3.1 – Types of Sets and Set Notation

Date: Feb. 2

Set: A collection of distinguishable objects. Sets are defined using braces.

e.g. The set of whole numbers is W = {0, 1, 2, 3 …}

Element: An object in a set.

e.g. 3 is an element of whole numbers. $3 \in W$

Universal set: A set of all the elements under consideration for a particular context, also called the sample space.

e.g. The universal set of digits is D = {0, 1, 2, 3, 4, 5, 6, 7, 8, 9}

Subset: A set whose elements all belong to another set. To show A is a subset of B, we write $A \subset B$.

e.g. The set of odd digits, O = {1, 3, 5, 7, 9} is a subset of D. $O \subset D$

Complement: All the elements of a universal set that do not belong to a subset of it. The complement is denoted with a prime sign (').

e.g. If O = {1, 3, 5, 7, 9}, then O' = {0, 2, 4, 6, 8}

Empty set: A set with no elements, denoted by {} or $\emptyset$.

e.g. The set of odd numbers divided by two is empty set.

Disjoint: Two or more sets having no elements in common.

e.g. The set of even numbers and the set of odd numbers are disjoint.

Mutually exclusive: Two or more events that cannot occur at the same time.

e.g. One cannot be alive and dead at the same time, so they are mutually exclusive.

Infinite set: A set with an infinite number of elements.

e.g. N = {1, 2, 3 …} has an infinite number of elements.

Set notation

A set is indicated by a letter, and includes the elements. Elements can be listed individually, or described in words. Triple dots can be used to indicate the set continues on indefinitely.

Set of whole numbers is W = $\{0,1,2,3\ldots\}$

Set of even integers is E = $\{\ldots -4,-2,0,2,4\ldots\}$

Set of X = $\{$all integers between 0 and 6, inclusive$\}$

or $\{x \mid 0 \leq x \leq 6, x \in I\}$ or $\{0,1,2,3,4,5,6\}$

To indicate a subset of a set, we use this symbol:

$\subset$ $\not\subset$ ← not a subset of

The set of my numbers, N = {-2, 0, 2}. All of these numbers are in the set of even integers, E, so my set is a subset of E. We write this as:

$N \subset E$

The complement of my subset is N' when we use E as the universal set.

$N = \{-2,0,2\}$ $N' = \{\ldots -6,-4,4,6\ldots\}$

It excludes my subset but includes all the other elements of the set. This also means that:

$N' \subset E$

If we have another set, B, that includes -1, 1, and 3, then B has no elements in common with the set of even integers. We get:

$B = \{-1,1,3\}$ $B \not\subset E$

$B \subset E = \emptyset$ or $B \subset E = \{\}$ ← B as a subset of E has no elements (empty set)

To indicate the number of elements in a set, we use the letter (lower case) n and include the set we are examining in brackets. So for my set of numbers, N, there are three elements.

$n(N) = 3$

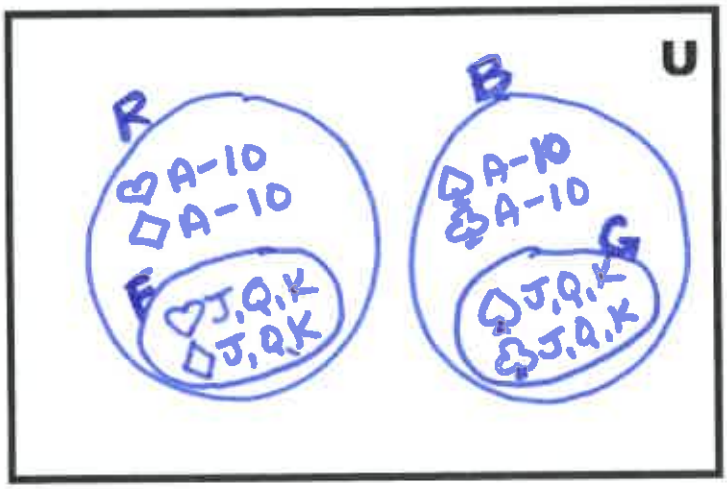
$n(B) = 3$

Venn diagrams

One way of indicating sets and subsets is to use a Venn diagram. A Venn diagram uses a rectangle to indicate the universal set, or all possible values included in the set. Circles are drawn inside the rectangle to indicate subsets of the universal set.

Example: Separate a standard deck of cards into red and black subsets. Then separate the cards into face cards and non-face cards. Write the set notations beside the Venn diagram. Include the number of elements in each subset.

universal set



* lets assume the Jokers have been removed.

$n(U) = 52$

$n(R) = 26$
$n(B) = 26$
$n(F) = 6$
$n(G) = 6$

$R \subset U$
$B \subset U$
$F \subset R$ $G \subset B$
$F \subset U$ $G \subset U$

We can write equations to describe the number of elements in a set.

Example: For the deck of cards above, write an equation to find the number of red non-face cards.

$n(U) - n(B) - n(F)$
$= 52 - 26 - 6 = 20$

Example: For the deck of cards above, write an equation to find the total number of non-face cards without using the universal set.

$n(R) - n(F) + n(B) - n(G)$
$26 - 6 + 26 - 6 = 40$

Example: List any disjoint sets from the set of cards above. How could we redraw the Venn diagram by disjoint sets?

- red and black (above)

Face cards and non-face cards

Note that the number of elements in a subset plus its complement must equal the universal set.

$$n(R) + n(R') = n(U)$$
$$26 + 26 = 52$$

When two sets are disjoint, the number of elements in either of them is the sum of the number in both of them.

$$n(R) + n(B) = n(R \text{ or } B)$$
$$26 + 26 = 52$$

3.2 – Exploring Relationships Between Sets

Date: _____

When sets are not disjoint (i.e. there are elements in common), we have to have ways of describing how the sets relate to one another.

Two words have specific meaning when dealing with sets: **AND** and **OR**.

AND: To use 'and' means we want the elements that are elements of both sets.

OR: To use 'or' means we want the elements of one set, the elements of the other set, and the elements that are in both sets.

Example: Given the following sets, create a Venn Diagram to show their relationships.

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

T={3,6,9,12}

F={4,8,12}

How many elements are in both?