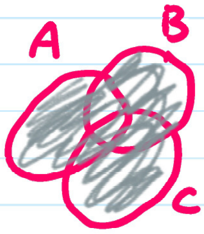
Three sets

23 October 2019 12:38

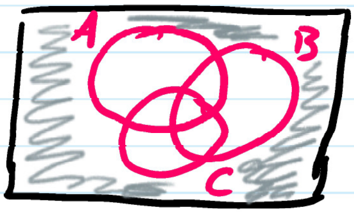
# Venn Diagrams

① $A \cup B \cup C$

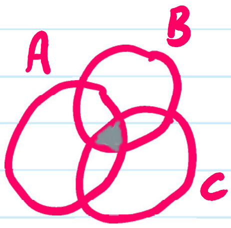
All the sets joined



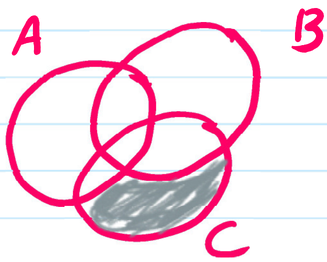

③ $(A \cup B \cup C)'$




② $A \cap B \cap C$




④ $C \setminus A \cup B$




Class work Pg 39 Q1+2.

T&T2 3.3 Venn...

T&T2 3.3 Venn...

# Sets

chapter 3

37

## Section 3.3 Venn diagrams involving three sets

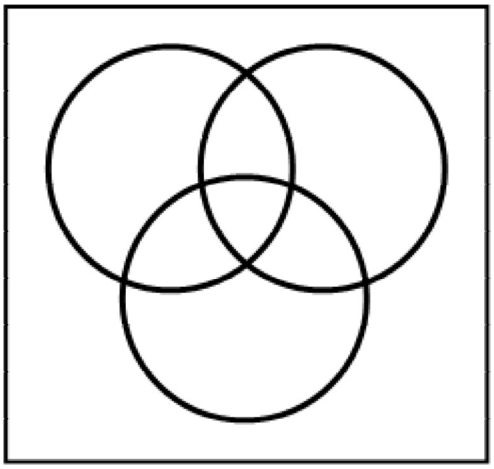
## Example 1

$U = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12\}$ $\quad$ $A = \{2, 4, 6, 8, 10\}$

$B = \{3, 4, 5, 6\}$ $\quad$ $C = \{5, 6, 7, 8\}$

Illustrate these sets on a Venn diagram and list the elements of.

(i) $A \cap B \cap C$ $\quad$ (ii) $B \cap C$ $\quad$ (iii) $(A \cap B) \setminus C$ $\quad$ (iv) $B \setminus (A \cap B \cap C)$



## Example 2

$A = \{1, 3, 5, 6\}$, $B = \{2, 3, 5, 7, 8\}$ and $C = \{3, 4, 6, 8\}$ are three sets.

Investigate whether (i) $(A \cap B) \cap C = A \cap (B \cap C)$

(ii) $(A \backslash B) \backslash C = A \backslash (B \backslash C)$

## Example 3

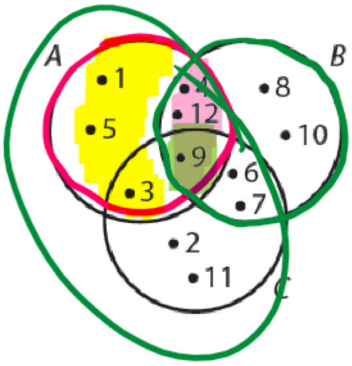
$A = \{3, 4, 5, 6\}$, $B = \{5, 6, 7, 8\}$ and $C = \{2, 4, 6, 8, 10\}$ are three sets.

(i) Investigate if $A \cup (B \cap C) = (A \cup B) \cap (A \cup C)$.

(ii) Investigate if $A \cap (B \cup C) = (A \cap B) \cup (A \cap C)$.

## Exercise 3.3

**1.** The given Venn diagram shows three sets $A$, $B$ and $C$. List the elements of the following sets:




(i) $A$ {1, 3, 4, 5, 9, 12} (ii) $B$ {4, 6, 7, 8, 9, 10, 12}

(iii) $A \cap B$ {4, 9, 12} (iv) $A \cap B \cap C$ {9, }

(v) $A \setminus B$ {1, 3, 5} (vi) $B \setminus (A \cup C)$ {8, 10}

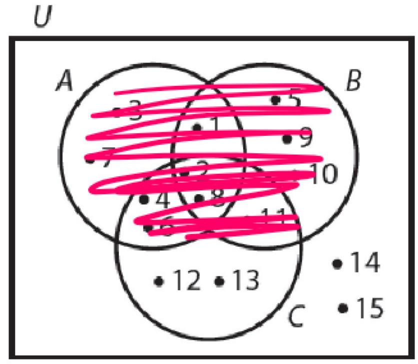
**2.** The given Venn diagram shows three sets $A$, $B$ and $C$ in the universal set $U$.

List the elements of the following sets:

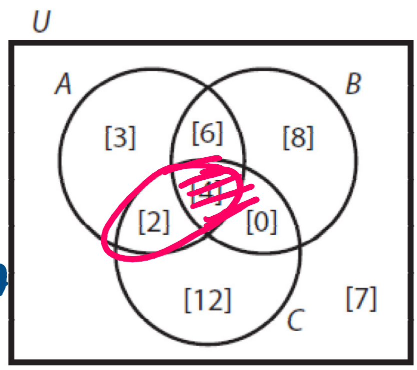
(i) $A \cap B \cap C$ {2,8}  (ii) $A \cap B$ {1,2,8}

(iii) $A \setminus (B \cup C)$ {3,7}  (iv) $(A \cap B) \setminus C$ {1}

(v) $C \setminus (A \cup B)$ {1,13}  (vi) $(A \cup B \cup C)'$ {14, 15}



**3.** The Venn diagram on the right shows the universal set $U$ and three intersecting sets $A$, $B$ and $C$. The number of elements in each region is given in brackets.




Use the Venn diagram to find

(i) $\#(A)$ 2+3+4+6= 15

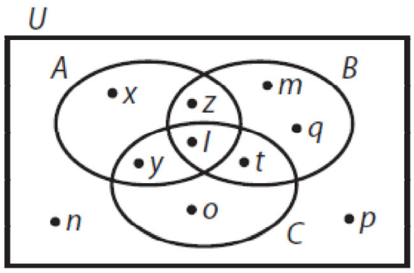
(ii) $\#[(A \cup B) \mid C]$ 3+6+8=17

(iii) $\#(A \cup B \cup C)'$ =7

(iv) $\#[A \setminus (B \cup C)]$ =3

(v) $\#[(A \cap C) \setminus B]$. =2

**4.** $A$, $B$ and $C$ are three sets in the universal set $U$ as shown in the given Venn diagram.
Say if each of the following statements is true or false:




(i) $A \setminus B = \{x, y\}$

(ii) $\#B = 5$

(iii) $C \setminus A = \{o, t, l\}$

(iv) $\#(A \cup C) = 6$

(v) $B \cap C = \{l, o, t\}$

(vi) $\#(A \cup B) = 9$

(vii) $A \cap B \cap C = \{l\}$

(viii) $(A \cap C) \setminus B = \{y, l\}$

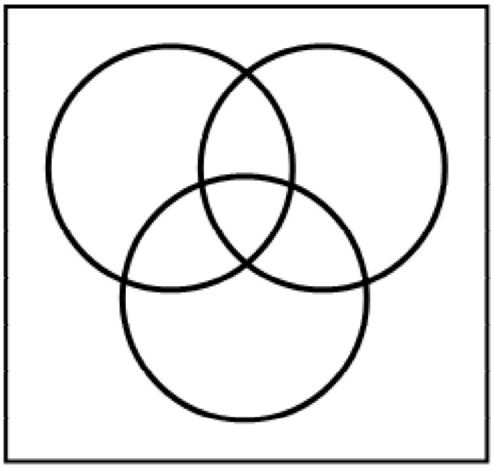
**5.** Draw a Venn diagram showing three intersecting sets $A$, $B$ and $C$ in the universal set $U$. Enter the correct cardinal number in each region based on the following information:

$\#(A \cap B \cap C) = 2$ $\quad \#(A \cap B) = 7$ $\quad \#(B \cap C) = 6$ $\quad \#(A \cap C) = 8$

$\#(A) = 16$ $\quad \#(B) = 20$ $\quad \#(C) = 19$ $\quad \#(U) = 50.$

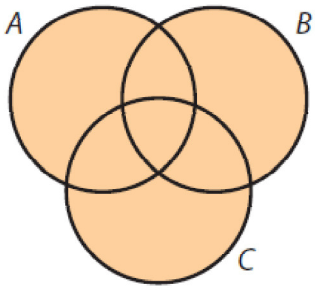
Use your diagram to find

(i) $\#(A \cup B)'$ (ii) $\#[A \backslash (B \cup C)]$ (iii) $\#[(A \cup B) \backslash C]$.

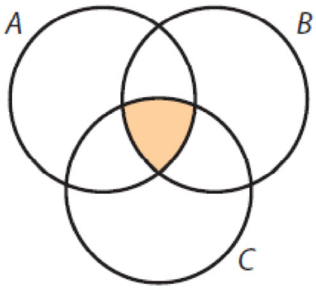


**6.** Describe the set indicated by the shaded area in each of the following Venn Diagrams:

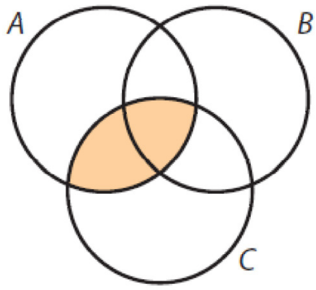
(i)




(ii)




(iii)



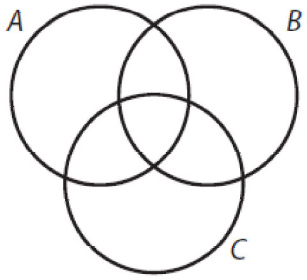
**7.** Using separate Venn diagram similar to that shown on the right, shade in the region that represents each of the following sets:

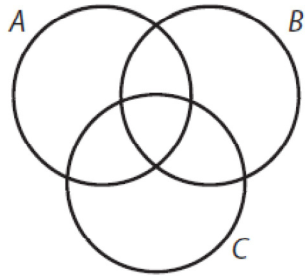
(i) $A \cap B$

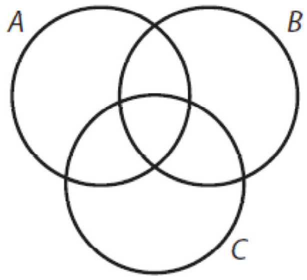
(ii) $(A \cap B) \setminus C$

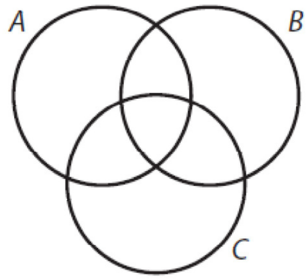
(iii) $A \setminus (B \cup C)$

(iv) $(B \cap C) \setminus A$.



**8.** State whether each of the following statements is always true for $a, b, c \in R$. If the statements is not true, give an example to show why.

(i) $a + b = b + a$

(ii) $(a + b) + c = a + (b + c)$

(iii) $a \div b = b \div a$

(iv) $a - b = b - a$

(v) $(a - b) - c = a - (b - c)$

(vi) $a \div (b \div c) = (a \div b) \div c$

**9.** Name the property of real numbers illustrated by these examples:

(i) $6 + 7 = 7 + 6$

(ii) $(3 \times 4) \times 5 = 3 \times (4 \times 5)$

(iii) $6 - 4 \neq 4 - 6$

(iv) $2(4 + 5) = (2 \times 4) + (2 \times 5)$

(v) $(8 - 4) - 2 \neq 8 - (4 - 2)$

(vi) $(24 \div 6) \div 2) \neq 24 \div (6 \div 2)$

**10.** $A = \{0, 2, 4, 6, 8, 10\}$, $B = \{1, 2, 3, 4, 5\}$ and $C = \{3, 4, 5, 6, 7\}$.
Use these three sets to show that

$$A \cup (B \cap C) = (A \cup B) \cap (A \cup C).$$

What property of sets does this statement illustrate?

**11.** Use the sets in Question **10.** above to show that

$$(A \setminus B) \setminus C \neq A \setminus (B \setminus C)$$

What property of sets does this statement illustrate?

**12.** Which property of sets is illustrated by each of the following?

(i) $A \cup B = B \cup A$

(ii) $A \cap (B \cap C) = (A \cap B) \cap C$

(iii) $(A \cup B) \cup C = A \cup (B \cup C)$

(iv) $A \cap (B \cup C) = (A \cap B) \cup (A \cap C)$

(v) $A \cup (B \cap C) = (A \cup B) \cap (A \cup C)$

(vi) $A \setminus (B \setminus C) \neq (A \setminus B) \setminus C$

# Answers

## Exercise 3.3

**1.** (i) {1, 3, 4, 5, 9, 12} (ii) {4, 6, 7, 8, 9, 10, 12}
(iii) {4, 9, 12} (iv) {9}
(v) {1, 3, 5} (vi) {8, 10}

**2.** (i) {2, 8} (ii) {1, 2, 8}
(iii) {3, 7} (iv) {1}
(v) {12, 13} (vi) {14, 15}

**3.** (i) 15 (ii) 17 (iii) 7 (iv) 3 (v) 2

**4.** (i) T (ii) T (iii) F (iv) T
(v) F (vi) F (vii) T (viii) F

**5.** (i) 21 (ii) 3 (iii) 17

**6.** (i) $A \cup B \cup C$ (ii) $A \cap B \cap C$
(iii) $A \cap C$

**8.** (i) T (ii) T
(iii) Not true; $3 \div 4 \neq 4 \div 3$
(iv) Not true; $2 - 3 \neq 3 - 2$
(iii) Not true; $(11 - 12) - 13 \neq 11 - (12 - 13)$
(iv) Not true; $4 \div (6 \div 8) \neq (4 \div 6) \div 8$

# Answers

**9.** (i) Addition is commutative
(ii) Multiplication is associative
(iii) Subtraction is not commutative
(iv) Multiplication is distributive over addition
(v) Subtraction is not associative
(vi) Division is not associative

**10.** Union of sets is distributive over intersection

**11.** Set difference is not associative

**12.** (i) Union of sets is commutative
(ii) Intersection of sets is associative
(iii) Union of sets is associative
(iv) Intersection of sets is distributive over union
(v) Union of sets is distributive over intersection
(vi) Set difference is not associative