Exploring Relationships between Sets

Key Math Learnings:

By the end of this lesson, you will learn the following concepts:

- explore what the different regions of a Venn diagram respresents
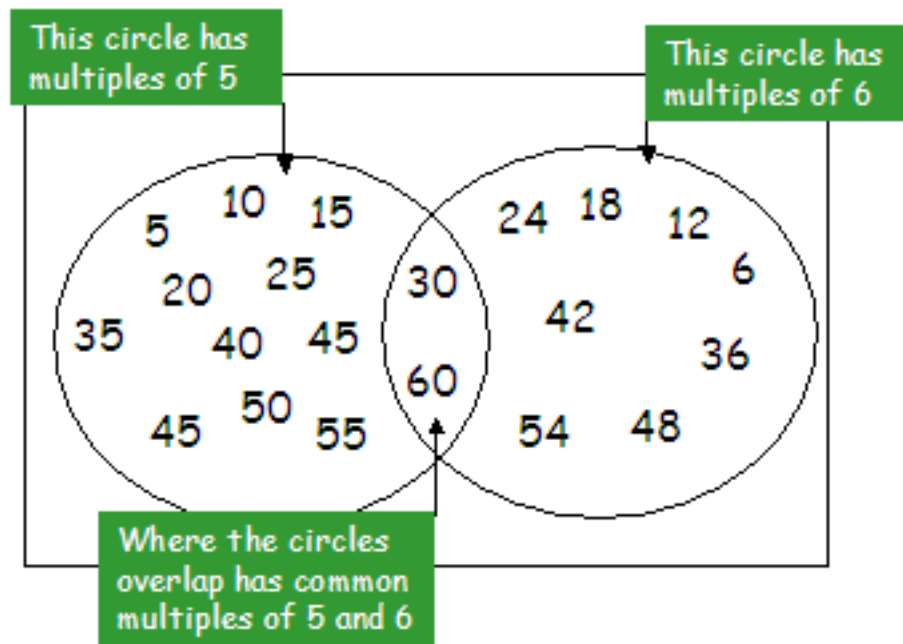
Achievement Indicators

- Explain what a specified region in a Venn diagram represents, using connecting words (and, or, not) or set notation.
- Organize information such as collected data and number properties, using graphic organizers, and explain the reasoning.

Venn Diagrams

Venn Diagram: A diagram (graphic organizer) that shows the relationships between different groupd of things (sets and subsets)

How do I draw a Venn Diagram

1. Start with a rectangle that represents the universal set (all the possible elements in the group)

2. We draw circles in the rectangle that represents the classifications within the universal set. These are called subsets.

3. Sometimes this circles can overlap. That means an element belongs to more than one subset.

This circle has multiples of 5

This circle has multiples of 6

10 15
5
20 25 30
35
40 45
60
45 50 55

24 18 12
6
42
36
54 48

Where the circles overlap has common multiples of 5 and 6

4. If the element does not belong to a subset then it is written outside the circle but in the rectangle

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Click here for more notes Venn Diagrams (Purple Math)

Click here for some practice problems on Venn Diagrams (NLVM)

Click here for a video of solving problems using Venn Diagrams (Youtube)

Example:
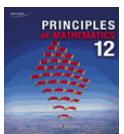
Complete "Further Your Understanding" question 1 on page 20 of your textbook.

Consider the following sets:
- $U = \{2, 3, 4, 6, 8, 9, 10, 12, 14, 15\}$
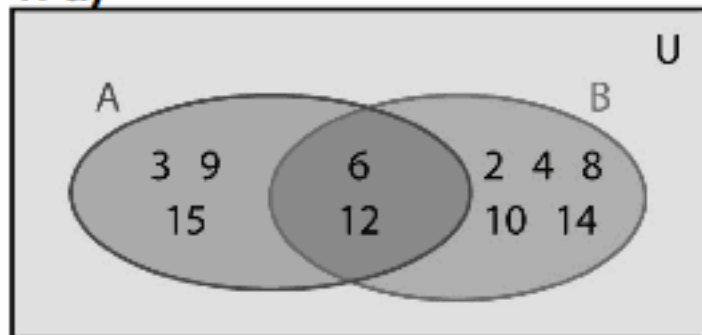- $A = \{3, 6, 9, 12, 15\}$
- $B = \{2, 4, 6, 8, 10, 12, 14\}$

a) Illustrate these sets using a Venn diagram.

b) Determine the number of elements

  i)   in set A.   v)   in set A **and** set B.
  ii) in set A but not in set B.   vi) in set A **or** set B.
  iii) in set B.   vii) in A'.
  iv) in set B but not in set A.

Solution

1. a)

b) i) $n(A) = 5$

ii)
$$n(A \text{ but not } B) = n(A) - n(A \text{ and } B)$$
$$n(A \text{ but not } B) = 5 - 2$$
$$n(A \text{ but not } B) = 3$$

iii) $n(B) = 7$

iv) $n(B \text{ but not } A) = n(B) - n(A \text{ and } B)$
$n(B \text{ but not } A) = 7 - 2$
$n(B \text{ but not } A) = 5$
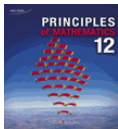
v) $n(A \text{ and } B) = 2$

vi) $n(A \text{ or } B) = n(A \text{ but not } B) + n(A \text{ and } B)$
$+ n(B \text{ but not } A)$
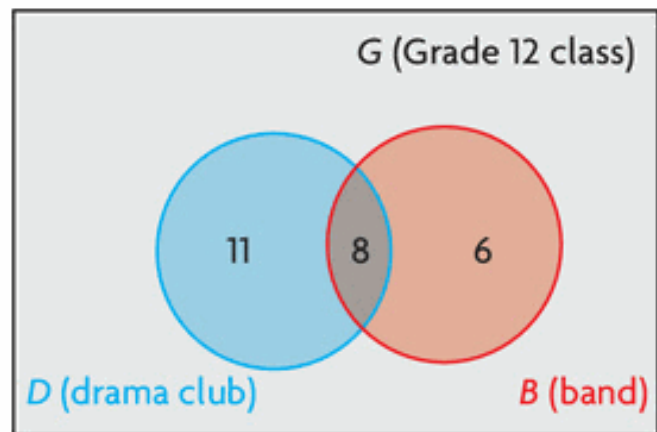$n(A \text{ or } B) = 3 + 2 + 5$
$n(A \text{ or } B) = 10$

vii) $n(A) = 5$, therefore $n(A') = 5$

Example:

Complete " Further Your Understanding" question 2 on page 21 of your textbook.

There are 38 students in a Grade 12 class. The number of students in the drama club and the band are illustrated in the Venn diagram. Use the diagram to answer the following questions.

a) How many students are in both the drama club and the band?

b) How many students are in the drama club but not in band?
How many are in the band but not in the drama club?

c) How many students are in the drama club? How many are in the band?

d) How many students are in at least one of the drama club or the band?

e) How many students are in neither the drama club nor the band?

Solution

2. a) 8 students are in both the drama club and the band.

b) 11 students are in the drama club only.
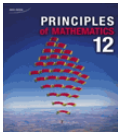6 students are in the band only.

c) Drama: 11 + 8 = 19
Band: 8 + 6 = 14

d) Drama club or band: 11 + 8 + 6 = 25

e) 38 students in grade 12 – 25 in drama club or band = 13 students in neither drama club nor band

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Example:

Complete "Further Your Understanding" question 3 on page 21 of your textbook.

Anna surveyed 45 students about their favourite sports. She recorded her results.

Favourite Sports	Number of Students
hockey	20
soccer	14
neither hockey nor soccer	16

a) Determine how many students like hockey and soccer.
b) Determine how many students like only hockey or only soccer.
c) Draw and label a Venn diagram to show the data.

Solution

3. a) hockey or soccer: 45 – 16 = 29
hockey and soccer: 20 + 14 = 34
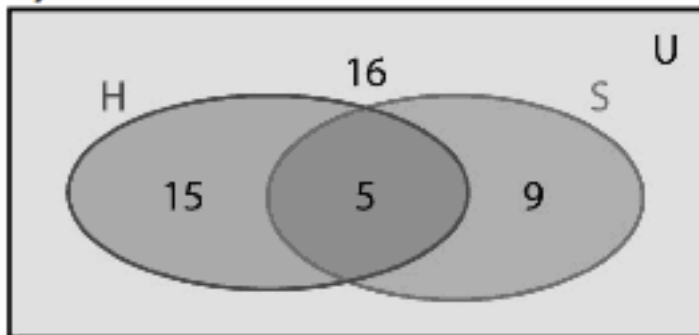overlap: 34 – 29 = 5
5 students like hockey and soccer.
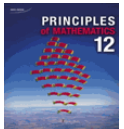**b)** only hockey: 20 – 5 = 15
only soccer: 14 – 5 = 9
15 + 9 = 24
24 students like only hockey or only soccer.
c)

Example:

Complete "Further Your Understanding" question 4 on page 21 of your textbook.

There are 55 guests at a ski resort in British Columbia. Of these guests, 25 plan to go skiing and 32 plan to go snowboarding. There are 9 guests who do not plan to ski or snowboard.
a) Determine how many guests plan to ski and snowboard.
b) Determine how many guests plan to only ski.
c) Determine how many guests plan to only snowboard.

Solution

4. a) ski or snowboard: 55 – 9 = 46
ski and snowboard: 25 + 32 = 57
Overlap: 57 – 46 = 11
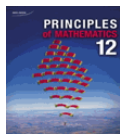11 guests plan to ski and snowboard.
b) only ski: 25 – 11 = 14
14 guests will only ski.
c) only snowboard: 32 – 11 = 21
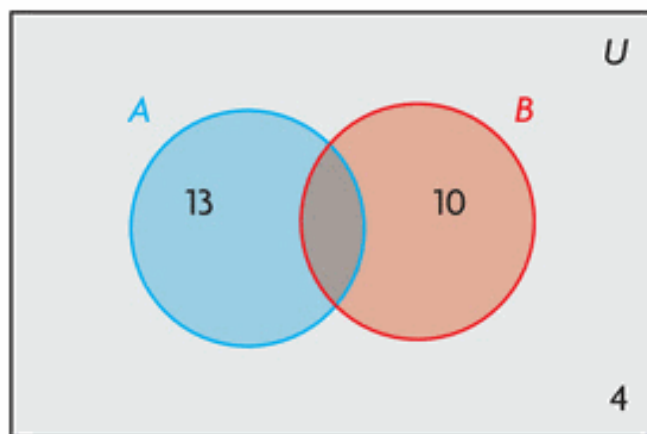21 guests will only snowboard.

Example:

Complete "Further Your Understanding" question 5 on page 21 of your textbook.

Ryan drew the following Venn diagram incorrectly. There are 25 items in the universal set, U, and 4 items that are not in set A or set B.

a) Determine $n(A \text{ and } B)$, $n(A \text{ only})$, and $n(B \text{ only})$.

b) Redraw Ryan's Venn diagram with the data you determined in part a).

Solution

5. a) $n(U) - n(U$ but not A or B): $25 - 4 = 21$
$n(A) + n(B)$: $13 + 10 = 23$
$n(A$ and B): $23 - 21 = 2$
$n(A$ only): $13 - 2 = 11$
$n(B$ only): $10 - 2 = 8$
b)