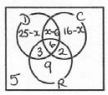
1	(a)		2, 4, 6, 12	1	B1	
	(b)		5, 7, 8, 9, 10, 11, 13, 14	1	B1	
	(c)			2	M1	for $\frac{a}{14}$ with $a < 14$ **or** $\frac{3}{b}$ with $b > 3$ **or** for 3 and 14 used with incorrect notation e.g. 3 : 14
			$\frac{3}{14}$		A1	for $\frac{3}{14}$ oe **or** 0.214(…)
						Total 4 marks

2	a		8	1	B1	
	b	$A = \{10, 11, 12, 13, 14\ 15, 16, 17\}$ $B = \{13, 14, 15, 16, 17, 18, 19, 20, 21\}$ **or** $A \cup B = \{10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21\}$			M1	may be seen in a Venn diagram (allow for example 10 – 17 for A and 13 – 21 for B or 10 – 21 for $A \cup B$) **or** for an answer with one missing element or one extra element
			22, 23, 24, 25	2	A1	
	c	$A' = \{18, 19, 20, 21, 22, 23, 24, 25\}$ $B = \{13, 14, 15, 16, 17, 18, 19, 20, 21\}$			M1	may be seen in a Venn diagram (allow 18 – 25 for A' and 13 – 21 for B) **or** for an answer with one missing element or one extra element
			18, 19, 20, 21	2	A1	
	d		13, 14, 15, 16, 17	1	B1	
						Total 6 marks

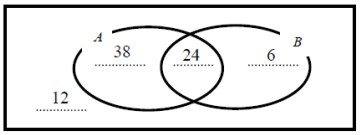
3	ai		b, l, u, e, g, r, y	1	B1	No incorrect or repeats
	aii		w, h, i, t	1	B1	No incorrect or repeats
	b		No with reason	1	B1	eg 'e is in all three sets' **OR** 'all three sets share a member' **OR** $B \cap G \cap W = (\{\})e(\{\})$
						Total 3 marks

4	(a)			3	B3	All 8 values inserted correctly B2 for 4 to 7 correct values B1 for 2 or 3 correct values NB: Expressions involving x do not have to be simplified.
	(b)	"$[(25 - x) + (x - 6) + (16 - x) + 3 + 6 + 2 + 9 + 5]$" = 50		2	M1ft	For sum of all their values = 50 oe
			10		A1	
	(c)		14	1	B1ft	
						Total 6 marks

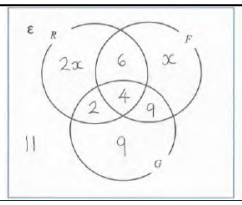
5	(i)		45	3	B1	
	(ii)		12		B1	
	(iii)		28		B1	
						Total 3 marks

6	(a)(i)	other seen orders of letters: a, b, d, e, i, l, n, r, z b, r, I, a, e, z, l, n, d	b, r, a, z, i, l, e, n, d	1	B1	no repeats, letters can be in any order. Condone capital letters rather than lower case letters. (no need for commas)
	(ii)		b, z	1	B1	No repeats, letters can be in any order. Condone capital letters. (no need for a comma)
	(b)		correct explanation that shows they know the meaning of intersection and empty set	1	B1	eg letter 'a' is in both sets $B \cap K = \{a\}$ Set B and set K have an element (or letter) in common. There is a letter that is in set B and in set K There is an intersection so it isn't the null set There is a letter in common (do **not** allow 'letters' or 'elements' (plural) in common) (If students mention the letter that is in common, it must be the correct one (ie a))
						Total 3 marks

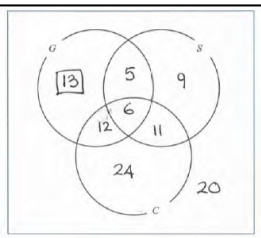
7	(a) (i)		24, 30	1	B1	No repeats, omissions or extra values
	(ii)		21, 23, 25, 27, 29	1	B1	No repeats, omissions or extra values
	(b)		$(A \cup B)'$ or $A' \cap B'$	1	B1	or $(B \cup A)'$ or $B' \cap A'$
						Total 3 marks

8	(a)		12, 38, 24, 6	2	B2	B2 for all 4 correct values, in correct regions. B1 for 2 or 3 correct values in correct regions
	(b) (i)		$\frac{24}{80}$ oe	1	B1ft	0.3 ft their 24
	(ii)	eg 62 + "12" or 80 – "6" oe		2	M1ft	A complete method to find the number of elements in the required set.
			$\frac{74}{80}$ oe		A1 ft	0.925 Penalise incorrect probability notation once only
						Total 5 marks

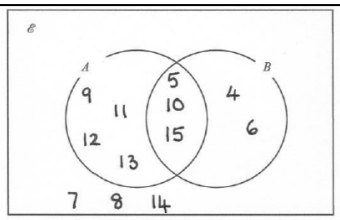
9	(i)		21, 27	1	B1	
	(ii)		21, 23, 24, 25, 27, 29	1	B1	
						Total 2 marks

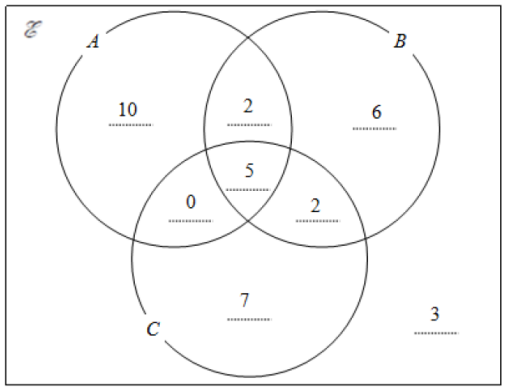
10	(a)			3	B3	For all sections completed correctly (B2 for 5 or 6 sections correct (excl x), B1 for 3 or 4 sections correct (excl x))
	(b)	$2x + 6 + x + 2 + 4 + 9 + 9 + 11 = 80$ $(80 – 6 – 2 – 4 – 9 – 9 – 11) \div 3$		3	M1ft	ft their Venn diagram A correct equation to find x or subtracting all numerical values from 80 and dividing by 3 or other fully correct method to find x with all sections completed
		$x = 13$			A1	correct value for x
			38		B1	their $2x + 12$
						Total 6 marks

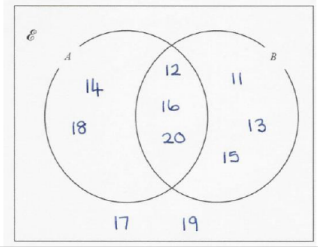
11 (a)(i)		9, 15	1	B1	no repeats
(a)(ii)		9, 11, 12, 13, 15, 17, 18, 19	1	B1	no repeats or omissions
(b)	**No must be ticked along with a reason for the award of this mark**	No with a correct reason	1	B1	No with eg 24/it is not in the universal set, 24/it is not between 9 and 20 (need some sort of reference that the numbers in the sets do not go beyond 20)
(c)		10, 18 and two from 9, 11, 13, 15, 17, 19	2	B2 (B1	for 10, 18 and two from 9, 11, 13, 15, 17, 19 a set of 4 numbers of which 3 are correct or a set of 5 numbers including 10, 18, and no more than one incorrect number or a set of 3 or more numbers from {10, 18, 9, 11, 13, 15, 17, 19})
					Total 5 marks

12 (a)		Fully correct Venn diagram	3	B1 B2	For 13 correct in G only For all 7 others correct (B1 for 4, 5 or 6 others correct (does not need to be complete for this))	
(b)(i)		36	1	B1ft	ft from a diagram where values are present in the required regions	If these 3 parts are given as probabilities, please mark incorrect the first time but award marks from there on if numerator is correct
(ii)		44	1	B1ft		
(iii)		35	1	B1ft		
(c)		$\frac{18}{53}$	2	B2ft	oe 0.33(96…) or 33(.96…)% ft their Venn diagram or (B1 for $\frac{18}{m}$ where $m>18$ or $\frac{n}{53}$ where $n<53$ or for 18 : 53 or other incorrect notation or B1ft their Venn diagram for $\frac{"18"}{m}$ where $m>"18"$ or $\frac{n}{"53"}$ where $n<"53"$)	
					Total 8 marks	

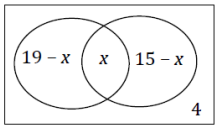
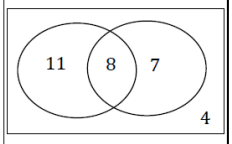
13 (i)		19	1	B1	
(ii)		0	1	B1	
(iii)		11	1	B1	
(iv)		28	1	B1	
				Total 4 marks	

14			3	B3 (B2 (B1	all 4 parts of diagram correct for 2 or 3 parts correct) for 1 part correct) SCB1 if no marks scored, award B1 if 4,6 in the section $A \cap B'$ and 9, 11, 12, 13 in the section $A' \cap B$
					Total 3 marks

15		Fully correct Venn diagram	4	B4 for all 8 sections correct If not B4, then award B3 for 6 or 7 sections correct B2 for 4 or 5 sections correct B1 for 2 or 3 sections correct Allow the section where 0 should be to be blank if all other sections are populated with a number.
				Total 4 marks

16			3	B3 Fully correct (B2 for 2 or 3 'regions' correct, B1 for one 'region' correct)
				Total 3 marks

17 (a)(i)		5, 7, 11, 13	1	B1
(ii)		5, 6, 8, 10, 12, 14, 15	1	B1
(b)		Correct reason	1	B1 eg 9 is not a member of C **or** 9 is not in C **or** C only contains 6, 8, 10, 12, 14 **or** 9 is outside of C there must be no contradictory or incorrect statements
				Total 3 marks

18	$(19 + 15 + 4) - 30$ or $38 - 30$ or $19 + 15 - 26$ or  or $19 - x + x + 15 - x + 4 = 30$ oe		4	M1 for a **correct** method to find the number of people booking breakfast and dinner	M1A1 for a fully correct Venn diagram  or for $\frac{8}{30}$
	8			A1 can be shown in a Venn diagram or a valid calculation	
	$\frac{8}{30}\times\frac{7}{29}$ or $\frac{8}{30}\times\frac{8}{30}=\frac{64}{900}$ or $\frac{16}{225}$ oe			M1 for the use of $\frac{k}{30}\times\frac{k-1}{29}$ where $k < 30$ or $\frac{"8"}{n}\times\frac{"8"-1}{n-1}$ where $n > 8$	
	Correct answer scores full marks (unless from obvious incorrect working)	$\frac{28}{435}$		A1 oe awrt 0.064 or awrt to 6.4%	
				Total 4 marks	

19	(a)		6	1	B1
	(b)		36	1	B1
	(c)		15	1	B1
					Total 3 marks