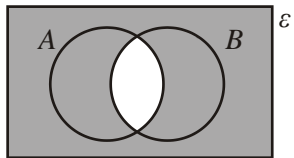


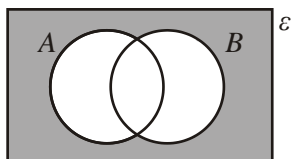
Answers November Questions Sets and Logic Review Packet

1. (a) $A \cap B$ (A1)

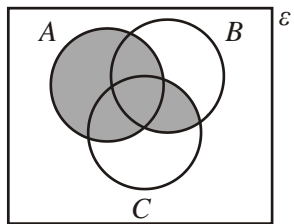
(b) The complement of $(A \cap B)$ (A1)



(c) The complement of $(A \cup B)$ (A1)



(d) $A \cup (B \cap C)$ (A1)



[4]

2. (a) $m \wedge (s \vee d)$ (A2)

Notes: (A1) for $m \wedge$
 (A1) for $(s \vee d)$
 (A1)(A0) if brackets are missing

OR

$(m \wedge s) \vee (m \wedge d)$ (A2) (C2)

Notes: (A1) for both brackets correct, (A1) for disjunctive “or”
 (A1)(A0) if brackets are missing.

(b) If you choose a salad then you do not choose a dessert. (A2)

Notes: (A1) for “if ...then...”
 (A1) for salad and no dessert in the correct order.

OR

If you choose a salad you do not choose a dessert. (A2) (C2)

(c)

s	d	$\neg s$	$\neg s \Rightarrow d$
T	T	F	T
T	F	F	T
F	T	T	T
F	F	T	F

Note: (A1) for each correct column

(A1)(A1)(ft)

(C2)
[6]

3. a = F
b = F
c = T
d = F
e = T
f = F

(A1)
(A1)
(A1)
(A1)
(A1)
(A1)

[6]

4. (a) If x is a factor of 6 then x is a factor of 24

(A1) 1

- (b) If x is a factor of 24 then x is a factor of 6 (or $q \Rightarrow p$)

(A1) 1

- (c) False

(R1)

4, 8, 12 are all factors of 24 but not of 6
(any one of the three factors will do)

(A1) 2

[4]

5.

p	q	$\neg q$	$(p \wedge \neg q)$	$(p \vee q)$	$(p \wedge \neg q) \Rightarrow (p \vee q)$
T	T	F	F	T	T
T	F	T	T	T	T
F	T	F	F	T	T
F	F	T	F	F	T

(A1)

(A1)

(A2)

(A4)

(C8)

[8]

6. (a) If the train arrives on time then I am not late for school. (A2) (C2)
Note: Award (A1) for “If... then” in correct order and (A1) for “not”.

(b) $\neg p \wedge \neg q$ (A2) (C2)
Note: Award (A1) for both \neg symbols and (A1) for \wedge .

(c) missing elements are

F
T
F

 (A3) (C3)

(d) The implications are **not** logically equivalent. (A1) (C1)

[8]

7. (a) Paula eats chocolates and does not watch television (A1)
 For “and” (A1) (C2)
 For the rest correct

(b) Paula eats chocolates or watches television but not both (A1)
 For correct...or... (A1) (C2)
 For “but not both”

(c) If Paula watches television then she does not eat chocolates (A1)
 for if...then (A1) (C2)
 for antecedent and consequent both correct

[6]

8. (a) (i) $\neg(p \vee q)$ alternatively $\neg p \wedge \neg q$ (A1)
 (ii) $\neg(p \wedge q)$ alternatively $\neg p \vee \neg q$ (A1)

(b)

<i>p</i>	<i>q</i>	$\neg p$	$\neg p \vee q$
T	T	F	T
T	F	F	F
F	T	T	T
F	F	T	T

(A2)

Note: Award (A1) for each bold column.

[4]

9. (a) $2x = 2$ (M1)
 $x = 1$ (A1) (C2)

(b) Yes (A1) (C1)

(c) $x^2 = x \Rightarrow 2x + 3 = 5$ (A1)(A1)(A1) (C3)

*Note: Award (A1) for $x^2 = x$, (A1) for \Rightarrow , (A1) for $2x + 3 = 5$.
 Accept also: If $x^2 = x$ (A1) then (A1) $2x + 3 = 5$ (A1).*

(d) $x = 0$ (A2) (C2)

[8]

10.

p	q	$\neg p$	$\neg q$	$p \wedge \neg q$	$\neg p \vee q$	$(p \wedge \neg q) \Rightarrow (\neg p \vee q)$
T	T	F	F	F	(d) T	T
T	F	F	T	(b) T	F	(f) F
F	T	(a) T	F	(c) F	T	(g) T
F	F	T	T	F	(e) T	(h) T

(A8)

Note: Award (A1) for each correct answer.

[8]

11. (a) $\neg p \rightarrow \neg q$ (A3) (C3)

(b)

p	q	$\neg p$	$\neg q$	$\neg p \rightarrow \neg q$
T	T	F	F	T
T	F	F	T	T
F	T	T	F	F
F	F	T	T	T

(A1) (A1) (A1)
 No it is not valid (A2)

(A5) (C5)

[8]

12. (a) (i) *If you do not watch the music TV channel, then you do not like music.* (C1)
(C1)
(ii) *If you like music, then you watch the music TV channel.* (C1)
(C1) 4

(b)

		(i)	(ii)	(iii)	(iv)		
p	q	$\neg p$	$\neg q$	$p \Rightarrow q$	$\neg p \Rightarrow \neg q$	$p \vee \neg q$	$\neg p \wedge q$
T	T	F	F	T	T	T	F
T	F	F	T	F	T	T	F
F	T	T	F	T	F	F	T
F	F	T	T	T	T	T	F

(A4) 4

Note: Award (A1) for each correct bold column. (ft) with errors in (ii) which are same as in (i).

- (c) $(\neg p \Rightarrow \neg q)$ and $(p \vee \neg q)$ are logically equivalent. (C1) 1
Note: Follow through with candidate's answers to part (b) (i), (ii), (iii) and (iv). This may mean there are no equivalent statements.

[9]

13. (a) (i) $p \Rightarrow q$ (A1)
(ii) $r \vee \neg q$ (A1) 2
(b) $p \Rightarrow q, r \vee \neg q$
 $\neg r$ (A1)
Therefore, $\neg p$ (A1)
OR
 $\{(p \Rightarrow q) \wedge (r \vee \neg q) \wedge \neg r\} \Rightarrow \neg p$ (A2) 2

[4]

14. (a) Conclusion $x \geq 3$ (A2) (C2)
(b) If $r = 12$ then $p = 3$ (A2) (C2)

[4]

15. (a) $(p \vee \neg q)$ (A1)
(b) *If you have understood this topic and will not be able to do this question, then you have not understood this topic.* (A3)

Note: Award (A1) for each correct translation of $\neg q$, $\neg p$, and \Rightarrow . Maximum 3 marks.

[4]

16. (a) (i) “The food supply is adequate and the visitors are hungry but the oven is not working,” (or equivalent statement). (A2)
- (ii) “Either the oven is working and the food supply is adequate or the visitors are not hungry,” (or equivalent statement). (A2) 4

(b) $(p \wedge q) \Rightarrow (p \vee q)$ (A2) 2

Notes: Award (A1) for $(p \wedge q)$ and $(p \vee q)$, (A1) for \Rightarrow .

(c)

p	q	$(p \wedge q)$	$(p \vee q)$	$(p \wedge q) \Rightarrow (p \vee q)$
T	T	T	T	T
T	F	F	T	T
F	T	F	T	T
F	F	F	F	T

(A2)

Therefore, $(p \wedge q) \Rightarrow (p \vee q)$ is a tautology (R1) 3

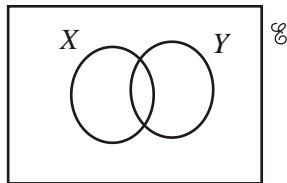
Notes: Follow through from part (ii) (b).

Award [$\frac{1}{2}$ mark] for each correct bold column and round up.

Award (R1) for a correct conclusion based on truth values in column headed $(p \wedge q) \Rightarrow (p \vee q)$.

[9]

17. (a)



(A1) 1

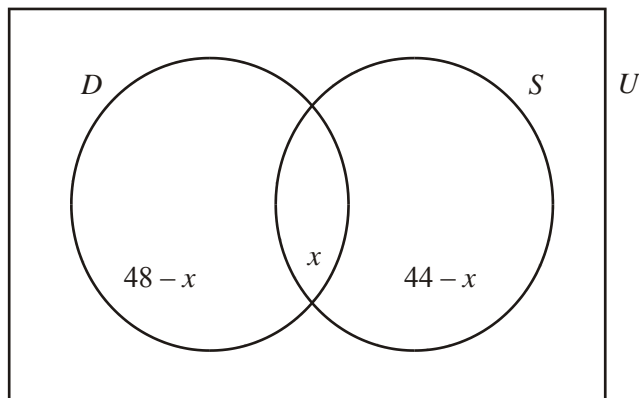
Note: Award (A1) for a diagram correctly labelled with X, Y and U.

- (b) (i) $(X \cap Y) = \{6, 12\}$ (A1)
- (ii) $X \cap \bar{Y} = \{2, 4, 8, 10, 14\}$ (A2) 3

- (c) $(X \cup Y)' = \bar{(X \cup Y)} = \{1, 5, 7, 11, 13\}$ (A1)
- $n(X \cup Y)' = 5$ (A1) 2

[6]

18. (a) (i)



(A3) 3

Note: Award (A1) for a correct diagram (labelled), (A1) for x in the correct position, (A1) for either $(48 - x)$ or $(44 - x)$ correctly positioned.

(ii) $48 - x + x + 44 - x = 60$ (or equivalent), allow **ft** from (i) (M1)
 $\Rightarrow x = 32$ (A1) 2

(iii) The set of members who **did not** attend for **both** Drama and Sports (or equivalent) (A2) 2

(iv) $P(D \text{ or } S) = \left[\frac{48 - 32}{60} + \frac{44 - 32}{60} \right]$ (M1)(M1)

Note: Award (M1) for either $\frac{48 - 32}{60}$ or $\frac{44 - 32}{60}$, (M1) for adding.

$= \frac{28}{60}$ or $\frac{7}{15}$ or 0.467 (3 s.f.) or 46.7% (3s.f.) (A1) 3

(b) (i) $P(\text{Female and } (S \text{ or } D)) = \frac{20}{60}$ (M1)

$= \frac{1}{3}$ or 0.333 (3 s.f.) or 33.3% (3s.f.) (A1) 2

(ii) $P(\text{Male and both } D \text{ and } S) = \left[\frac{32 - 8}{60} \right]$ (M1)

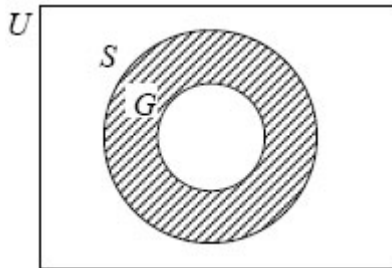
$= \frac{2}{5}$ or 0.4 or 40% (A1) 2

[14]

19. (a) "If the water is not cold and not boiling then it is warm"
(or equivalent statement) (A2)
- (b) $p \Leftrightarrow \neg(q \vee r)$ or $p \Leftrightarrow \neg q \wedge \neg r$ (A2)
- Note: Award (A1) for $p \Leftrightarrow$ and (A1) for $\neg(q \vee r)$.*

[4]

20. (a)



(A1)(A1)(A1) 3

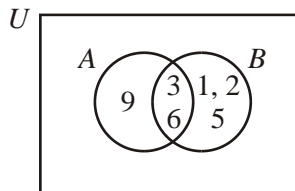
Note: Award (A1) for rectangle, (A1) for S drawn and named, (A1) for G completely inside S.

- (b) shading on diagram (A1)(ft) 1
- (c) sports cars that are not green (A2) 2
- Note: Award (A1) for sports cars intersecting with not green cars.*

[6]

21. (a) (i) $A = \{3, 6, 9\}$ (A1) (C1)
- (ii) $B = \{1, 2, 3, 5, 6\}$ (A1) (C1)
- Note: Candidates must list all the elements and no extra elements for each (A1)*

- (b)



(A2) (C2)

*Notes: Follow through from (a).
Award (A1) for 3 and 6 in the intersection.
Award (A1) for other values correctly positioned*

[4]

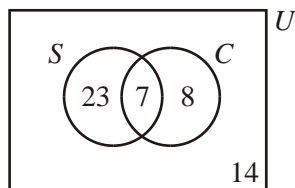
22. (a)

	Study Spanish	Do not study Spanish	Total
Have computers	7	8	15
Do not have computers	23	14	37
Total	30	22	52

(A3) 3

*Notes: Award ½ mark for each correct bold entry.
Round up to a maximum 3 marks.*

(b)



(A2) 2

*Notes: Award 1 mark for correctly labelled diagram indicating all of S , C and U .
Award ½ mark for any two correct entries from 23, 7, 8 and 14, up to a maximum of 1 mark.*

(c) “Students who have computers or do not study Spanish”
(or equivalent statements)

(C2) 2

Notes: Award (R0) for “Students who have computers but do not study Spanish”. It is incorrect.

(d) $n(C \cup S') = 29$

(A1) 1

(e) (i) $\frac{7}{52}$

(M1)(A1) 2

(ii) $\frac{8}{52}$

(M1)(A1) 2

(iii) $\frac{7}{30}$

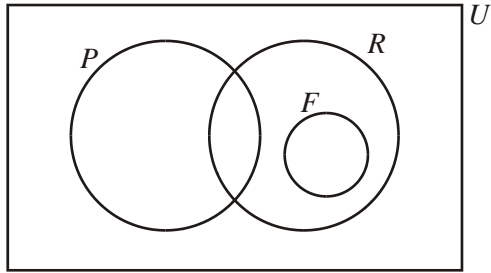
(M1)(A1) 2

Notes: If no method is shown, award (M1)(A1) if and only if answer is correct, otherwise award zero marks. However, award (M1) if correct method is shown; even if final answer is wrong.

Accept probabilities expressed as decimals or percentages.

[14]

23.



(A4)

Note: Award (A1) for rectangle, (A1) for F entirely within R ,
 (A1) for F disjoint from P , (A1) for $P \cap R$ non-empty.

[4]

24. (a) $n(\text{MTV} \cap \text{BBC}) = 11$ (A1)
 (b) $n(\text{MTV} \cup \text{BBC}) = 74$ (A1)
 (c) $n(\text{CNN} \cap \text{BBC} \cap \text{MTV}') = 2$ (A1)
 (d) $n(\text{MTV} \cup \text{CNN} \cap \text{BBC}') = 77$ (A1)

[4]

25. (a) $A \cap B$ (A2)
 (b) $(A \cup B)'$ or $A' \cap B'$ (A2)
 (c) $A' \cap B$ (A2)

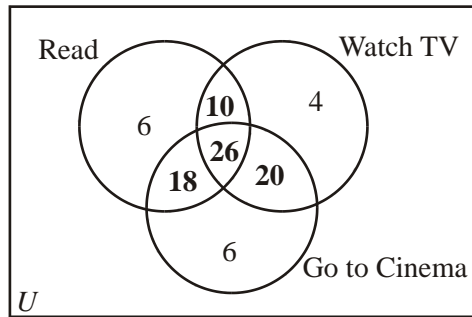
Note: Award (A1) for A' , (A1) for $\cap B$.

- (d) $(A \cup B) \cap C$ or $(A \cap C) \cup (B \cap C)$ (A2)

Note: Award (A1) for both $(A \cap C)$ and $(B \cap C)$ and (A1) for
 \cup . (A1) for $(A \cup B)$ and (A1) for $\cap C$.

[8]

26. (a)



(A4) (C4)

Notes: Award (A1) for Venn Diagram drawn correctly (circles and rectangle).

Award (A3) for all four correct (A2) for three correct (A1) for two correct and (A0) for one correct.

- (b) (i) $60 - (10 + 26 + 20)$ (M1)
 $= 4$ (A1)
- (ii) $70 - (18 + 26 + 20)$ (M1)
 $= 6$ (A1) (C4)

[8]

27. (a) $a = 4, b = 1$ (A1)(A1) 2

(b) $30 - (4 + 12 + 1 + 2 + 4 + 4) = 3$ (M1)(A1) (or (A2)) 2

(c) $\frac{24}{30} \left(= \frac{4}{5} \right)$ (A1)(A1) 2

Note: Award (A1) for numerator, (A1) for denominator.

(d) $\frac{6}{19}$ (A1)(A1) 2

Note: Award (A1) for numerator, (A1) for denominator.

[8]

28. (a) True (A2) (C2)

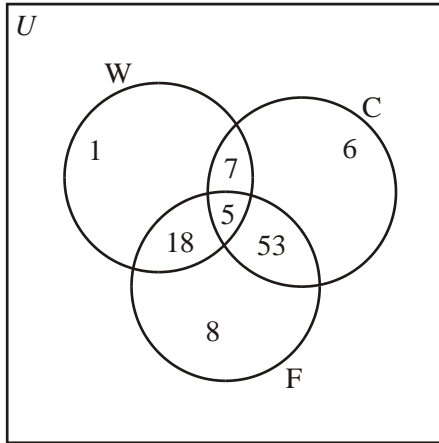
(b) False (A2) (C2)

(c) True (A2) (C2)

(d) True (A2) (C2)

[8]

29. (a)



(A4) 4

Note: Award (A1) for the box and circles, (A3) for 7 correct entries, (A2) for 5 or 6 correct, (A1) for 3 or 4 correct.

(b) $100 - (1 + 7 + 6 + 18 + 5 + 53 + 8) = 2$ (M1)(A1) 2

(c) (i) $P(\text{coffee}) = \frac{71}{100} (= 0.71)$ (A1)

(ii) $P(W \cup F \cap C') = \frac{27}{100} (= 0.27)$ (A1)

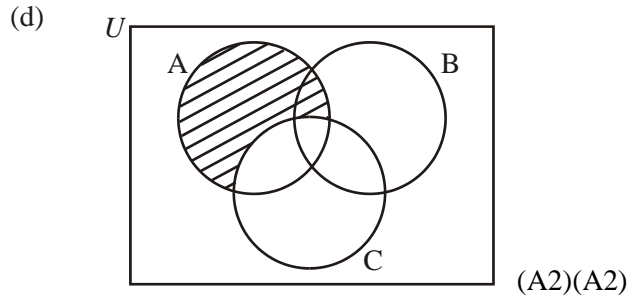
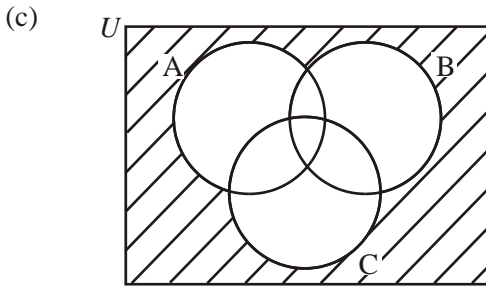
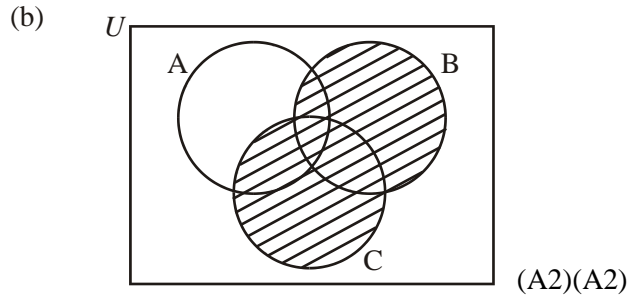
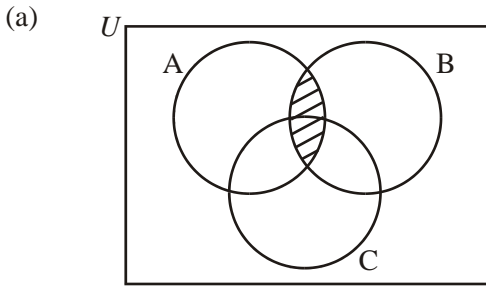
(iii) $P(F' | W) = \frac{8}{31} (= 0.258)$ (A1)(A1) 4

Note: Award (A1) for 8, (A1) for 31.

(d) $P(\text{both drank all 3}) = \frac{5}{100} \times \frac{4}{99}$ (A1)(A1)
 $= \frac{20}{9900} (= 0.00202)$ (A1) 3

[13]

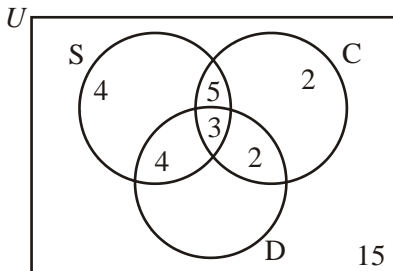
30.



Note: Award (A0), (A0), (A2) ft, (A2) ft if \cup and \cap are consistently reversed.

[8]

31.



- (a) 3 intersecting circles and rectangle. (A1)
 correct numbers (A4) 5

Note: Award (A4) for all 7 numbers correct, (A3) for 6 correct, (A2) for 5 correct, (A1) for 4 correct. (Do not count the number in D only on the Venn Diagram at this stage.)

- (b) $4 + 5 + 3 + 4 + 2 + 2 + 15 + x = 40$ (M1)
 $35 + x = 40$
 $x = 5$
 Therefore, five play drums only. (A1) 2
 (AG)

(c) $\frac{4}{40} \left(\frac{1}{10}, 10\%, 0.1 \right)$ (A2) 2

Note: Award (A1) for 4, (A1) for 40.

(d) $\frac{21}{40} (52.5\%, 0.525)$ (A2) 2

Note: Award (A1) for 21, (A1) for 40.

(e) $\frac{8}{16} \left(\frac{1}{2}, 50\%, 0.5 \right)$ (A3) 3

Note: Award (A1) for 8, (A2) for 16. Do not separate (A2).

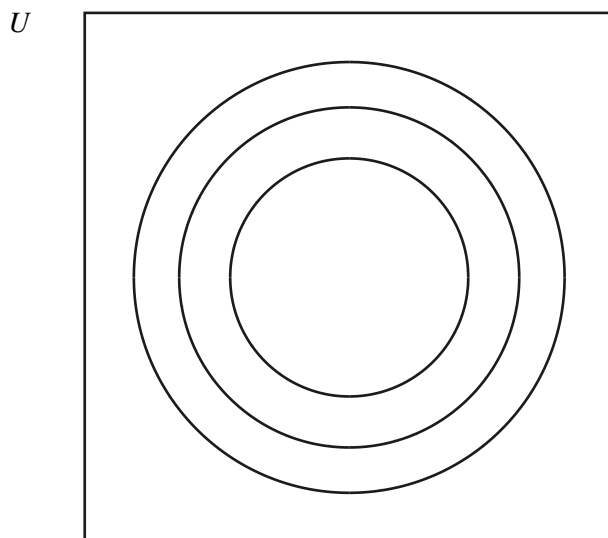
[14]

32. (a) For example, 2, -3 etc (A1) (C1)

(b) For example, $\frac{3}{5}$ (not $\frac{6}{1}$) (A1) (C1)

(c) For example, $\sqrt{2}$, π (A1) (C1)

(d)



For $\mathbb{Z} \subset \mathbb{Q}$ (A1)
 For $\mathbb{Z} \subset \mathbb{R}$ (A1)
 For $\mathbb{Q} \subset \mathbb{R}$ (A1)
 Accept \mathbb{R} as U . (C3)

[6]

33. (a) (i) $\{-3, -2, -1, 0, 1, 2, 3\}$ (A1)(A1)

Notes: Award (A1) for set brackets.

Award (A1) for all and only correct numbers.

(ii) $\{0, 1, 4, 9\}$ (A1)

Notes: Award (A1) for all and only correct numbers.

If domain and range reversed, can follow through in (ii).

(iii) $f(x) = x^2$ (A2) (C5)

Note: Allow any other rule that works.

(b) $[1, \infty]$ or $\{x \in \mathbb{R} \mid x \geq 1\}$ (A1) (C1)

[6]

34. (a) $A = 8, 10, 12, 14, 16$ (A1) (C1)

(b) $B = 3, 6, 9, 12, 15, 18$ (A1) (C1)

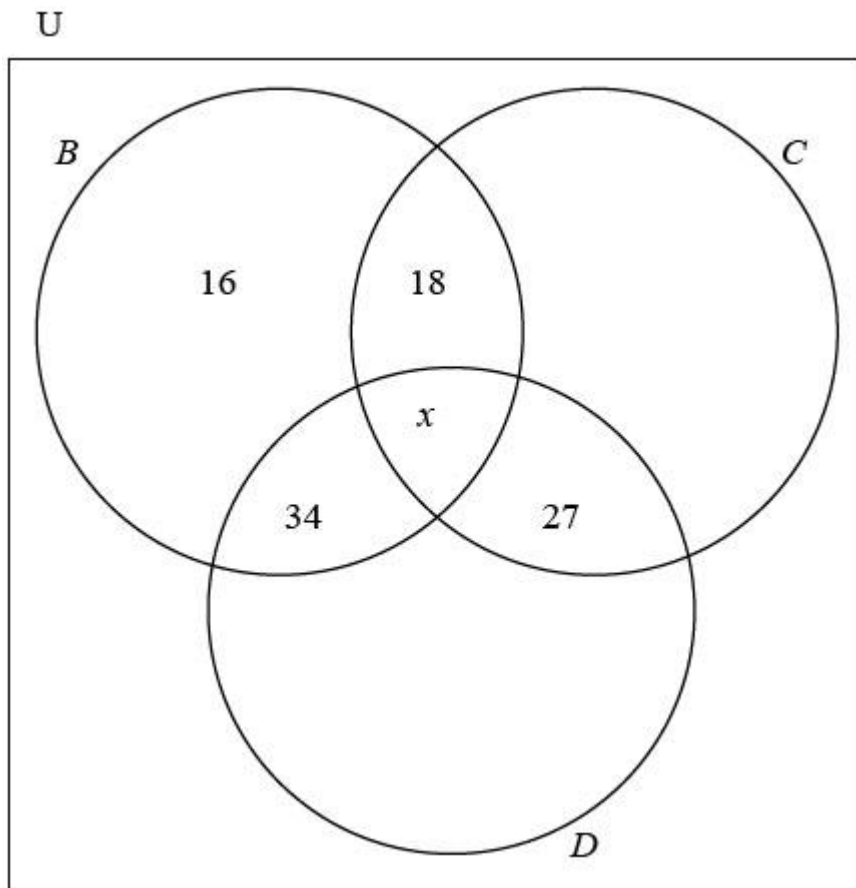
(c) $A \cup B = 3, 6, 8, 9, 10, 12, 14, 15, 16, 18$ (A2)(ft) (C2)

Note: Award (A1) only if a single element is missing or a single extra element is present, (A0) otherwise.

(d) $B' = 1, 2, 4, 5, 7, 8, 10, 11, 13, 14, 16, 17, 19, 20$ (A1)(ft)

$A \cap B' = 8, 10, 14, 16$ (A1)(ft) (C2)

[6]



35. (a)

(A2)

(C2)

Notes: (A1) only if 1 error

(A0) otherwise

(b) $x + 16 + 18 + 34 = 99$

$x = 31$

(A1)

(C1)

(c) Choir only = $88 - (18 + 27 + 31) = 12$

(A1)(ft)

Drama only = $110 - (27 + 34 + 31) = 18$

(A1)(ft)

Total = $16 + 34 + 18 + 31 + 12 + 27 + 18 = 156$

(A1)(ft)

(C3)

[6]