

Y2S2 XMQs and MS

(Total: 65 marks)

1. P3_Sample Q4 . 10 marks - Y2S2 Conditional probability
2. P3_Specimen Q4 . 11 marks - Y2S2 Conditional probability
3. P31_2019 Q1 . 8 marks - Y1S5 Probability
4. P31_2020 Q1 . 8 marks - Y2S2 Conditional probability
5. P31_2021 Q1 . 7 marks - Y1S6 Statistical distributions
6. P31_2021 Q4 . 11 marks - Y2S2 Conditional probability
7. P31_2022 Q5 . 10 marks - Y2S2 Conditional probability

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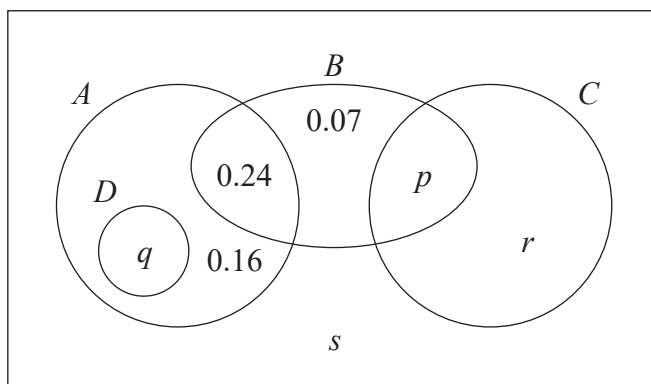
Question	Scheme	Marks	AOs
4(a)	$P(A' B') = \frac{P(A' \cap B')}{P(B')} \text{ or } \frac{0.33}{0.55}$	M1	3.1a
	$= \frac{3}{5} \text{ or } 0.6$	A1	1.1b
		(2)	
(b)	e.g. $P(A) \times P(B) = \frac{7}{20} \times \frac{9}{20} = \frac{63}{400} \neq P(A \cap B) = 0.13 = \frac{52}{400}$ or $P(A' B') = 0.6 \neq P(A') = 0.65$	B1	2.4
		(1)	
(c)		B1	2.5
		M1	3.1a
		A1	1.1b
		M1	1.1b
		A1	1.1b
	(5)		
(d)	$P(B \cup C)' = 0.22 + 0.22 \text{ or } 1 - [0.56]$ or $1 - [0.13 + 0.23 + 0.09 + 0.11]$	M1	1.1b
	$= 0.44$	A1	1.1b
		(2)	
(10 marks)			
Notes:			
(a) M1: for a correct ratio of probabilities formula and at least one correct value. A1: a correct answer			
(b) for a fully correct explanation: correct probabilities and correct comparisons.			
(c) B1: for box with B intersecting A and C but C not intersecting A . (Or accept three intersecting circles, but with zeros entered for $A \cap C$ and $A \cap B \cap C$) No box is B_0 M1: for method for finding $P(B \cap C)$ A1: for 0.09 M1: for 0.13 and their 0.09 in correct places and method for their 0.23 A1: fully correct			
(d) M1: for a correct expression – fit their probabilities from their Venn diagram. A1: cao			

9MA0/03 Mock Paper: Statistics and Mechanics mark scheme

Question	Scheme	Marks	AOs
4(a)	$P(S \cap D') = 0$	B1	1.1b
		(1)	
(b)	$P(C S \cap D) = \frac{0.27}{0.6} = \frac{9}{20} = 0.45$	M1	3.1b
	$\therefore 80 \times "0.45"$	M1	1.1b
	$= 36$	A1	1.1b
		(3)	
(c)	$[P(C) \times P(S) = P(C \cap S)]$		
	$P(S) = 0.6, P(C) = 0.27 + v + u, P(S \cap C) = 0.27$	M1	3.1a
	$0.6 \times (0.27 + u + v) = 0.27 \quad \text{or} \quad u + v = 0.18 \quad \text{o.e}$	A1	1.1b
	$\left[P(D C) = \frac{P(D \cap C)}{P(C)} \right] \quad P(D \cap C) = 0.27 + v$	M1	3.1a
	$\frac{14}{15} = \frac{0.27 + v}{0.27 + v + u} \quad \text{or} \quad 14u - v = 0.27 \quad \text{o.e}$	A1	1.1b
	$15u = 0.45$	M1dd	1.1b
	$u = 0.03 \quad v = 0.15$	A1	1.1b
	$w = 0.22$	A1ft	1.1b
		(7)	
(11 marks)			
Notes:			
(a) B1: correct answer only			
(b) M1: for a correct ratio of probabilities formula with at least one correct value and multiplying by 80 A1: a correct answer			
(c) M1: for translating the problem and realising the equation $P(C) \times P(S) = P(C \cap S)$ needs to be used with at least 2 parts correct. A1: a correct equation M1: for a correct probability formula with $P(D \cap C) = 0.27 + v$ A1: a second correct equation M1dd: dependent on the previous 2 method marks being awarded. Solving the two simultaneous equations by eliminating one variable. May be implied by either u or v correct A1: u correct A1: v correct A1ft: $w = 0.22$, ft <i>their</i> u, v provided that $u + v + w < 0.4$			

Question	Scheme	Marks	AOs
1(a)		B1	1.1b
		dB1	1.1b
		(2)	
(b)	$\frac{9}{10} \times \frac{4}{5} \times \frac{2}{3}$	M1	1.1b
	$= \frac{12}{25} (= 0.48)$	A1	1.1b
	(2)		
(c)	$\frac{9}{10} \times \frac{1}{5} + \frac{9}{10} \times \frac{4}{5} \times \frac{1}{3}$ or $1 - \left(\frac{1}{10} + \frac{9}{10} \times \frac{4}{5} \times \frac{2}{3} \right)$	M1	3.1b
	$= \frac{21}{50} (= 0.42)$	A1	1.1b
	(2)		
(d)	$[P(\text{Red from } B \text{Red selected})] = \frac{\frac{9}{10} \times \frac{1}{5}}{\frac{1}{10} + \frac{9}{10} \times \frac{1}{5} + \frac{9}{10} \times \frac{4}{5} \times \frac{1}{3}} \left[= \frac{9}{26} \right]$	M1	3.1b
	$= \frac{9}{26}$	A1	1.1b
	(2)		
(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)		

1. The Venn diagram shows the probabilities associated with four events, A , B , C and D



- (a) Write down any pair of mutually exclusive events from A , B , C and D (1)

Given that $P(B) = 0.4$

- (b) find the value of p (1)

Given also that A and B are independent

- (c) find the value of q (2)

Given further that $P(B'|C) = 0.64$

- (d) find (4)
- (i) the value of r
- (ii) the value of s



Qu 1	Scheme	Marks	AO
(a)	A, C <u>or</u> D, B <u>or</u> D, C	B1 (1)	1.2
(b)	$[p = 0.4 - 0.07 - 0.24 =]$ 0.09	B1 (1)	1.1b
(c)	A and B independent implies $P(A) \times 0.4 = 0.24$ <u>or</u> $(q + 0.16 + 0.24) \times 0.4 = 0.24$	M1	1.1b
	so $P(A) = 0.6$ and $q =$ 0.20	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 $r =$ 0.16	M1 A1	3.1a 1.1b
(ii)	Using sum of probabilities = 1 e.g. "0.6" + 0.07 + "0.25" + s = 1 so $s =$ 0.08	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		

Qu 1	Scheme	Marks	AO
(a)	Disadvantage: e.g. Not random; cannot use (reliably) for inferences	B1 (1)	1.1b
(b)	[Sight or correct use of] $X \sim B(36, 0.08)$	M1	3.3
(i)	$P(X = 4) = 0.167387\dots$ awrt 0.167	A1	1.1b
(ii)	$[P(X \geq 7) = 1 - P(X \leq 6) =] 0.022233\dots$ awrt 0.0222	A1 (3)	1.1b
(c)	$P(\text{In dance club and dance tango}) = 0.4 \times 0.08 = \underline{\underline{0.032}}$ or $\frac{4}{125}$ or <u>3.2%</u>	B1 (1)	1.1b
(d)	[Let $T =$ those who can dance the Tango. Sight or use of] $T \sim B(50, "0.032")$ $[P(T < 3) = P(T \leq 2) =] 0.7850815\dots$ awrt 0.785	M1 A1 (2)	3.3 1.1b
(7 marks)			
Notes			
(a)	B1 for a suitable disadvantage:		
	Allow (B1)	Do NOT allow (B0)	
	Not random <u>or</u> less random (o.e.)	Not representative	
	Cannot use (reliably) for inferences	Less accurate	
	(More likely to be) biased	Any comment based on time or cost	
		Any mention of skew	
		Any mention of non-response	
(b)	M1 for sight of $B(36, 0.08)$ Allow in words: <u>binomial</u> with $n = 36$ and $p = 0.08$ may be implied by one correct answer to 2sf <u>or</u> sight of $P(X \leq 6) = 0.97776\dots$ i.e. awrt 0.98 Allow for $36C4 \times 0.08^4 \times 0.92^{32}$ as this is "correct use"		
(i)	1 st A1 for awrt 0.167 NB An answer of just awrt 0.167 scores M1(\Rightarrow)1 st A1		
(ii)	2 nd A1 for awrt 0.0222		
(c)	B1 for 0.032 o.e. (Can allow for sight of 0.4×0.08)		
(d)	M1 for sight of $B(50, "0.032")$ ft their answer to (c) provided it is a probability $\neq 0.08$ may be implied by correct answer <u>or</u> sight of $[P(T \leq 3)] = 0.924348\dots$ i.e. awrt 0.924 or $P(T \leq 2)$ as part of $1 - P(T \leq 2)$ calc. A1 for awrt 0.785		
MR	Allow MR of 50 (e.g. 30) provided clearly attempting $P(T \leq 2)$ and score M1A0		

4. A large college produces three magazines.

One magazine is about green issues, one is about equality and one is about sports.

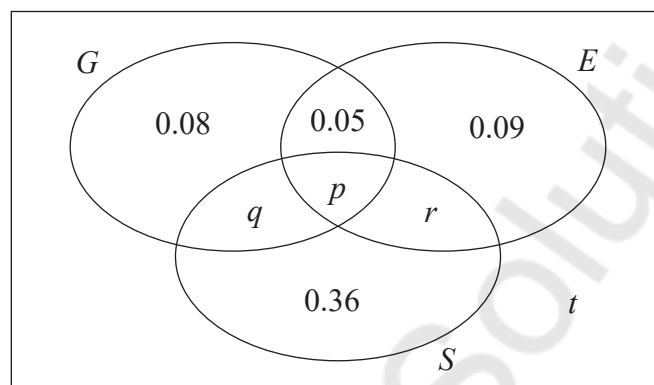
A student at the college is selected at random and the events G , E and S are defined as follows

G is the event that the student reads the magazine about green issues

E is the event that the student reads the magazine about equality

S is the event that the student reads the magazine about sports

The Venn diagram, where p , q , r and t are probabilities, gives the probability for each subset.



- (a) Find the proportion of students in the college who read exactly one of these magazines.

(1)

No students read all three magazines and $P(G) = 0.25$

- (b) Find

(i) the value of p

(ii) the value of q

(3)

Given that $P(S | E) = \frac{5}{12}$

- (c) find

(i) the value of r

(ii) the value of t

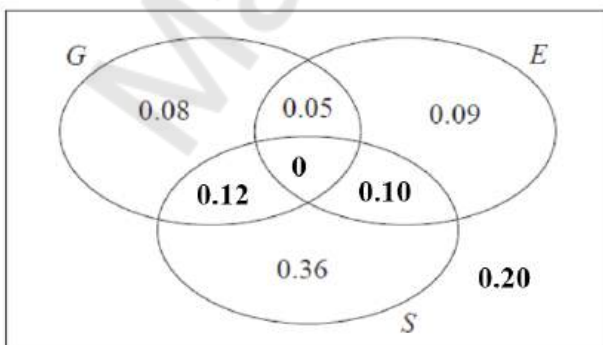
(4)

- (d) Determine whether or not the events $(S \cap E')$ and G are independent. Show your working clearly.

(3)



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)	$P(S \cap E') = 0.36 + "q" [= 0.48]$ $P([(S \cap E')] \cap G) = "q" [= 0.12] \text{ and } P(G) = 0.25 \text{ and}$ $P(S \cap E') \times P(G) = "0.48" \times \frac{1}{4} \text{ or } 0.12$ $P(S \cap E') \times P(G) = 0.12 = P([(S \cap E')] \cap G) \text{ so are independent}$	B1ft M1 A1 (3)	1.1b 2.1 2.2a
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 $0 \leq p \leq 0.12$) \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 $0 \leq p < 0.86$ but " $+ 0$ " is not required. 1 st A1ft for a correct ratio of probabilities (on LHS) allowing ft of their p where $0 \leq p < 0.86$ 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 $0 \leq q \leq 0.12$) M1 for attempting all required probs (labelled) <u>and</u> 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 (BOM1A1) If unsure about an attempt using conditional probabilities, please send to review.		



5. A company has 1825 employees.
The employees are classified as professional, skilled or elementary.

The following table shows

- the number of employees in each classification
- the two areas, A or B , where the employees live

	A	B
Professional	740	380
Skilled	275	90
Elementary	260	80

An employee is chosen at random.

Find the probability that this employee

- (a) is skilled, (1)
- (b) lives in area B and is not a professional. (1)

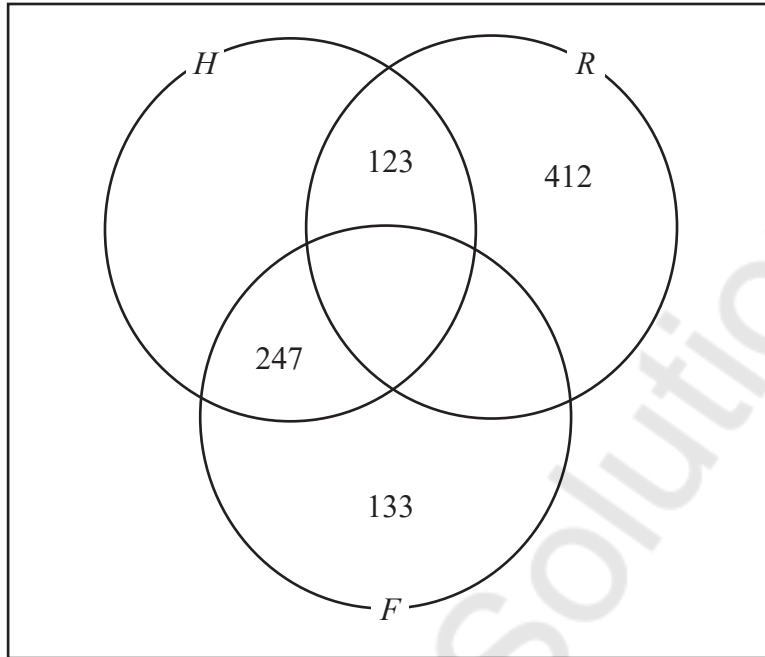
Some classifications of employees are more likely to work from home.

- 65% of professional employees in both area A and area B work from home
 - 40% of skilled employees in both area A and area B work from home
 - 5% of elementary employees in both area A and area B work from home
 - Event F is that the employee is a professional
 - Event H is that the employee works from home
 - Event R is that the employee is from area A
- (c) Using this information, complete the Venn diagram on the opposite page. (4)
- (d) Find $P(R' \cap F)$ (1)
- (e) Find $P([H \cup R]')$ (1)
- (f) Find $P(F | H)$ (2)



Question 5 continued

Only use this diagram if you need to redraw your Venn diagram.



DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

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(Total for Question 5 is 10 marks)



P 7 2 1 3 0 A 0 1 5 2 0

Question	Scheme	Marks	AOs
5(a)	$\frac{365}{1825}$ or $\frac{1}{5}$ or 0.2 oe	B1	1.1b
		(1)	
(b)	$\frac{170}{1825}$ or $\frac{34}{365}$ or awrt 0.093	B1	1.1b
		(1)	
(c)	$90 \times 0.4 + 80 \times 0.05 [= 40]$ or $90 \times 0.6 + 80 \times 0.95 [= 130]$ or $740 \times 0.65 [= 481]$ or $740 \times 0.35 [= 259]$ 	M1	3.1b
		B1 B1 A1	1.1b 1.1b 1.1b
		(4)	
(d)	$P(R' \cap F) = \frac{380}{1825} \left[= \frac{76}{365} = 0.208... \right]$ oe awrt 0.208	B1	1.1b
		(1)	
(e)	$\left[\frac{133 + "130"}{1825} = \right] \frac{"263"}{1825}$ awrt 0.144	B1ft	1.1b
		(1)	
(f)	$\frac{247 + "481"}{247 + "481" + 123 + "40"}$	M1	3.4
	$= \frac{728}{891}$ awrt 0.817	A1	1.1b
		(2)	
Notes: (10 marks)			
		Look out for answers given in the question. If you see answers in the question and in the answer space those in the answer space take precedence.	
(a)	B1	Allow equivalent	
(b)	B1	Allow equivalent	
(c)	M1	Correct method to find one of the values 40 or 130 or 481 or 259 Implied by 40, 481, 259 or 130 seen in correct place on diagram	
	B1	One of the highlighted correct	
	B1	A second value highlighted correct or their ("259" + "481") = 740 or their ("40" + "481") = 521 or their ("40" + "130") = 170	
	A1	Fully correct	
(d)	B1	380/1825 oe or awrt 0.208	
(e)	B1ft	Correct answer or Ft their 130 (> 0) do not allow if blank Allow ft correct to 3 sf.	
(f)	M1	For a single fraction with the numerator < denominator and n is an integer we will award for n/891 or n/(sum of their 4 values in H, each > 0) or awrt 0.817	
	A1	728/891 oe or awrt 0.817	