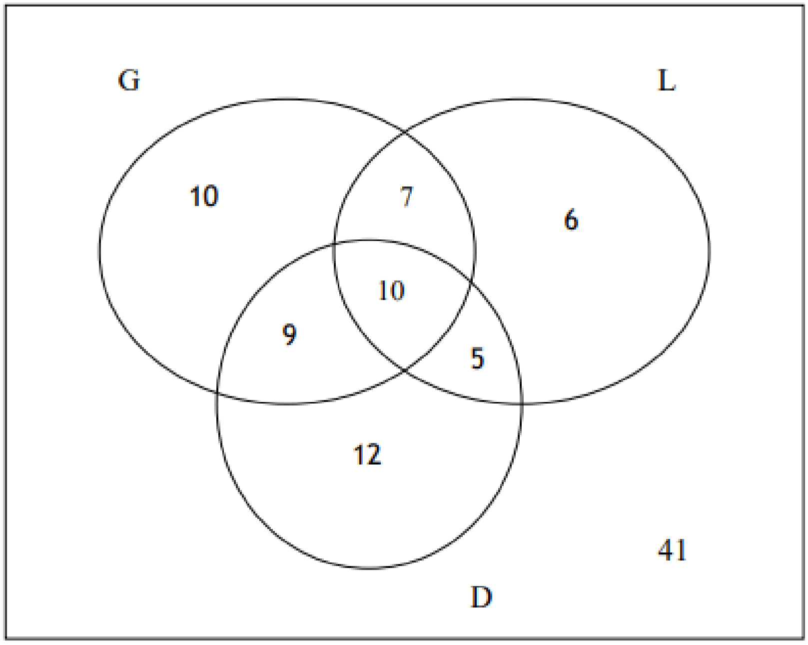
Conditional Probability and Venn Diagrams (From Edexcel 6683)

Q1, (Jun 2006, Q6)

(a)



3 closed curves that intersect — **M1**

Subtract at either stage — **M1**

9,7,5 — **A1**

10,6,12 — **A1**

41 & box — **A1**

(6)

(b) $P(G,\overline{LH},\overline{D}) = \frac{10}{100} = \frac{1}{10}$ — **B1∫**

(1)

(c) $P(\overline{G},\overline{LH},\overline{D}) = \frac{41}{100}$ — **B1∫**

(1)

(d) $\text{P(Only two attributes)} = \frac{9+7+5}{100} = \frac{21}{100}$ — **M1A1∫**

(2)

(e) $P(G \mid LH\&DH) = \frac{P(G\ \&\ LH\ \&\ DH)}{P(LH\ \&\ DH)} = \frac{\frac{10}{100}}{\frac{15}{100}} = \frac{10}{15} = \frac{2}{3}$ awrt 0.667 — **M1A1∫A1**

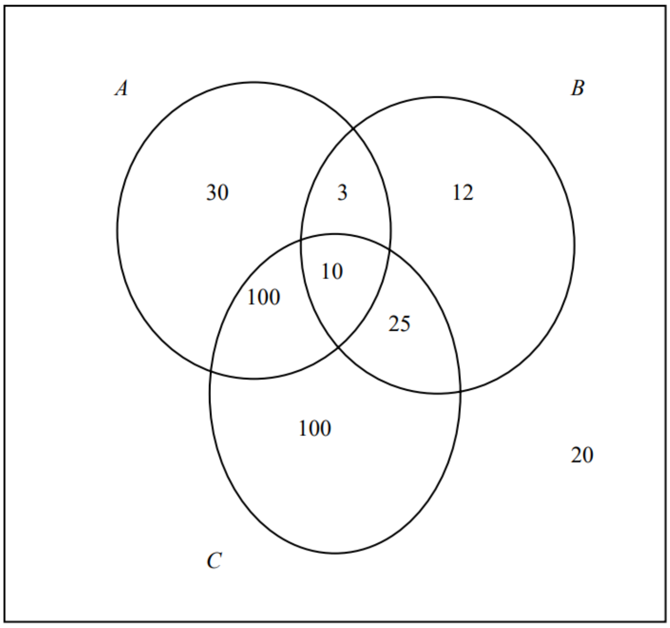
N.B. Assumption of independence M0

(3)

Total 13

Q2,(Jun 2008, Q5)

(a)



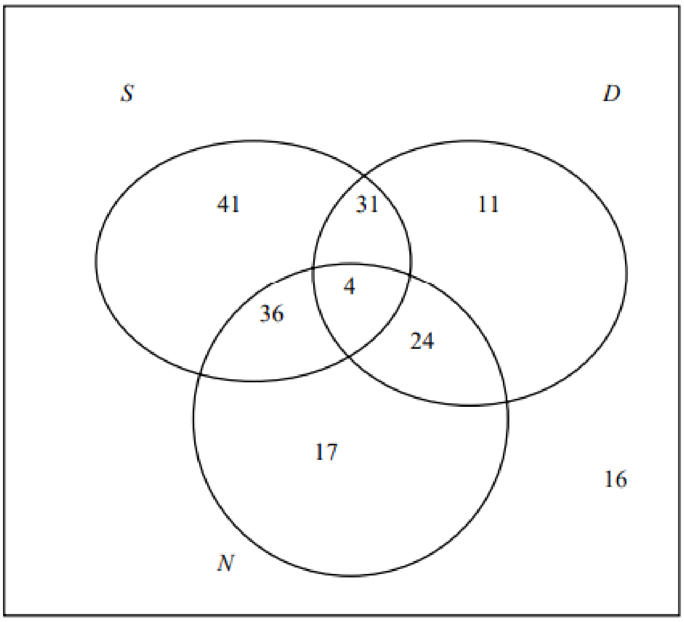
(a)		3 closed intersecting curves with labels	M1
		100 100,30	A1
		12,10,3,25	A1
		Box	B1
			[4]
(b)	$\text{P(Substance } C) = \dfrac{100+100+10+25}{300} = \dfrac{235}{300} = \dfrac{47}{60}$ or exact equivalent		M1A1ft [2]
(c)	$\text{P(All 3} \mid A) = \dfrac{10}{30+3+10+100} = \dfrac{10}{143}$ or exact equivalent		M1A1ft [2]
(d)	$\text{P(Universal donor)} = \dfrac{20}{300} = \dfrac{1}{15}$ or exact equivalent		M1A1 cao [2]
			Total 10

Notes:

(a) 20 not required. Fractions and exact equivalent decimals or percentages.
(b) M1 For adding their positive values in C and finding a probability
A1ft for correct answer or answer from their working
(c) M1 their 10 divided by their sum of values in A
A1ft for correct answer or answer from their working
(d) M1 for 'their 20' divided by 300
A1 correct answer only

Q3, (Jan 2010, Q4)

(a)

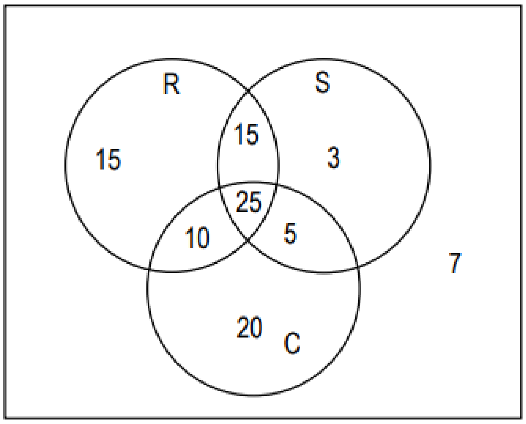


(a)	3 closed curves and 4 in centre	M1
	Evidence of subtraction	M1
	31,36,24	A1
	41,17,11	A1
	Labels on loops, 16 and box	B1
		(5)
(b)	P(None of the 3 options)$=\frac{16}{180}=\frac{4}{45}$	B1ft (1)
(c)	P(Networking only)$=\frac{17}{180}$	B1ft (1)
(d)	P(All 3 options/technician)$=\frac{4}{40}=\frac{1}{10}$	M1 A1 (2)
		Total [9]

Q4, (Jun 2010, 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)	$\text{P}(A\cap C)=0$	B1 (1)
(d)	$\text{P(C}\mid\text{reads at least one magazine)}=\frac{6+3}{20}=\frac{9}{20}$	M1 A1 (2)
(e)	$\text{P}(B)=\frac{10}{30}=\frac{1}{3}$, $\text{P}(C)=\frac{9}{30}=\frac{3}{10}$, $\text{P}(B\cap C)=\frac{3}{30}=\frac{1}{10}$ or $\text{P}(B\mid C)=\frac{3}{9}$	M1
	$\text{P}(B)\times\text{P}(C)=\frac{1}{3}\times\frac{3}{10}=\frac{1}{10}=\text{P}(B\cap C)$ or $\text{P}(B\mid C)=\frac{3}{9}=\frac{1}{3}=\text{P}(B)$	M1
	So yes they are statistically independent	A1cso (3)
		Total 10

Q5, (Jan 2012, Q6)

(a)		3 closed curves and 25 in correct place 15,10,5 15,3,20 Labels R, S, C and box	M1 A1 A1 B1
	All values/100 or equivalent fractions award accuracy marks.		(4)
(b)	7/100 or 0.07	M1 for ('their 7'in diagram or here)/100	M1 A1 (2)
(c)	(3+5)/100 = 2/25 or 0.08		M1A1 (2)
(d)	(25+15+10+5)/100 = 11/20 or 0.55		M1 A1 (2)
(e)	$P(S \cap C' \mid R) = \dfrac{P(S \cap C' \cap R)}{P(R)}$	Require denominator to be 'their 65' or 'their $\dfrac{65}{100}$'	M1
	$= \dfrac{15}{65}$	require 'their 15' and correct denominator of 65	A1
	$= \dfrac{3}{13}$ or exact equivalents.		A1
			(3)
			Total 13

Q6, (Jun 2007, Q4)

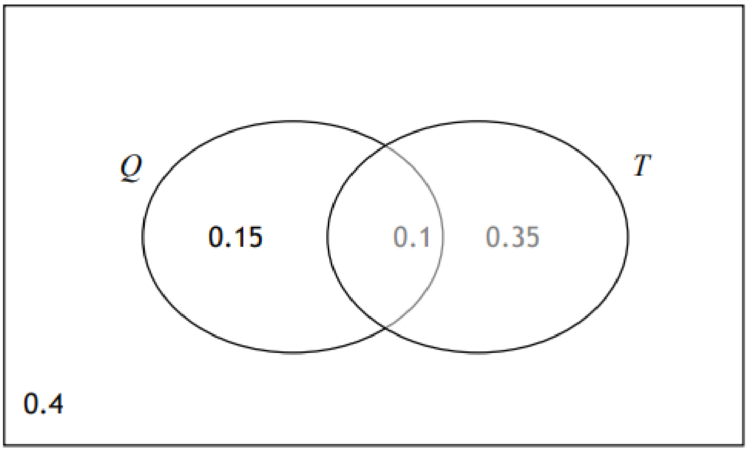
(a) $P(Q \cup T) = 0.6$ — **B1**

$P(Q) + P(T) - P(Q \cap T) = 0.6$ — **M1**

$P(Q \cap T) = 0.1$ — **A1**

(3)

(b)



Venn — **M1**

0.15, 0.35 — **A1**∫

0.4 and box — **B1**

(3)

(c) $P(Q \cap T' | Q \cup T) = \frac{0.15}{0.60} = \frac{1}{4}$ or 0.25 or 25% — **M1A1∫A1**

(3)

Total 9 marks

Q7, (Jan 2013, Q7)

(a) $P(A \cup B) = 0.35 + 0.45 - 0.13$ or $0.22 + 0.13 + 0.32$ — M1

$= \underline{0.67}$ — A1

(2)

(b) $P(A' | B') = \frac{P(A' \cap B')}{P(B')}$ or $\frac{0.33}{0.55}$ — M1

$= \frac{3}{5}$ or 0.6 — A1

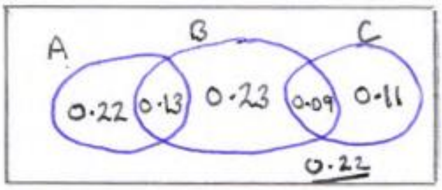
(2)

(c) $P(B \cap C) = 0.45 \times 0.2$ — M1

$= \underline{0.09}$ — 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. — M1

$= \underline{0.44}$ — A1 (2)

12

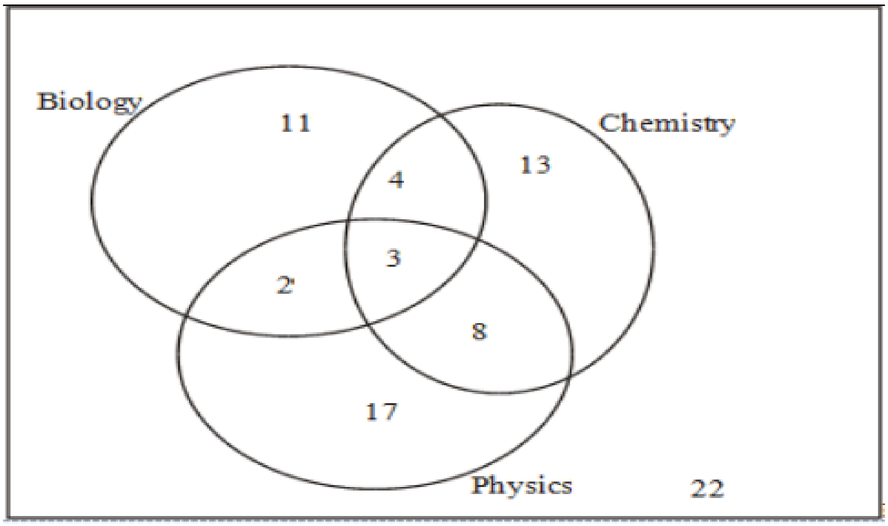
Q8, (Jun 2014, Q8)

(a)	$[\mathrm{P}(A) = 1 - 0.18 - 0.22\ ] \quad = \quad \mathbf{0.6}$ (or exact equivalent)	B1
		(1)
(b)	$\mathrm{P}(A \cup B) = \text{"}0.6\text{"} + 0.22 \quad = \quad \mathbf{0.82}$ (or exact equivalent)	B1ft
		(1)
(c)	$x = \mathrm{P}(A \cap B)$ | Use $\mathrm{P}(B)\mathrm{P}(A' \mid B) = \mathrm{P}(A' \cap B)$ | **Establish** independence before or after 1st M1and score marks for (d) (RH ver)	M1
	$\frac{x}{x+0.22} = 0.6$ | $\mathrm{P}(B) \times [1 - 0.6] = 0.22$ | **Find** $\mathrm{P}(B)$	
	$x = 0.6x + 0.132$ | Use $\mathrm{P}(A \cap B) = \mathrm{P}(A \mid B)\mathrm{P}(B)$ | Use $\mathrm{P}(B)\mathrm{P}(A) = \mathrm{P}(A \cap B)$	dM1
	$0.4x = 0.132$ | $\mathrm{P}(A \cap B) = 0.6 \times 0.55$ | $\mathrm{P}(A \cap B) = 0.6 \times 0.55$	
	$x = \mathbf{0.33}$ (or exact equivalent)	A1cso
		(3)
(d)	$\mathrm{P}(B) = 0.55$	
	$\mathrm{P}(B) \times \mathrm{P}(A) = 0.55 \times 0.6$ | **or** stating $\mathrm{P}(A) = \mathrm{P}(A \mid B)\ [= 0.6]$	M1
	$= 0.33$	
	$\mathrm{P}(B) \times \mathrm{P}(A) = \mathrm{P}(A \cap B)$ therefore (statistically) independent | **or** $\mathrm{P}(A) = \mathrm{P}(A \mid B)$ therefore (statistically) independent	A1cso **(2)**
		Total 7

Q9, (Jun 2013(R), Q6)

(a)	$[\mathrm{P}(B) = 0.4,\ \mathrm{P}(A) = p + 0.1 \text{ so}] \quad 0.4 \times (p + 0.1) = 0.1$ or $0.4 \times \mathrm{P}(A) = 0.1$	M1
	$p = \frac{1}{4} - 0.1$ $\quad$ $\underline{\mathbf{p = 0.15}}$	M1A1 (3)
(b)	$\frac{5}{11} = \left[\frac{\mathrm{P}(B \cap C)}{\mathrm{P}(C)} = \right]\frac{0.2}{0.2 + q}$ or $\frac{5}{11} = \frac{0.2}{\mathrm{P}(C)}$	M1
	$11 \times 0.2 = 5 \times (0.2 + q)$	dM1
	$\underline{\mathbf{q = 0.24}}$	A1
	$r = 0.6 - (p + q)$ i.e. $\underline{\mathbf{r = 0.21}}$	A1ft (4)
(c)	$\left[\frac{\mathrm{P}((A \cup C) \cap B)}{\mathrm{P}(B)}\right] = \frac{0.3}{0.4}$	M1
	$= \underline{\mathbf{0.75}}$	A1 (2)
		[9]

Q10, (Jun 2015, Q3)

(a)		B1 M1 A1 A1 B1 (5)
(b)	$\frac{'13'}{80}$ <u>or</u> 0.1625	B1ft (1)
(c)	$\frac{28+30-11}{80}$ or $\frac{2+3+4+8+13+17}{80}$ or $1-\frac{(11+22)}{80}=\frac{47}{80}$ <u>or</u> 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)	$P(B\mid C)=\frac{7}{28}$, $P(B)=\frac{20}{80}$ $P(C\mid B)=\frac{7}{20}$, $P(C)=\frac{28}{80}$ $P(B\cap C)=\frac{7}{80}$, $P(B) = \frac{20}{80} P(C)=\frac{28}{80}$ $P(B\mid C)=P(B)$, $P(C\mid B)=P(C)$ 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)

Q11, (Jun 2016, Q4)

(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$]$ $0.6 \times (0.42 + t) = 0.27$	M1	
	$0.42 + t = \dfrac{0.27}{0.6}$ <u>or</u> $0.6t = 0.018$	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)	$\left[\dfrac{\mathrm{P}(D \cap R \cap B)}{\mathrm{P}(R \cap B)} =\right] = \dfrac{0.27}{0.27+0.33}$ <u>or</u> $\mathrm{P}(D \mid R \cap B) = \mathrm{P}(D \mid B) = \mathrm{P}(D)$	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)	$40 \times \text{"}0.45\text{"}$ and $37 \times \text{"}\dfrac{15}{37}\text{"}$	M1	
	$= \underline{\mathbf{33}}$	A1	
			(2)
		[13 marks]	