k) = 1$ $\text{So } k = \frac{600}{137} \quad (*)$	M1 A1cso (2)	1.1b 1.1b
(b)	(Cases are:) $D_1 = 30, D_2 = 50$ and $D_1 = 50, D_2 = 30$ and $D_1 = 40, D_2 = 40$ $P(D_1 + D_2 = 80) = \frac{k}{50} \times \frac{k}{30} \times 2 + \left(\frac{k}{40}\right)^2$ $= 0.0375619... \text{ awrt } \underline{\underline{0.0376}}$	M1 M1 A1 (3)	2.1 3.4 1.1b
(c)	Angles are: $a, a + d, a + 2d, a + 3d$ $S_4 = a + (a + d) + (a + 2d) + (a + 3d) = 360$ $2a + 3d = 180 \text{ (o.e.)}$ Smallest angle is $a > 50$ consider cases: $d = 10$ so $a = 75$ <u>or</u> $d = 20$ so $a = 60$ [$d = 30$ gives $a = 45$ no good] $P(D = 10 \text{ or } 20) = \frac{3k}{20} = \frac{90}{137}$	M1 M1 A1 M1 A1 (5)	3.1a 2.1 2.2a 3.1b 1.1b
(10 marks)			
Notes			
(a)	M1 for clear use of sum of probabilities = 1 (all terms seen) A1 cso (*) M1 scored and no incorrect working seen.		
Verify	(Assume $k = \frac{600}{137}$) to score the final A1 they must have a <u>final</u> comment " $\therefore k = \frac{600}{137}$ "		
(b)	1 st M1 for selecting at least 2 of the relevant cases (may be implied by their correct probs) e.g. allow 30, 50 and 50,30 i.e. D_1 and D_2 labels not required 2 nd M1 for using the model to obtain a correct expression for two different probabilities. May use letter k or their value for k . $\text{Allow for } \frac{k}{50} \times \frac{k}{30} + \left(\frac{k}{40}\right)^2 \text{ or } 2 \times \left(\frac{k}{50} \times \frac{k}{30} + \left(\frac{k}{40}\right)^2\right)$		
	A1 for awrt 0.0376 (exact fraction is $\frac{705}{18769}$)		
(c)	1 st M1 for recognising the 4 angles and finding expressions in terms of d and their a 2 nd M1 for using property of quad with these 4 angles (equation can be un-simplified) Allow these two marks for use of a (possible) value of d e.g. $a + a + 10 + a + 20 + a + 30 = 360$ (If at least 3 cases seen allow A1 for e.g. $4a = 300$) <u>or</u> allow M1M1 for a set of 4 angles with sum 360 and possible value of d (3 cases for A1) e.g. (for $d = 20$) 60, 80, 100, 120 1 st A1 for $2a + 3d = 180$ condition (o.e.) [Must be in the form $pa + qd = N$] 3 rd M1 for examining cases and getting $d = 10$ and $d = 20$ only 2 nd A1 for $\frac{90}{137}$ or exact equivalent The correct answer and no obviously incorrect working will score 5/5 A final answer of awrt 0.657 (0.65693...) with no obviously incorrect working scores 4/5		

Question T3_Q4

Qu 4	Scheme	Marks	AO
(a)	$0.08 + 0.09 + 0.36 = \underline{0.53}$	B1 (1)	1.1b
(b)(i)	$[P(G \cap E \cap S) = 0 \Rightarrow] \underline{p = 0}$	B1	1.1b
(ii)	$[P(G) = 0.25 \Rightarrow] 0.08 + 0.05 + q + "p" = 0.25$ $\underline{q = 0.12}$	M1 A1 (3)	1.1b 1.1b
(c)(i)	$[P(S E) = \frac{5}{12} \Rightarrow] \frac{r + "p"}{r + "p" + 0.09 + 0.05} = \frac{5}{12}$ $[12r = 5r + 5 \times 0.14 \Rightarrow] \underline{r = 0.10}$	M1 A1ft A1	3.1a 1.1b 1.1b
(ii)	$[0.08 + 0.05 + "0.12" + "0" + 0.09 + "0.10" + 0.36 + t = 1 \Rightarrow] \underline{t = 0.20}$	B1ft (4)	1.1b
(d)	$P(S \cap E') = 0.36 + "q" [= 0.48]$ $P([(S \cap E')] \cap G) = "q" [= 0.12] \text{ and } P(G) = 0.25 \text{ and}$ $P(S \cap E') \times P(G) = "0.48" \times \frac{1}{4} \underline{\text{or } 0.12}$ $P(S \cap E') \times P(G) = 0.12 = P([(S \cap E')] \cap G) \text{ so are independent}$	B1ft M1 A1 (3)	1.1b 2.1 2.2a
(11 marks)			
Notes			
(a)	B1 for 0.53 (or exact equivalent) [Allow 53%]		
(b)(i)	B1 for $p = 0$ (may be placed in Venn diagram)		
(ii)	M1 for a linear equation for q (ft letter " p " or their value if $0, p, 0.12$) $\Rightarrow$ by $p + q = 0.12$ A1 for $q = 0.12$ (may be placed in Venn diagram)		
(c)(i)	M1 for a ratio of probabilities (r on num and den) (on LHS) with num < den and num <u>or</u> den correct ft. Allow ft of letter " p " <u>or</u> their p where $0, p < 0.86$ but "+ 0" is not required. 1 st A1ft for a correct ratio of probabilities (on LHS) allowing ft of their p where $0, p < 0.86$ 2 nd A1 for $r = 0.1(0)$ or exact equivalent (may be in Venn diagram) Ans only 3/3		
(ii)	B1ft for $t = 0.2(0)$ (o.e.) <u>or</u> correct ft i.e. $0.42 - (p + q + r)$ where p, q, r and t are all probs		
(d)	B1ft for $P(S \cap E') = 0.48$ (with label) (ft letter " q " or their value if $0, q, 0.12$) M1 for attempting all required probs (labelled) and using them in a correct test (allow ft of q) A1 for all probs correct and a correct deduction (no ft deduction here)		
SC	No "P" If correct argument seen apart from P for probability for all 3 marks, award (B0M1A1) If unsure about an attempt using conditional probabilities, please send to review.		

