A Level Statistics

AQA Past Exam Questions

Solutions

TOPIC: Probability Theory

Candidates may use any calculator allowed by Pearson regulations. Calculators must not have retrievable mathematical formulae stored in them.

Instructions

• Use **black** ink or ball-point pen.

• If pencil is used for diagrams/sketches/graphs it must be dark (HB or B). Coloured pencils and highlighter pens must not be used.

• **Fill in the boxes** at the top of this page with your name, centre number and candidate number.

• Answer **all** questions and ensure that your answers to parts of questions are clearly labelled.

• Answer the questions ***on paper***

• You should show sufficient working to make your methods clear. Answers without working may not gain full credit.

• Unless otherwise stated, statistical tests should be carried out at the 5% significance level.

• When a calculator is used, the answer should be given to three significant figures unless otherwise stated.

Information

• ***You may use the*** booklet 'Statistical Formulae and Tables'

• There are **17** questions in this question paper. The total mark for this paper is ***229***

• The marks for **each** question are shown in brackets – use this as a guide as to how much time to spend on each question.

Advice

• Read each question carefully before you start to answer it.

• Try to answer every question.

• Check your answers if you have time at the end.

• If you change your mind about an answer, cross it out and put your new answer and any working underneath.

• Check your answers if you have time at the end.

AQA_JAN_2012_6

Q	Solution	Marks	Total	Comments
6	**See supplementary sheet for alternative solutions to parts (a)(i) and (b)(ii)**			
(a)(i)	Table Method (2- way with either R or C totals) *A* | *A′* | **Total** *E* | 0.55 | **0.05** | 0.60 *E′* | **0.30** | **0.10** | **0.40** **Total** | 0.85 | **0.15** | 1.00	B1 B1 Bdep1	 3	0.15 or 0.4; CAO; allow fractions 0.05 and 0.3; CAO; allow fractions 0.1; AG so dependent on B1 B1
(ii)	P(≥1) = 0.9 or 9/10	B1	1	CAO
(iii)	P(1) = 0.3 + 0.05 = 1 – (0.55 + 0.10) = 0.35 or 35/100 or 7/20	B1	1	CAO
(b)(i)	P(3) = 0.55 × 0.30 = 0.165 or 165/1000 or 33/200	B1 B1	 2	OE; implied by correct answer CAO
(ii)	0.55 × (1 – 0.3) or 0.385 (0.3 × 0.75) or 0.225 or (0.05 × 0.75) or 0.0375 or (0.35 × 0.75) or 0.2625 (0.385 + 0.2625) + 0.165 = 0.812 to 0.813 or $\frac{8125}{10000}$ or $\frac{1625}{2000}$ or $\frac{325}{400}$ or $\frac{65}{80}$ or $\frac{13}{16}$	M1 M1 B1 A1	 4	 At least one of these expressions or values OE; implied by correct answer AWFW (0.8125) CAO
		Total	**11**	

AQA_JAN_2013_5

Q	Solution	Marks	Total	Comments
5				**Ratios (eg 3:10) are only penalised by 1 accuracy mark at first correct answer**
(a)(i)	P(F & C) = **0.3 or 3/10 or 30%**	B1	**(1)**	CAO (0.3)
(ii)	P(G or S) = **0.45 or 45/100 or 45%**	B1	**(1)**	CAO (0.45)
(iii)	$P(C \mid F) = \frac{0.3 \text{ or } (i)}{0.55} =$	M1		
	30/55 or 6/11	A1		CAO (6/11)
	or			
	(0.54 to 0.55) or (54% to 55%)		**(2)**	AWFW (0.54545)
(iv)	$P(R' \mid D) = \frac{0.25 \text{ or } (0.30-0.05)}{0.30}$	M1 M1		Correct numerator Correct denominator
	25/30 or 5/6	A1		CAO (5/6)
	or			
	(0.83 to 0.834) or (83% to 83.4%)		**(3)**	AWFW (0.83333)
(v)	$P(F \mid C') = \frac{0.25 \text{ or } (0.60-0.35)}{0.60}$	M1		Correct expression
	25/60 or 5/12	A1		CAO (5/12)
	or			
	(0.416 to 0.42) or (41.6% to 42%)		**(2, 3)**	AWRT (0.41667)
			9	
(b)	$P = [P(F \& C)]^2 + [P(F \& G)]^2$	M1		Attempt at **sum of at least 2 squared terms; 0 < term < 1**; not $(a+b)^2$ May be implied by a **correct** expression or a **correct** answer
	$0.30^2 + 0.25^2$ **or** $0.09 + 0.0625 =$	A1		OE Ignore additional terms or integer multipliers May be implied by a **correct** answer
	1525/10000 or 305/2000 or 61/400	A1		CAO (0.1525)
	or			
	(0.152 to 0.153) or (15.2% to 15.3%)		**3**	AWFW
		Total	**12**	

AQA_JUNE_2012_4

Q	Solution	Marks	Total	Comments
4				**Ratios (eg 194:640) are only penalised by 1 accuracy mark at first correct answer**
(a)(i)	$P(B = 3) =$ **194/640 or 97/320 or 0.303 or 30.3%**	B1	1	CAO or AWRT (0.303125)
(ii)	$P(T \geq 2) = \frac{172+256+135}{640}$ **or** $1-\frac{77}{640}$ **or** $\frac{563}{640}$	M1		
	$= \underline{\mathbf{563/640}}$	A1	2	CAO
	or (0.879 to 0.88) or (87.9% to 88%)			AWFW (0.879688)
(iii)	$P(B = 3 \ \& \ T \geq 2) =$ $\frac{72+99+16}{640}$ **or** $\frac{194-7}{640}$ **or** $\frac{187}{640}$	M1		
	$= \underline{\mathbf{187/640 \text{ or } 0.292 \text{ or } 29.2\%}}$	A1	2	CAO or AWRT (0.292188)
(iv)	$P(B \leq 3 \mid T = 2) =$ $\frac{(14+67+72)}{172}$ **or** $\frac{172-19}{172}$ **or** $\frac{153}{172}$	M1		Correct numerator (accept both ÷ 640)
		M1		Correct denominator
	$= \underline{\mathbf{153/172}}$	A1	3	CAO
	or (0.888 to 0.89) or (88.8% to 89%)			AWFW (0.889535)
				Answers as fractions, percentages or ratios lose accuracy (A & B) marks in (b) & (c)
(b)	$(a)(i) \times (a)(ii) \neq (a)(iii)$ since	M1		Attempted
	$0.303 \times 0.88 =$ **0.265 to 0.27 ≠ 0.292**	A1	2	AWFW & AWRT
SC	Any **correct fully-explained** reasoning, using other than answers from part (a), which results in an inequality (≠) **with both sides as numerically correct decimals** (to 3 dp) ⇒ B1 (eg $P(B = 3) = 0.303 \neq P(B = 3 \mid T = 2) = 72/172 = 0.419$) but no/unclear/incomplete reasoning or no/incorrect/incomplete numerical work ⇒ B0			
(c)	$P(2T \cap 3T \cap \geq 4T \mid B = 3) = \frac{72}{194} \times \frac{99}{193} \times \frac{16}{192}$	M1		Correct 3 values multiplied in numerator
		M1		Correct 3 values multiplied in denominator $0.371 \times 0.513 \times 0.083$ (all AWRT) ⇒ M1 M1 (OE products)
	abc multiplied by 6 or 3	M1		$0 < (a, b \ \& \ c) < 1$
	$= \underline{\mathbf{0.095 \text{ to } 0.0952}}$	A1	4	AWFW (0.095187)
Notes	**1** Incorrect answer with no working ⇒ 0 marks **2** The **3 correct fractions/decimals** identified but not multiplied (eg added) ⇒ M1 M0 M0 A0 **3** The **3 correct fractions/decimals** identified together with 0.016 (AWRT) ⇒ M1 M1 M0 A0 **4** A denominator of ${}^{194}C_3 = 1198144$ ⇒ M2 (2nd & 3rd M1 marks)			
	Total		**14**	

AQA_JAN_2007_5

Q	Solution	Marks	Total	Comments
5(a)	$P(D' \cap E' \cap F') = 0.4 \times 0.3 \times 0.2$	M1		At least 1 probability correct
	$= 0.024$	A1	2	CAO; OE
(b)	$P(D' \cap E' \cap F) = 0.4 \times 0.3 \times 0.8$	M1		At least 2 probabilities correct
	$= 0.096$	A1	2	CAO; OE
(c)	P(One) = (b) + $P(D \cap E' \cap F') + P(D' \cap E \cap F')$	M1		Use of 3 possibilities; ignore multipliers
	$=$(b) + $(0.6 \times 0.3 \times 0.2) + (0.4 \times 0.7 \times 0.2)$	M1		At least 1 new term correct
	$= 0.096 + 0.036 + 0.056 = 0.188$	A1	3	CAO; OE
(d)	P(One or two) = (c) + (3 terms each of 3 probabilities) **or** = 1 – (a) – (1 term of 3 probabilities)	M1		(c) + P(Two) Used; OE; ignore multipliers 1 – (a) – P(Three)
	$= 0.188 + (0.6 \times 0.7 \times 0.2) +$ $(0.6 \times 0.3 \times 0.8) + (0.4 \times 0.7 \times 0.8)$ $= 0.188 + 0.084 + 0.144 + 0.224$ **or** $= 1 - 0.024 - (0.6 \times 0.7 \times 0.8)$ $= 1 - 0.024 - 0.336$	M1		At least 1 new term correct
	$= 0.64$	A1	3	CAO; OE
	Total		**10**	

AQA_JUNE_2013_5

Q	Solution	Marks	Total	Comments
5(a)(i)	$P(A = 2) = 0.90 \times 0.95 =$ **0.85 to 0.86**	B1		AWFW (0.855 or 171/200 OE)
(ii)	$P(A = 1) = (0.90 \times 0.05) + (0.10 \times 0.95)$ **or** $= 1 - [0.855 + (0.10 \times 0.05)]$	M1		May be implied by a **correct** answer Do **not** ignore extra terms
	= **0.14**	A1	3	CAO (7/50 OE)
(b)(i)	$P(A_W \cap D_W) = 0.90 \times 0.80$	M1		May be implied by a **correct** answer
	= **0.72**	A1	2	CAO (18/25 OE)
(ii)	$P(A_B \cap D_B) =$ (b)(i) $\times 0.95$ ($\times 1$) **or** $= 0.90 \times 0.80 \times 0.95$ ($\times 1$) **or** = (a)(i) $\times 0.80$	M1		May be implied by a **correct** answer
	0.68 to 0.685	A1	2	AWFW (0.684 or 171/250 OE)
(iii)	$P(A_T \cap D'_T) = 0.95 \times 0 =$ **0**	B1	1	CAO; award on value only
(iv)	P(neither) = $P([A'_W \cap D'_W] \cap [A'_T \cap D'_T])$			
	$(1 - 0.90) \times (1 - 0.15)$	M1		Accept 0.085 or 17/200 OE Award M1 and m1 on value(s) only
	$(1 - 0.95) \times (1 - 0)$	m1		Accept 0.05 or 1/20 OE
	or P(neither) = $P(A'_W \cap A'_T) \cap P(D'_W \mid A'_W) \cap P(D'_T \mid A'_T)$			
	$(1 - 0.90) \times (1 - 0.95)$	(M1)		Accept 0.005 or 1/200 OE Award M1 and m1 on value(s) only
	$(1 - 0.15) \times (1 - 0)$	(m1)		Accept 0.85 or 17/20 OE
	$= 0.085 \times 0.05$ **or** 0.005×0.85			OE
	= **0.0042 to 0.0043**	A1	3	AWFW (0.00425 or 17/4000 OE)
	Total		**11**	

Q	Solution	Marks	Total	Comments
5(a)(i)	$P(G') = 1 - 0.70 = 0.3(0)$	B1	1	CAO; OE
(ii)	$P(G \cap S') =$			
	$0.70 - (0.25 \text{ or } 0.55 \text{ or } 0.45)$	M1		Can be implied only if answer is correct
	or $1 - 0.55$			
	$= 0.45$	A1	2	CAO; OE
(iii)	$P(1 \text{ only}) =$			
	$0.70 + 0.55 - (2 \times 0.25)$			Can be implied only if answer is correct;
	or $1 - 0.25$	M1		allow no $(\times 2)$ but not by implication
	or $0.45 + 0.30$			from answer
	$= 0.75$	A1	2	CAO; OE
(b)	$P(G' \cap G' \cap G' \cap G') = [(a)(i)]^4$	M1		Can be implied by correct answer Ignore multiplier of 4
	$= 0.0081$	A1	2	CAO; OE
(c)	$P(H_G) = P(A_G \cap H_G) + P(A_{G'} \cap H_G) =$			
	(0.70×0.60) or 0.42	M1		Can be implied by correct answer Ignore additional terms
	(0.30×0.10) or 0.03	M1		Can be implied by correct answer
	$= 0.42 + 0.03 = 0.45$	A1	3	CAO; OE
(d)	$P(H_O) = 1 - [0.35 + (c)]$	M1		Can be implied by correct answer
	$= 0.2(0)$	A1	2	CAO; OE
	Total		**12**	

AQA_JAN_2009_4

Q	Solution	Marks	Total	Comments
4	$P(C) = 0.6 \quad P(C \cap B) = 0.25$ $\{P(C \text{ only}) = 0.35 \quad P(B \text{ only}) = 0.4\}$			*In (a), ratios (eg 4 : 10) are only penalised by 1 mark at first correct answer*
(a) (i)	$P(C') = 1 - P(C) = 1 - 0.6 = 0.4$	B1	1	CAO; or equivalent
(ii)	$P(C \cap B') = 0.6 - 0.25$ $= 1 - (0.4 + 0.25)$ $= 0.35$	M1 A1	2	Can be implied by correct answer CAO; or equivalent
(iii)	$P(B) =$ (i) $+ p$ with $p < 0.6$ $=$ (i) $+ 0.25$ $= 0.65$ **OR** $P(B) = 1 -$ (ii) $= 0.65$ **OR** $1 = P(C) + P(B) - P(C \cap B)$ Thus $P(B) = 1 - (0.6 - 0.25)$ $= 0.65$	M1 A1 A1 (M2) (A1) (M1) (A1) (A1)	3	Can be implied by correct answer Can be implied by correct answer CAO; or equivalent Can be implied by correct answer Can be implied by correct answer Can be implied by correct answer CAO; or equivalent
(b)	$P(L \mid G_C) = 0.9 \quad P(L \mid G_{CB}) = 0.7$ $P(L \mid G_B) = 0.3$			
(i)	$P(G \cap L) \Rightarrow$ (a)(ii) $\times$ 0.9 (0.315) 0.25×0.7 (0.175) [(a)(iii) $- 0.25$] $\times 0.3$ (0.12) Note: Each pair of multiplied probabilities must be > 0 to score the corresponding method mark $\Rightarrow 0.315 + 0.175 + 0.12 = 0.61$	M1 M1 M1 A1	4	Follow through or correct Follow through or correct Ignore any multiplying factors Ignore any additional terms CAO
(ii)	Probability $= \{1 -$ (b)(i)$\}^5$ $= 0.39^5 = 0.009$	M1 A1	2	Allow $5 \times \{1 -$ (b)(i)$\}^5$ AWRT (0.00902)
		Total	**12**	

AQA_JAN_2010_4

Q	Solution	Marks	Total	Comments
				Ratios (eg 65:1000) are only penalised by 1 mark at first correct answer
4(a)(i)	P(all 3 walk) = 0.65 × 0.40 × 0.25	M1		Can be implied by **correct** answer
	= 65/1000 = 13/200 = 0.065	A1	2	CAO; do not confuse with 0.65
(ii)	P(Rita by bus) = 0.25×(1−0.15)×(1−0.20)	M1		Can be implied by **correct** answer
	= 17/100 = 0.17	A1	2	CAO
(iii)	P(2 cycle) = 0.10 × 0.45 × (0.25 + 0.20) = 0.02025 + 0.10 × (0.40 + 0.15) × 0.55 = 0.03025 + (0.65 + 0.25) × 0.45 × 0.55 = 0.22275 (0.27325)	B1		CAO at least 1 of these 3 terms or equivalent but allow a '× 3'
	P(3 cycle) = 0.10 × 0.45 × 0.55 = 0.02475	B1		CAO
	P(≥ 2 cycle) = P(2 cycle) + P(3 cycle)	M1		Sum of 4 or 7 terms each a product of 3 probabilities but not '× 3'
	= 0.298	A1	4	CAO
	or P(0 cycle) = 0.90 × 0.55 × 0.45 = 0.22275	(B1)		CAO
	P(1 cycles) = 0.10 × 0.55 × 0.45 = 0.02475 + 0.90 × 0.45 × 0.45 = 0.18225 (0.47925) + 0.90 × 0.55 × 0.55 = 0.27225	(B1)		CAO at least 1 of these 3 terms but allow a '× 3'
	P(≥ 2 cycle) = 1 − [P(0 cycle) + P(1 cycles)]	(M1)		1 − [sum of 4 terms each a product of 3 probabilities but not '× 3']
	1 − 0.702 = 0.298	(A1)		CAO
(b)(i)	P(WW) = (0.65 × 0.90) = 0.585 P(CC) = (0.10 × 0.70) = 0.070	B1		CAO either
	P(WW or CC) = 0.585 + 0.070	M1		Sum of 2 terms each a product of 2 probabilities
	= 0.655	A1	3	CAO; or equivalent
(ii)	P(different) = 1 − (b)(i) = 0.345	B1F	1	F on (b)(i) providing $0 < p < 1$
		Total	**12**	

Q	Solution	Marks	Total	Comments
2(a)(i)	$P(M \cap C) = \frac{175}{645} = \frac{35}{129} = 0.271$	B1	1	AWRT; accept either correct fraction
(ii)	$P(M) = \frac{519}{645} = \frac{173}{215} = 0.804$ to 0.805	B1	1	AWFW; accept either correct fraction
(iii)	$P(LD) = \frac{63}{645} = \frac{21}{215} = 0.097$ to 0.098	B1	1	AWFW; accept either correct fraction
(iv)	$P(L\|F) = \frac{94}{126} = \frac{47}{63}$	M1		Accept $\frac{94}{645} \div \frac{126}{645}$
	$= 0.746$	A1	2	AWRT
(v)	$P(M\|L') = \frac{519-255}{645-349} = \frac{175+54+35}{193+63+40}$	M1 M1		Allow one arithmetic slip Allow one arithmetic slip
	$= \frac{264}{296} = \frac{132}{148} = \frac{66}{74} = \frac{33}{37}$			Any of these implies M1 M1
	$= 0.891$ to 0.893	A1	3	AWFW
(b)	$P(L \cap L\|F) = \left(\frac{94}{126} \times \frac{93}{125}\right)$ or $\frac{8742}{15750}$	B1		Or $\left(\frac{47}{63} \times \frac{93}{125}\right)$ or $\frac{4371}{7875}$ or $\frac{1457}{2625}$
	$= 0.555$	B1	2	AWRT
(c)	$P(L \cap C \cap (LD + O))$			
	$= \frac{349}{645} \times \frac{193}{644} \times \frac{63+40}{643}$	M1 M1		Correct numerator Correct denominator
	SC The three correct fractions identified but not multiplied $\Rightarrow$ M1 M0 M0 A0			
	$\times 6$ or 3	M1		Note that a denominator of $\binom{645}{3}$ $\Rightarrow$ M2 (second and third M1 marks)
	$= 0.155$ to 0.157	A1	4	AWFW
	NB: 0.026 with no working $\Rightarrow$ M1 only $0.026 \times 6 = 0.156$ with no working $\Rightarrow$ 4 marks			
	Total		**14**	

AQA_JUNE_2007_2

Q	Solution	Marks	Total	Comments
2	Ratios: Penalise first occurrence only of a correct answer			
(a)(i)	P(Welsh back) = $\frac{7}{50}$ or 0.14	B1	1	CAO; OE
(ii)	P(English) = $\frac{14+8}{50}$ =	B1		Correct expression; PI
	$\frac{22}{50}$ or $\frac{11}{25}$ or 0.44	B1	2	CAO; OE
(iii)	P(not English) = 1 – (ii) =			
	$\frac{28}{50}$ or $\frac{14}{25}$ or 0.56	B1√	1	√ on (ii) if used; $0 < p < 1$
(iv)	P(Irish | back) = $\frac{P(\text{Irish} \cap \text{back})}{P(\text{back})} = \frac{6}{\sum(\text{back})}$ =	M1		Used; may be implied by values or answer
	$\frac{6}{23}$ or 0.26 to 0.261	A1	2	CAO/AWFW (6/50 ⇒ 0)
(v)	P(forward | not Scottish) = $\frac{P(\text{forward} \cap \text{not Scottish})}{P(\text{not Scottish})}$ = $\frac{14+5+6}{50-4} = \frac{27-2}{50-4}$ =	M1		Used; OE May be implied by values or answer
	$\frac{25}{46}$ or 0.54 to 0.544	A1	2	CAO/AWFW (25/50 ⇒ 0)
(b)	P(4 × English) =			
	$\left(\frac{22}{50}\right)\times\left(\frac{21}{49}\right)\times\left(\frac{20}{48}\right)\times\left(\frac{19}{47}\right)$ =	M1 M1		Reducing non-tabulated value 4 times Reducing 50 and multiplying 4 terms (ignore multipliers)
	$\frac{175560}{5527200}$ or $\frac{209}{6580}$			
	or 0.0317 to 0.032	A1	3	CAO/AWFW
	Total		**11**	

AQA_JUNE_2008_2

Q	Solution	Marks	Total	Comments
2(a)	$\text{P}(Blue) = \frac{160}{400} = 0.4$ or $\frac{2}{5}$ or $\frac{160}{400}$	B1	1	CAO; or equivalent
	In (b) to (e), method marks are for single fractions, or equivalents, only			
(b)	$\text{P}(Marker) = \frac{280}{400}$	M1		$270 \leq$ Numerator ≤ 290 and Numerator < Denominator ≤ 400
	$= 0.7$ or $\frac{7}{10}$ or $\frac{280}{400}$	A1	2	CAO; or equivalent
(c)	$\text{P}(B \text{ or } M) = \text{P}(B \cup M) =$			
	$\frac{160+280-119}{400} = \frac{280+41}{400} = \frac{321}{400}$	M1		$290 \leq$ Numerator ≤ 321 and Numerator < Denominator ≤ 400
	$= 0.802$ to 0.803 or $\frac{321}{400}$	A1	2	AWFW/CAO (0.8025)
(d)	$\text{P}(Green \mid Highlighter) = \text{P}(G \mid H) = \frac{42}{120}$	M1		Numerator = 42 and $110 \leq$ Denominator ≤ 120
	$= 0.35$ or $\frac{7}{20}$ or $\frac{42}{120}$	A1	2	CAO; or equivalent
(e)	$\text{P}(Non\text{-}Permanent \mid Red) = \text{P}(P' \mid R) = \frac{21}{90}$	M1		Numerator = 21 and $80 \leq$ Denominator ≤ 90
	$= 0.233$ to 0.234 or $\frac{7}{30}$ or $\frac{21}{90}$	A1	2	AWFW/CAO (0.2333)
	Total		**9**	

AQA_JUNE_2009_1

Q	Solution	Marks	Total	Comments
1(a)				**In (a), ratios (eg 100:160) are only penalised by 1 mark at first correct answer**
(i)	$P(P) = 100/160 = 50/80 = 25/40 = 10/16$ $= 5/8 = 0.625$	B1	1	CAO
(ii)	$P(S') = 1 - \frac{32}{160}$ **or** $P(S) = \frac{32}{160}$	M1		Or equivalent Ignore labels of S' & S Can be implied by **correct** answer
	$= 128/160 = 64/80 = 32/40 = 16/20 = 8/10$ $= 4/5 = 0.8$	A1	2	CAO
(iii)	$P(S \text{ or } H) = P(S \cup H) =$ $\frac{60+32-18}{160}$ **or** $\frac{60+14}{160}$ **or** $\frac{32+8+16+18}{160}$	M1		Or equivalent Can be implied by **correct** answer
	$= 74/160 = 37/80 = 0.462$ to 0.463	A1	2	CAO/AWFW (0.4625)
(iv)	$P(T \mid P) = \frac{30/160}{\text{(i)}}$	M1		Or equivalent Can be implied by **correct** answer But watch for $18/160$ or $48/160$
	$= 3/100 = 3/10 = 0.3$	A1	2	CAO
(b)	$P(1C \ \& \ 1R \ \& \ 1S) =$			
	$\frac{24}{160} \times \frac{56}{159} \times \frac{32}{158}$	M1		Multiplication of any 3 different given subject totals
		M1		Multiplication of 160, 159 & 158
	$(0.15 \times 0.35220 \times 0.20253)$ $\times 6$	M1		Accept 3dp accuracy Award for $3 \leq$ multiplier ≤ 6
	$= 0.064$ to 0.0644	A1		AWFW (0.0642) Do not accept a fraction as answer A **correct** answer can imply 4 marks
	Special Case: (Any given subject total) ÷ 160 seen anywhere in (b)	(M1)	4	Can award if no marks scored in (b) Accept a decimal equivalent
		Total	**11**	

AQA_JUNE_2011_5

Q	Solution	Marks	Total	Comments
5 (a)(i)				
		B1		**0.35 and 0.7**; CAO
		B1		**0.55**; CAO
		B1	3	**0.1 and 0.2**; CAO
	Notes: Use of Venn or tree diagrams **without** table completion ⇒ B0 B0 B0 Printed table not completed but constructed and completed on Page 12/13 ⇒ B1 B1 B1 max			Accept fractional answers Do not accept percentages
(ii)	P(purchases exactly one) $= P(W \cap J') + 0.15$ $= 0.10 + 0.15$ $=$ **0.25 or 25/100 or 5/20 or 1/4**	M1 A1	2	Only c's equivalent to 0.10 **shown and added to** 0.15 Can be implied by **correct** answer CAO
(iii) (A)	$P(W \cup J) =$ **0.8** **&/≠** $P(W) + P(J) =$ **1.35** **or** $P(W \cap J) =$ **0.55** (>0); accept if indicated in a Venn diagram **or** $P(W) + P(J) =$ **1.35 >0 or impossible**	B1		Any one of these three **seen** *Ignore contradictions, explanations & justifications* *Do **not** accept use of W' and/or J'*
(B)	$P(W \mid J) = 0.55/0.70 =$ **0.79** **&/≠** $P(W) =$ **0.65** **or** $P(J \mid W) = 0.55/0.65 =$ **0.85** **&/≠** $P(J) =$ **0.70** **or** $P(W) \times P(J) =$ **0.45 to 0.46** **&/≠** $P(W \cap J) =$ **0.55**	B1 Bdep1	3	AWRT Any one of these three **seen** *Ignore contradictions, explanations & justifications* AWFW
(b)	**Do not allow multiplying factors in (b)**			
(i)	$P(0) = 0.15 \times 0.40 \times 0.45$ $=$ **0.027 or 27/1000**	B1 B1	2	Can be implied by **correct** answer or $1 - (0.2265 + 0.466 + 0.2805)$ CAO
(ii)	$P(2) =$ **0.85 × 0.60 × 0.45** $= 0.2295$ $+$ **0.85 × 0.40 × 0.55** $= 0.1870$ $+$ **0.15 × 0.60 × 0.55** $= 0.0495$ **or** $= 1 -$ **(0.027 + 0.2265 + 0.2805)** $=$ **0.466 or 466/1000 or 233/500**	M2 (M1) A1	3	*For either method:* **At least two bold** expressions correct **Only one bold** expression correct Can be implied by **correct** answer *For second method:* Must have '1 –' for any marks CAO; **do not** imply this from (i)
	Total		**13**	

AQA_JUNE_2017_4

Q	Solution	Marks	Total	Comments
4	**Accept the equivalent percentage answers with %-sign (see GN5)**			
(a) (i)	$P(A \cup B) = 0.45 + 0.20 =$ **0.65 or 13/20**	B1	(1)	CAO; accept 65/100
(ii)	$P(A \cap B) = 0.45 \times 0.20 =$ **0.09 or 9/100**	B1	(1)	CAO
(iii)	$P(A \cup B) = 0.45 + 0.20 - 0.09$ $= 0.56$ **or 14/25**	B1	(1)	CAO; accept 56/100 or 28/50
			3	
(b) (i)	$P(C' \cap D' \cap E') = 0.95 \times 0.91 \times 0.88$	M1		
	$= 0.76$ **to 0.761**	A1	(2)	AWFW (0.76076)
(ii)	$P(C' \cap D' \cap E) = 0.95 \times 0.91 \times 0.12$ $= 0.103$ **to 0.104**	B1	(1)	AWFW (0.10374)
(iii)	P(1 late) = 0.05 × 0.91 × 0.88 = 0.04004 + 0.95 × 0.09 × 0.88 = 0.07524 + (ii) = 0.10374	M1		Three combinations (≥2 correct)
	$= 0.219$ **to 0.22**	A1	(2)	AWFW (0.21902)
(iv)	P(≥2 late) = 1 − P(0 or 1 late) = 1 − ((i) + (iii))	M1		
	= 1 − (0.76076 + 0.21902) = **0.02 to 0.021**	A1		AWFW (0.02022)
	OR			
	P(≥2 late) = P(2 or 3 late) = 0.05 × 0.09 × 0.88 = 0.00396 + 0.05 × 0.91 × 0.12 = 0.00546 + 0.95 × 0.09 × 0.12 = 0.01026 + 0.05 × 0.09 × 0.12 = 0.00054	(M1)		Requires addition of (≥2 of 1st 3 terms) and (4th term)
	$= 0.02$ **to 0.021**	(A1)	(2)	AWFW (0.02022)
			7	
		Total	**10**	

AQA_JUNE_2015_4

Q	Solution	Marks	Total	Comments
4				Accept percentage equivalent answers in (a)(ii) & (a)(iii) but see GN3
(a)(i)				
		B1		0.12; CAO
		B1		0.4(0) and 0.72; CAO
		B1		0.24 and 0.48; CAO
			3	
(ii)	P(Buys exactly 1) = 0.12 + [0.24 or P($E' \cap M$) from (i)]	M1		
	= **0.36**	A1		CAO
			2	
(iii)	P($M \cap E$) = **0.16** which is **greater than/not equal to 0**	B2		**Correct** comparison of 0.16 with 0
	or			
	P($M \cup E$) = 1 − 0.48 = **0.52** but P(M) + P(E) = 0.40 + 0.28 = **0.68**	(B2)		**Correct** comparison of 0.52 with 0.68
			2	

Q	Solution	Marks	Total	Comments
4	**Continued** Part (a)	Total	7	
(b)				Accept percentage equivalent answers in (b) & (c)(ii) but see GN3
				(No marks for this table; it is simply here to help marking)
(i)	P(4 papers) = P($M \cap E \cap S \cap T$) =			
	0.16 × (0.85 × 0.20) **or** 0.16 × 0.17	M1		All correct Can be implied by a **correct** answer
	= **0.027**	A1		AWRT (0.0272)
			2	
(ii)	P(0 papers) = P($M' \cap E' \cap S' \cap T'$) =			
	0.48 × **(0.15 × 0.25)** **or** 0.48 × **0.0375**	M1		Seen Can be implied by a **correct** answer
	= **0.018**	A1		CAO (0.018)
			2	
(c) (i)	Chris (only) buys a **Friday morning** (newspaper) and a **Saturday** (morning) newspaper	B1 B1		Ignore additional comments about what he also does not buy
			2	
SCs	**1** "Chris does not buy either a Friday evening or a Sunday (morning) newspaper" (OE) ⇒ B1 **2** Statements of the form "(Friday morning) × (Saturday morning)" (OE) ⇒ B1 **3** Statements involving "probability and/or intersection" ⇒ B1 max			
(ii)	P($M \cap E' \cap S \cap T'$) =			
	0.24 × **(0.85 × 0.80)** **or** 0.24 × **0.68**	M1		Seen Can be implied by a **correct** answer
	= **0.163**	A1		AWRT (0.1632)
			2	
Note	**1** (0.40 × 0.72 × 0.85 × 0.80) = 0.19584 ⇒ M0 A0			
		Total	15	

AQA_JUNE_2015_4

Q	Solution	Marks	Total	Comments
4	**No MR or MC in this question**			
Notes	**1** **Percentage** answers must be penalised by **1 accuracy mark** at first **correct** answer only if no indication of percentage shown **2** **Ratio** answers (eg 4:5) are only acceptable in **(a)** and must be penalised by **1 accuracy mark** at first **correct** answer			
(a)(i)	$P(\geq 1) = 0.70 + 0.55 - 0.45 =$	M1		OE; eg $0.25 + 0.45 + 0.1$
	0.8 or 4/5 or 80%	A1	**(2)**	CAO
(ii)	$P(=1) = (i) - 0.45 = 0.25 + 0.1$			
	0.35 or 35/100 or 7/20 or 35%	AF1	**(1)**	F on (i) $0 < p < 1$
			3	
Note	**1** If answers to (i) & (ii) are correct but reversed, then award M1 A0 AF0			
(b)	$P(A) \times P(M) =$ **0.70 × 0.55 or 0.385**	B1		OE
	0.385 ≠ 0.45 or < 0.45	B1	**2**	Must compare to 0.45 OE **and** compare 'like with like'
Notes	**1** $P(M \mid A) =$ **0.45/0.70** $\neq P(M \mid A') =$ **0.10/0.30** $\neq P(M) =$ **0.55** $\Rightarrow$ B1 for any 2 (OE) values, B1 for comparison **2** $P(A \mid M) =$ **0.45/0.55** $\neq P(A \mid M') =$ **0.25/0.45** $\neq P(A) =$ **0.70** $\Rightarrow$ B1 for any 2 (OE) values, B1 for comparison			
(c)(i)	$P(AMBN) = (0.45$ **or** 0.385 **or** $0.70 \times 0.55) \times 0.85 \times 0.65$	M1		Can be implied by a **correct** answer Ignore any integer multipliers (eg 4)
	= **0.248 to 0.25 or 24.8% to 25%**	A1	**2**	AWFW (0.248625)
Notes	**1** Use of 0.385 gives an answer of 0.2127125 (0.212 to 0.213 AWFW) $\Rightarrow$ M1 A0 **2** The **3 correct terms** identified but not multiplied (eg added) $\Rightarrow$ M0 A0			
(ii)	$P(A'M'B'N') = P(A'M') \times P(B'N') = p \times P(B'N')$			
	$p =$ **0.2**	B1		CAO; can be implied from working or from a **correct** answer
	$p \times (0.15 \times 0.35)$	M1		$0 < p < 1$ Can be implied by a **correct** answer Ignore any integer multipliers (eg 4)
	= **0.01 to 0.011 or 1% to 1.1%**	A1	**3**	AWFW (0.0105)
Notes	**1** Use of $p = 0.3 \times 0.45 = 0.135$ gives answer of 0.0070875 (0.007 AWRT) $\Rightarrow$ B0 M1 A0 **2** The **3 correct terms** identified but not multiplied (eg added) $\Rightarrow$ B1 M0 A0			
		Total	**10**	

AQA_JUNE_2016_4

Q	Solution	Marks	Total	Comments
4(a)	**Accept the equivalent percentage answers with %-sign (see GN5)**			
(i)	P(CW) = **110/400 = 55/200 = 11/40 = 0.275**	B1	**(1)**	CAO; either of four listed answers
(ii)	P(SW ∩ H) = **56/400 = 28/200 = 14/100 = 7/50 = 0.14**	B1	**(1)**	CAO; any one of five listed answers
(iii)	$P(B \cap (H \cup C)) = \frac{30+24+24+26}{400} = \frac{104}{400} =$	M1		Numerator CAO
	104/400 = 52/200 = 26/100 = 13/50 = 0.26	A1	**(2)**	CAO; any one of five listed answers
(iv)	P(SW | C) = $\frac{45/400}{120/400}$ **or** $\frac{45}{120}$ =	M1		Fraction CAO
	45/120 = 15/40 = 9/24 = 3/8 = 0.375	A1	**(2)**	CAO; any one of four listed answers
(v)	P((E ∪ C) | W) = $\frac{(32+17+21+14)/400}{(150+110)/400}$ **or** $\frac{84}{260}$ =	M1		Numerator CAO
		M1		Denominator CAO
	$\frac{42}{130}$ **or** $\frac{21}{65}$ =	(M2)		
	42/130 = 21/65 = 0.323	A1	**(3)**	CAO/AWRT (0.32308)
			9	
(b)	$P(W \cap C) = \frac{45+25}{400}$ **or** $\frac{70}{400}$ (p_1)	B1		CAO; OE $\left(\frac{7}{40}, 0.175\right)$ Seen anywhere, even in an incorrect expression
	$P(B \cap H) = \frac{30+24}{400}$ **or** $\frac{54}{400}$ (p_2)	B1		CAO; OE $\left(\frac{27}{200}, 0.135\right)$ Seen anywhere, even in an incorrect expression
	Prob = $(p_1)^2 \times (p_2)^2$	M1		Providing $0 < p_1, p_2 < 1$ $(p_1 \times p_2 \times p_3 \times p_4) \Rightarrow$ M0
	$\times \binom{4}{2}$ or 6	m1		
	= **0.00334 to 0.00335**	A1	**5**	AWFW (0.0033488)
SCs	**1** Answer of 0.00056 (AWRT) without working ⇒ B1 B1 M1 m0 A0 **2** Answer of 0.02362 to 0.02363 (AWFW) without working ⇒ B1 B1 M0 m0 A0 **3** In each of the following (incorrect) expressions, $(\otimes \Rightarrow \times \text{ or } +)$ and ignore the value of n: $\left(\frac{70}{400} \otimes \frac{69}{400} \otimes \frac{54}{400} \otimes \frac{53}{400}\right) \times n$ ⇒ B1 B1 and $\left(\frac{70}{400} \otimes \frac{69}{399} \otimes \frac{54}{398} \otimes \frac{53}{397}\right) \times n$ ⇒ B1			
		Total	**14**	