Conditional Probability - Answers

June 2016 Mathematics Advanced Paper 1: Statistics 1

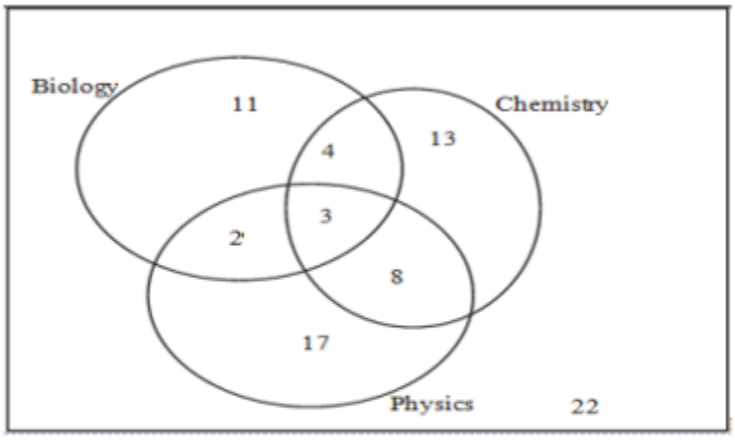
1.

Question Number	Scheme	Marks
4.(a)	$[\mathrm{P}(B\cap R')=]$ $\underline{\mathbf{0}}$	B1 (1)
(b)	$\mathrm{P}(B)=0.27+0.33=0.6,\ \mathrm{P}(D)=0.27+0.15+t$, $\mathrm{P}(B\cap D)=0.27$	M1
	$[\mathrm{P}(B)\times\mathrm{P}(D)=\mathrm{P}(B\cap D)$ gives$]$ $\quad 0.6\times(0.42+t)=0.27$	M1
	$0.42+t=\dfrac{0.27}{0.6}$ $\underline{\text{or}}$ $0.6t=0.018$	A1
	$t=\underline{\mathbf{0.03}}$	A1 (4)
(c)	$[u=]$ $1-(0.6+0.15+t)$	M1
	$u=\underline{\mathbf{0.22}}$	A1ft (2)
(d)(i)	$\left[\dfrac{\mathrm{P}(D\cap R\cap B)}{\mathrm{P}(R\cap B)}=\right]=\dfrac{0.27}{0.27+0.33}$ $\underline{\text{or}}$ $\mathrm{P}(D\mid R\cap B)=\mathrm{P}(D\mid B)=\mathrm{P}(D)$	M1
	$=\underline{\mathbf{0.45}}$	A1
(ii)	$\left[\dfrac{\mathrm{P}(D\cap[R\cap B'])}{\mathrm{P}(R\cap B')}=\right]=\dfrac{0.15}{0.15+u}$	M1
	$=\dfrac{15}{37}$	A1 (4)
(e)	$40\times$"0.45" and $37\times$"$\dfrac{15}{37}$"	M1
	$=\underline{\mathbf{33}}$	A1 (2)
		[13 marks]

	Notes	
(b)	1st M1 for attempting 3 suitable probabilities, one involving t (at least 2 correct) e.g. sight of 0.6, 0.27, 0.42 + t correctly labelled in terms of B,D,R or in a correct equation. May see e.g. $P(B\|D) = \frac{0.27}{0.42+t}$ 2nd M1 for using the independence to form a linear equation in t. ft their probs if stated. 1st A1 for solving leading to a correct equation as far as $p + t = q$ or $pt = q$ 2nd A1 for 0.03 or exact equivalent	
(c)	M1 for a correct expression for u . Allow their t or just letter t in a correct expression A1ft for 0.22 (or exact equivalent) or ft their t. i.e. $u = 0.25 - t$ provided u & t are probs Can score M1A1ft provided their u + their $t = 0.25$ where u and t are both in [0, 1]	
(d)(i)	M1 for a correct numerical ratio of probabilities A1 for 0.45 or exact equivalent (Answer only 2/2)	
(ii)	M1 for a correct numerical ratio of probabilities, ft their u, provided u is a probability A1 for $\frac{15}{37}$ or $0.\dot{4}0\dot{5}$ or allow awrt 0.41 following a correct expression (Ans only 2/2)	
(e)	M1 for a correct method for both 18 and 15 ft their 0.45 and their $\frac{15}{37}$ provided both in [0,1] NB $P(D)\times 77$ is M0 A1 for 33 only NB $\frac{27}{33}\times 40 = 32.7\ldots$ which rounds to 33 but scores M0A0. **(Ans only send to review)**	

June 2015 Mathematics Advanced Paper 1: Statistics 1

2.

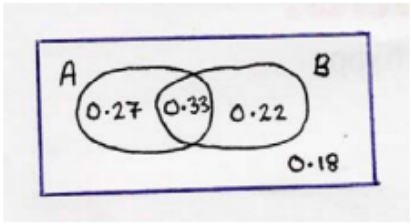
Question	Scheme	Marks
3. (a)		B1 M1 A1 A1 B1 (5)
(b)	$\frac{'13'}{80}$ or 0.1625	B1ft (1)
(c)	$\frac{28+30-11}{80}$ or $\frac{2+3+4+8+13+17}{80}$ or $1-\frac{(11+22)}{80}=\frac{47}{80}$ or 0.5875	M1 A1 (2)

(d)	$\frac{"17+8+13"}{"47"}$ or $\frac{\frac{"38"}{80}}{\frac{"47"}{80}}$ or $1-\frac{"2+3+4"}{"47"}=\frac{38}{47}$ (condone awrt 0.809)	M1 A1cao (2)
(e)	$P(B\|C)=\frac{7}{28}$, $P(B)=\frac{20}{80}$ $P(C\|B)=\frac{7}{20}$, $P(C)=\frac{28}{80}$ $P(B\cap C)=\frac{7}{80}$, $P(B) = \frac{20}{80}P(C)=\frac{28}{80}$ $P(B\|C)=P(B)$, $P(C\|B)=P(C)$ these may be implied by correct conclusion $P(B\cap C)=P(B)\times P(C)$ this approach requires the product to be seen So, they are independent.	M1 M1 A1 (3) (13 marks)
	Notes	
(a)	B1 for 3 intersecting circles with 3 in the centre. **Allow probs. or integers in diagram.** M1 for some correct subtraction e.g. at least one of 2, 4, 8 or for *B*: 20 – their(2+3+4) etc A1 for 2, 4 and 8 (ignore labels) A1 for 11, 13 and 17 (must be in compatible regions with 2, 4, 8 if no labels) B1 for correct labels and 22 and box (Do not treat "blank" as 0 so can't use 0 for ft in (c))	
(c)	M1 for a correct expression seen in (c) (or ft their diagram). Correct ans M1A1	
(d)	M1 for denominator of 47 or ft their numerator from part (c) and numerator of 38 or their (17 + 8 + 13) or (their 47) – their (2 + 3 + 4). Correct ans M1A1	
(e)	M1 for stating at least the required probs.& labelled for a correct test (can ft their diagram) M1 for use of a correct test with *B* and *C* Must see product attempted for $P(B\cap C)$ test. A1 for a correct test with all probabilities correct and a correct concluding statement. NB M0M1A0 should be possible but A1 requires both Ms	

May 2014 Mathematics Advanced Paper 1: Statistics 1

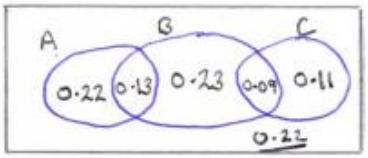
3.

Question Number	Scheme	Marks
8 (a)	$[\,P(A)=1-0.18-0.22\,]$ = **0.6** (or exact equivalent)	B1 **(1)**
(b)	$P(A\cup B)=$"0.6"$+0.22$ = **0.82** (or exact equivalent)	B1ft **(1)**
(c)	$x=P(A\cap B)$ | Use $P(B)P(A'\mid B)=P(A'\cap B)$ | **Establish** independence before or after 1st M1 and score marks for (d) (RH ver)	M1
	$\frac{x}{x+0.22}=0.6$ | $P(B)\times[1-0.6]=0.22$ | **Find** $P(B)$	
	$x=0.6x+0.132$ | Use $P(A\cap B)=P(A\mid B)P(B)$ | Use $P(B)P(A)=P(A\cap B)$	dM1
	$0.4x=0.132$ | $P(A\cap B)=0.6\times0.55$ | $P(A\cap B)=0.6\times0.55$	
	$x=$ **0.33** (or exact equivalent)	A1cso **(3)**
(d)	$P(B)=0.55$	
	$P(B)\times P(A)=0.55\times0.6$ $=0.33$ | **or** stating $P(A)=P(A\mid B)$ [= 0.6]	M1
	$P(B)\times P(A)=P(A\cap B)$ therefore (statistically) independent | **or** $P(A)=P(A\mid B)$ therefore (statistically) independent	A1cso **(2)**
		Total 7

	Notes	
(b)	B1ft for their (a) + 0.22 or 1 – $P(A' \cap B')$ Do not ft their (a) if it is > 0.78	
	NB 3 versions for (c). Check carefully that Ms are genuinely scored.	
	Look out for assuming independence and if you see P(*B*) = 0.55 check it is derived properly	
(c)	1st M1 for a correct equation for x e.g. $\frac{x}{x+0.22}=0.6$ or a correctly derived equation for P(B)	
	2nd dM1 for solving to get in form $kx = L$ or correct use of P(B) to find $P(A \cap B)$ [2nd or 3rd ver] or $P(A \cap B) = P(B) - 0.22$	
	A1cso for 0.33 Dep. on both Ms and no incorrect working seen.	
(d)	M1 for finding $P(B) \times P(A) = 0.33$ (values needed) or stating $P(A) = P(A\|B)$ (= 0.6 not needed)	
	A1cso for a correct statement: $P(B) \times P(A) = P(A \cap B)$ or $P(A) = P(A\|B)$ and stating independent	
	NB The M1 in (d) using $P(A \cap B)$ requires $P(B) = 0.55$ There is no ft of an incorrect P(B) Full marks in (d) is OK even if 0/3 in (c) {This Venn diagram may be helpful.} 	

Jan 2013 Mathematics Advanced Paper 1: Statistics 1

4.

Question Number	Scheme	Marks
7.		
(a)	$P(A \cup B) = 0.35 + 0.45 - 0.13$ or $0.22 + 0.13 + 0.32$ $= \underline{\mathbf{0.67}}$	M1 A1 (2)
(b)	$P(A' \mid B') = \frac{P(A' \cap B')}{P(B')}$ or $\frac{0.33}{0.55}$ $= \frac{3}{5}$ or 0.6	M1 A1 (2)
(c)	$P(B \cap C) = 0.45 \times 0.2$ $= \underline{\mathbf{0.09}}$	M1 A1 (2)
(d)	 Allow 1st B1 for 3 intersecting circles in a box with zeros in the regions for $A \cap C$ Do not accept "blank" for zero	B1 B1ft B1 B1 (4)
(e)	$P(B \cup C)' = 0.22 + \underline{0.22}$ or $1-[0.56]$ or $1-[0.13+0.23+0.09+0.11]$ o.e. $= \underline{\mathbf{0.44}}$	M1 A1 (2) **12**

	Notes	
	NB May see Venn diagram for A and B only used for (a) and (b) but M marks are awarded for correct expressions only. No ft from an incorrect diagram for M marks.	
(a)	M1 for attempt to use the addition rule. Correct substitution i.e. correct expression seen A1 for 0.67 only. Correct answer only scores 2/2	
(b)	M1 for a correct ratio of probabilities or a correct formula and at least one correct prob For a correct formula allow "1 − their (a)" instead of 0.33 but not for correct ratio case. Do not award for assuming independence i.e. $\frac{P(A'\cap B')}{P(B')}=\frac{0.65\times0.55}{0.55}$ is M0. M0 if num>denom A1 for 3/5 or any exact equivalent.	
(c)	M1 for correct expression. Need correct values for P(B) and P(C) seen. A1 for 0.09 or any exact equivalent. Correct answer only is 2/2	
(d)	**No labels *A*, *B*, *C* in (d) loses 1st B1 but can score the other 3 by implication** B1 for box with B intersecting A and C but C not intersecting A. No box is B0 B1ft for 0.13 and their 0.09 in correct places. [ft $P(B\cap C)$ from (c)] B1 for any 2 of 0.22, 0.22, 0.11 and 0.23 correct B1 for all 4 values correct	
(e)	M1 for a correct expression or follow through from their Venn diagram NB $P(B')\times P(C')=0.55\times0.8$ is OK. Do not ft "blank" for zero and M0 for negative probs. A1 for 0.44 only. Correct answer only is 2/2	

May 2010 Mathematics Advanced Paper 1: Statistics 1

5.

Question Number		Scheme	Marks
Q4	(a)	$\frac{2+3}{\text{their total}}=\frac{5}{\text{their total}}=\frac{1}{6}$ **(** given answer**)**	M1 A1cso (2)
	(b)	$\frac{4+2+5+3}{\text{total}}$, $=\frac{14}{30}$ or $\frac{7}{15}$ or $0.4\dot{6}$	M1 A1 (2)
	(c)	$P(A\cap C)=0$	B1 (1)
	(d)	$P(C\mid \text{reads at least one magazine})=\frac{6+3}{20}=\frac{9}{20}$	M1 A1 (2)
	(e)	$P(B)=\frac{10}{30}=\frac{1}{3}$, $P(C)=\frac{9}{30}=\frac{3}{10}$, $P(B\cap C)=\frac{3}{30}=\frac{1}{10}$ or $P(B\mid C)=\frac{3}{9}$	M1
		$P(B)\times P(C)=\frac{1}{3}\times\frac{3}{10}=\frac{1}{10}=P(B\cap C)$ or $P(B\mid C)=\frac{3}{9}=\frac{1}{3}=P(B)$	M1
		So yes they are statistically independent	A1cso (3)
			Total 10

(a)	M1 for $\frac{2+3}{\text{their total}}$ or $\frac{5}{30}$	
(b)	M1 for adding at least 3 of "4, 2, 5, 3" and dividing by their total to give a probability Can be written as separate fractions substituted into the completely correct Addition Rule	
(c)	B1 for 0 or 0/30	
(d)	M1 for a **denominator of 20** or $\frac{20}{30}$ leading to an answer with denominator of 20 $\frac{9}{20}$ only, 2/2	
(e)	1st M1 for attempting all the required probabilities for a suitable test 2nd M1 for use of a correct test - must have attempted all the correct probabilities. Equality can be implied in line 2. A1 for fully correct test carried out with a comment	