Representing Relations

5.1 Representing Relations

How are we Related !!!!

Legend
- Direct descendant
- - - - Marriage
- ⬭ Female
- ☐ Male

Simon - - - - Marie-Anne

Elisabeth - - - - Étienne

Marie-Madeleine - - - - Louis

Joseph   Angélique
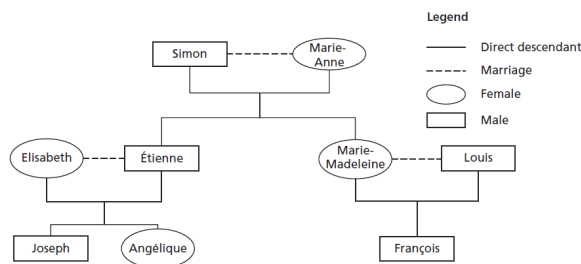
François

- **How is Joseph related to Simon?**

- **How are Angelique and Francois related?**

- **How does the family tree show these relations?**

Terminology

A *set* is a collection of distinct objects.

Set of Fruit

Fruit
apple
blueberry
cherry
huckleberry

Set of Colours

Colour
red
green
blue

An *element* of a set is one object in the set.
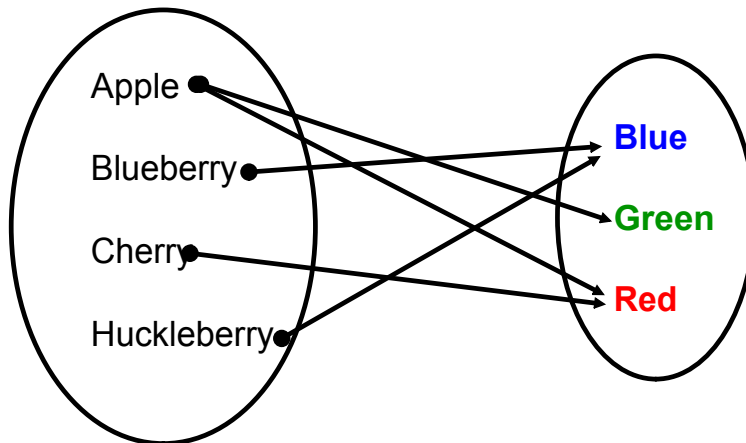
Set of Fruit

Fruit
apple
blueberry
cherry
huckleberry

Apple is an **element** of the set of Fruit

A *relation* associates the elements of one set with the elements of another set

① # Arrow Diagram

Apple • → Blue
Blueberry • → Green
Cherry • → Red
Huckleberry •

(Apple → Blue, Apple → Green, Blueberry → Red, Cherry → Red, Huckleberry → Blue)

Some other ways to display the relation :

② ## Use a table

Fruit	Colour
apple	red
apple	green
blueberry	blue
cherry	red
huckleberry	blue

③ Use a set of *ordered pairs* to display a relation.

$$\left\{ \begin{array}{l} \text{(fruit, colour)} \\ \text{(apple, red) , (apple, green) , (blueberry, blue) ,} \\ \text{(cherry, red) , (huckleberry, blue)} \end{array} \right\}$$

(0,1)   (2,3)

④ graph

⑤ Written explanation

Northern communities can be associated
with the *territories* they are in.

Community	Territory
Hay River	NWT
Iqaluit	Nunavut
Nanisivik	Nunavut
Old Crow	Yukon
Whitehorse	Yukon
Yellowknife	NWT

a) Describe this relation in words.
b) Represent this relation:
    i)   as a set of ordered pairs
    ii)   as an arrow diagram

Community	Territory
Hay River	NWT
Iqaluit	Nunavut
Nanisivik	Nunavut
Old Crow	Yukon
Whitehorse	Yukon
Yellowknife	NWT

The relation shows the
association between
a community and its
territory.

i)

The communities are the first ordered pairs.
The teritories are the second ordered pairs.

{
(community, territory)
(Hay River, NWT) , (Iqaluit, Nunavut) , (Nanisivik, Nunavut) ,
(Old Crow, Yukon), (Whitehorse, Yukon) , (Yellowknife , NWT)
}

Community	Territory
Hay River	NWT
Iqaluit	Nunavut
Nanisivik	Nunavut
Old Crow	Yukon
Whitehorse	Yukon
Yellowknife	NWT

ii)

is located in

Hay River
Iqaluit
Nanisivik
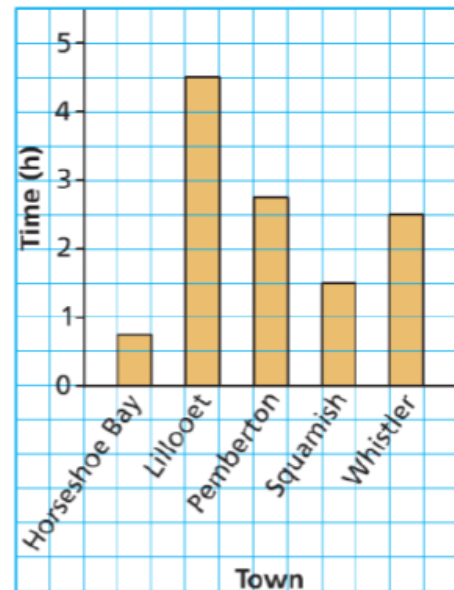Old Crow
Whitehorse
Yellowknife

Nunavut
NWT
Yukon
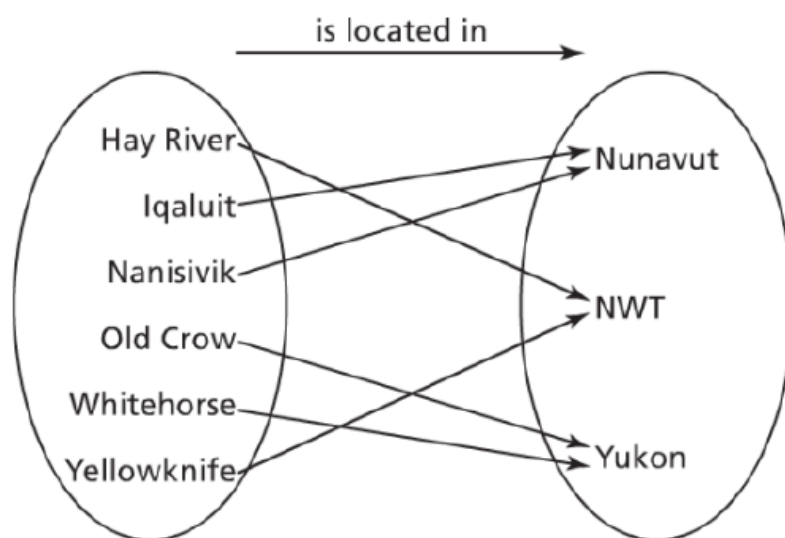
You Try !!

Different towns in British Columbia can be associated with the average time, in hours, that it takes to drive to Vancouver.
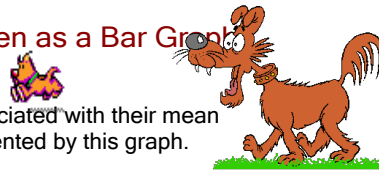
Town	Time (h)
Horseshoe Bay	0.75
Lillooet	4.5

Represent the relation as a *table*.

solution:

Town	Average Time (h)
Horseshoe Bay	0.75
Lillooet	4.5
Pemberton	2.75
Squamish	1.5
Whistler	2.5

Representing a Relation Given as a Bar Graph

Different breeds of dogs can be associated with their mean heights. Consider the relation represented by this graph.

Mean Heights of Different Breeds of Dogs
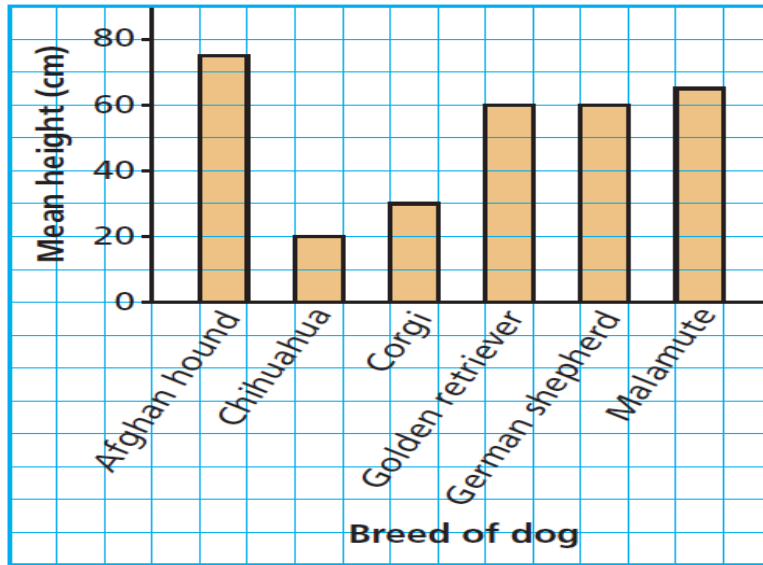
Represent the relation:
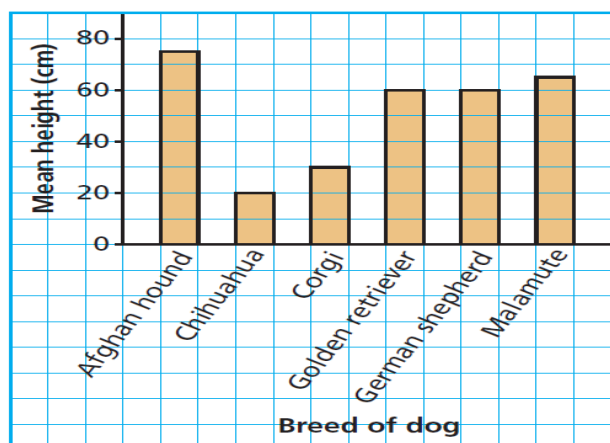 a) as a table

  b) as an arrow diagram

Represent the relation:

a) as a table

In the table, write the breeds of dogs in the first column and the mean heights in centimetres in the second column.
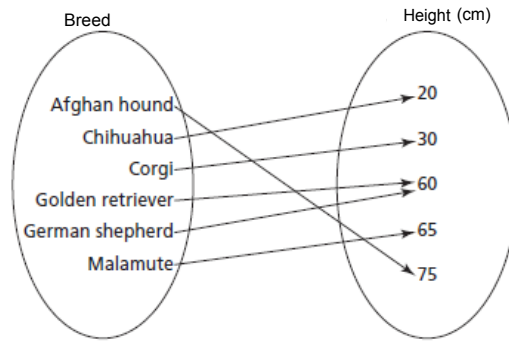
Breed of Dog	Mean Height (cm)
Afghan hound	75
Chihuahua	20
Corgi	30
Golden retriever	60
German shepherd	60
Malamute	65

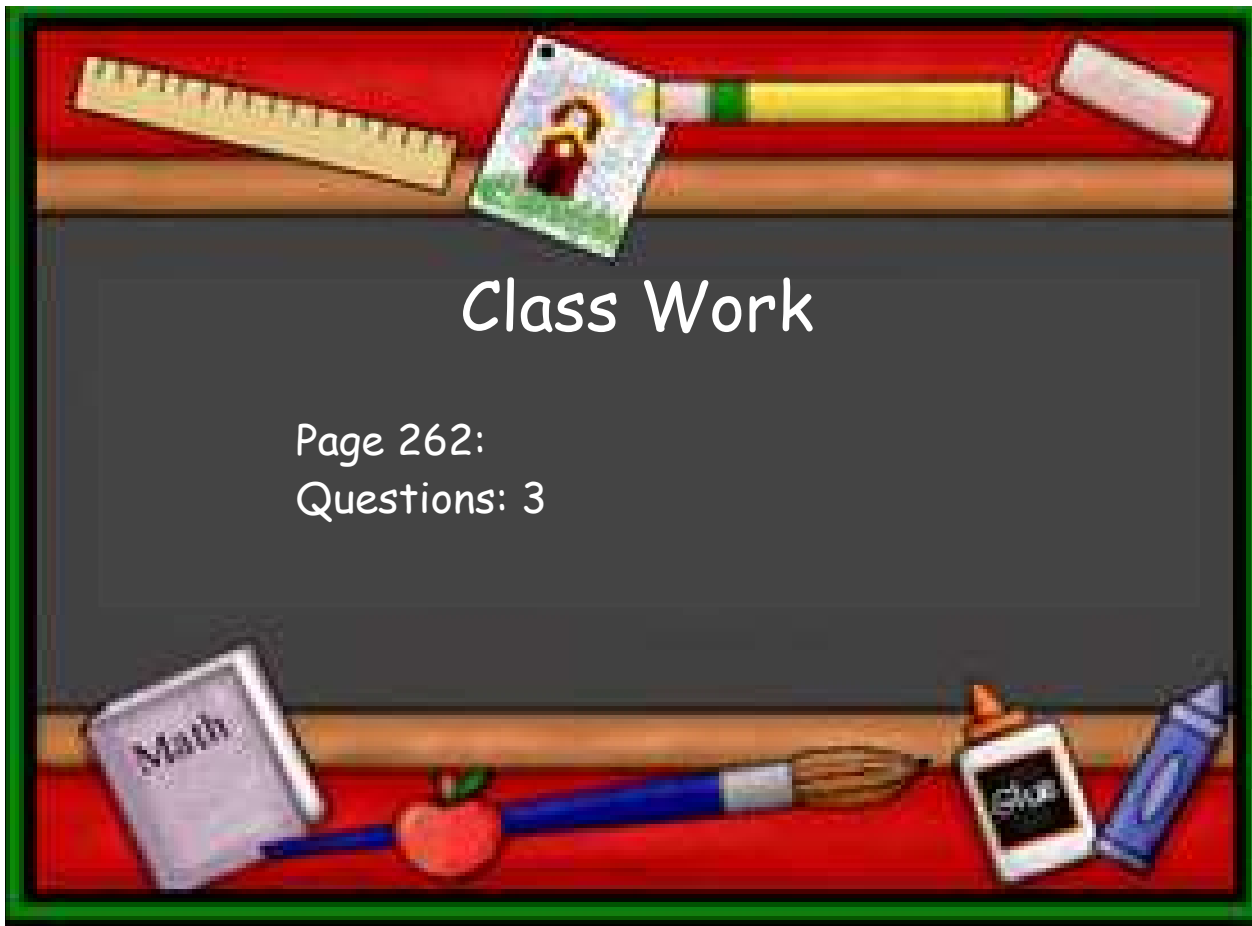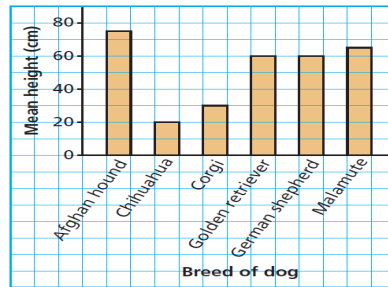**Mean Heights of Different Breeds of Dogs**

b) as an arrow diagram

b) In the arrow diagram, write the breeds of dogs in the first set and the mean heights in centimetres in the second set.

Breed   Height (cm)

Afghan hound
Chihuahua
Corgi
Golden retriever
German shepherd
Malamute

20
30
60
65
75

Mean Heights of Different Breeds of Dogs

Mean height (cm)

80
60
40
20
0

Afghan hound
Chihuahua
Corgi
Golden retriever
German shepherd
Malamute

Breed of dog

Class Work

Page 262:
Questions: 3

3. For each table below:
   i) Describe the relation in words.
   ii) Represent the relation:
      ■ as a set of ordered pairs
      ■ as an arrow diagram

a)

Coin	Value ($)
penny	0.01
nickel	0.05
dime	0.10
quarter	0.25
loonie	1.00
toonie	2.00

b)

Sport	Equipment
badminton	shuttlecock
badminton	racquet
hockey	puck
hockey	stick
tennis	ball
tennis	racquet
soccer	ball

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a)

Coin	Value ($)
penny	0.01
nickel	0.05
dime	0.10
quarter	0.25
loonie	1.00
toonie	2.00

The relation shows the association of coins to their value.

3. a) i) The relation shows the association ~~"has a value in dollars of"~~ from a set of coins to a ~~set of numbers~~.

   ii) As a set of ordered pairs:
       {(penny, 0.01), (nickel, 0.05), (dime, 0.10),
   (quarter, 0.25), (loonie, 1.00), (toonie, 2.00)}

As an arrow diagram:
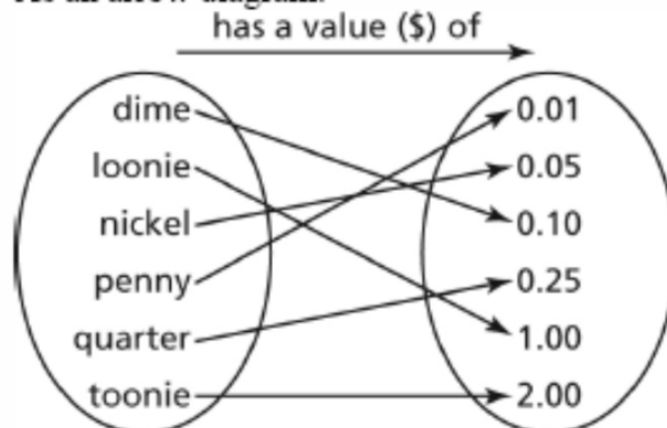
has a value ($) of

dime → 0.01
loonie → 0.05
nickel → 0.10
penny → 0.25
quarter → 1.00
toonie → 2.00

b)

Sport	Equipment
badminton	shuttlecock
badminton	racquet
hockey	puck
hockey	stick
tennis	ball
tennis	racquet
soccer	ball

The relation shows the association of a sport to its equipment

b) i) The relation shows the association "is played with a" from a set of sports to a set of equipment.

ii) As a set of ordered pairs: (sport, equipment)
{(badminton, racquet), (badminton, shuttlecock), (hockey, puck), (hockey, stick), (tennis, ball), (tennis, racquet), (soccer, ball)}
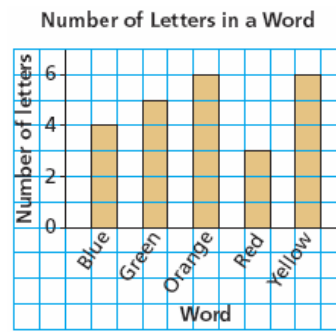
As an arrow diagram:

is played with a
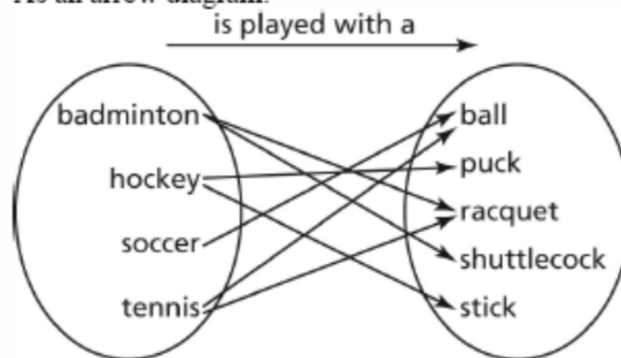
Homework

Page 262-263 4, 5, 7, 13, 14

$$(m^2 - 5m)^2 - 36 = (m^2 - 5m + 6)(m^2 - 5m - 6)$$
$$= (m - 2)(m - 3)(m - 6)(m + 1)$$

$$x^2 - y^2$$
$$(x + y)(x - y)$$
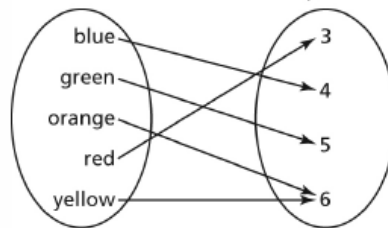
4. Consider the relation represented by this graph.
Represent the relation:
a) as a table
b) as an arrow diagram

Number of Letters in a Word

4. a) As a table:

Word	Number of Letters
blue	4
green	5
orange	6
red	3
yellow	6

b) As an arrow diagram:
has this number of letters

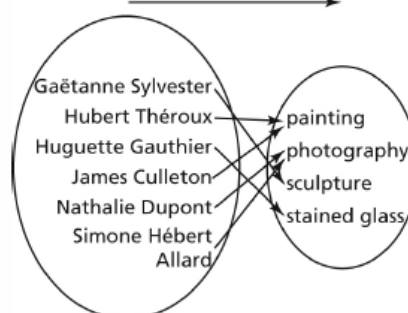5.1 Representing Relations

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5. This table shows some of Manitoba's francophone artists and the medium they use.
a) Describe the relation in words.
b) Represent this relation:
    i) as a set of ordered pairs
    ii) as an arrow diagram

| Artist	Medium
Gaëtanne Sylvester	sculpture
Hubert Théroux	painting
Huguette Gauthier	stained glass
James Culleton	painting
Nathalie Dupont	photography
Simone Hébert Allard	photography

5. a) The relation shows the association "creates art using the medium of" from a set of francophone artists from Manitoba to a set of artistic mediums.

b) i) As a set of ordered pairs:
    {(Gaëtanne Sylvester, sculpture),
    (Hubert Théroux, painting),
    (Huguette Gauthier, stained glass),
    (James Culleton, painting),
   (Nathalie Dupont, photography),
    (Simone Hébert Allard, photography)}

ii) As an arrow diagram:
creates art using
the medium of

Typical Masses of Species of Salmon

Species: Sockeye, Pink, Coho, Chum, Chinook

Mass (kg): 0 2 4 6 8 10 12 14

6. a) Describe the relation represented by this bar graph.

   b) Represent the relation as a set of ordered pairs.

   c) Represent the relation in a different way.
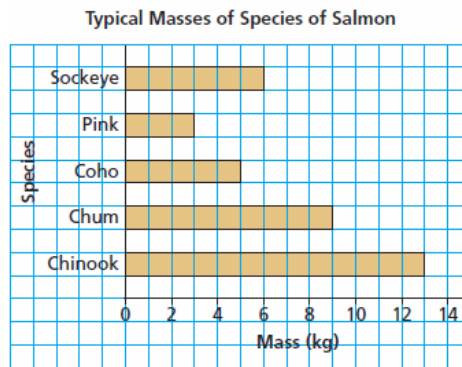
6. a) The relation shows the association "has a typical mass, in kilograms, of" from a set of salmon species to a set of masses.

   b) As a set of ordered pairs:
      {(Chinook, 13), (Chum, 9), (Coho, 5), (Pink, 3), (Sockeye, 6)}

   c) As an arrow diagram:
      has a typical mass (kg) of

      Chinook, Chum, Coho, Pink, Sockeye → 3, 5, 6, 9, 13
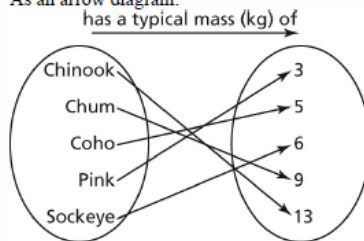
5.1 Representing Relations

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7. For a word game, words that begin with the letter Z can be difficult to find.

   a) What does this arrow diagram represent?

   b) Represent this relation in two different ways.

   c) Create an arrow diagram for words beginning with the letter X, then represent the relation in two different ways.

is the number of letters in

3, 4, 5, 6, 7, 8 → Zamboni, zany, zebra, Zen, zeppelin, zero, zombie
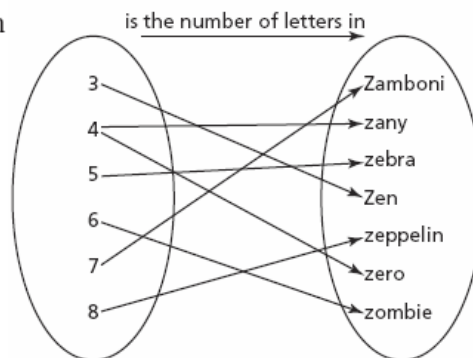
7. a) The arrow diagram shows a relation with the association "is the number of letters in" from a set of numbers to a set of words beginning with the letter Z.

   b) As a set of ordered pairs:
      {(3, Zen), (4, zany), (4, zero), (5, zebra), (6, zombie), (7, Zamboni), (8, zeppelin)}

      As a table:

Number	Word beginning with Z
3	Zen
4	zany
4	zero
5	zebra
6	zombie
7	Zamboni
8	zeppelin

   c) Chosen words and representations may vary. For example:
      As an arrow diagram:
      is the number of letters in

   4, 5, 9, 10 → xenon, xenophilia, Xerox, X-ray, xylem, xylophone
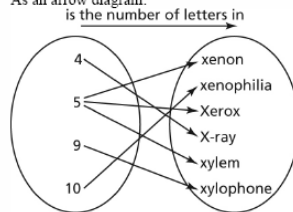
   As a set of ordered pairs:
      {(4, X-ray), (5, xenon), (5, Xerox), (5, xylem), (9, xylophone), (10, xenophilia)}

   As a table:

Number	Word beginning with X
4	X-ray
5	xenon
5	Xerox
5	xylem
9	xylophone
10	xenophilia

...ions

8. In the diagram below:
   a) Describe the relation in words.
   b) List two ordered pairs that belong to
      the relation.

| French words | translates to → | English words |
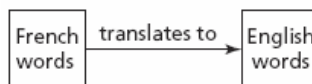
8. a) The diagram shows a relation with the association
      "translates to" from the set of French words to the set
      of English words.
   b) Answers may vary. For example: Two ordered pairs
      that satisfy the relation are: (oui, yes) and (et, and)

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9. A digital clock displays digits from 0 to 9 by lighting up
   different segments in two squares. For example,
   the digit 2 needs 5 segments to light up, as shown.

   a) List the set of ordered pairs of the form:
      (digit, number of segments lit up)
   b) Represent this relation in two different ways.

9. a) {(0, 6), (1, 2), (2, 5), (3, 5), (4, 4), (5, 5), (6, 6), (7, 3),
      (8, 7), (9, 6)} Some digital clocks may show the
      number 9 with 5 line segments.
   b) Representations may vary. For example:
      As an arrow diagram:
      has this number of lit segments
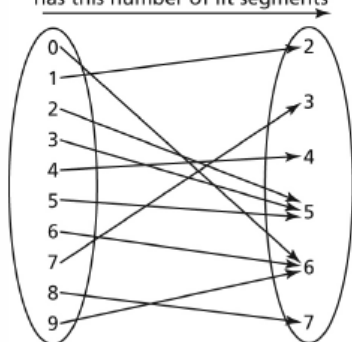
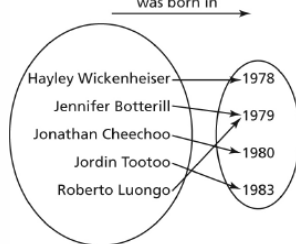As a table of values:

Digit	Number of lit segments
0	6
1	2
2	5
3	5
4	4
5	5
6	6
7	3
8	7
9	6

tions

10. Here are some Canadian hockey players and the year they were born.
Jennifer Botterill (1979); Jonathan Cheechoo (1980);
Roberto Luongo (1979); Jordin Tootoo (1983); Hayley Wickenheiser (1978)
For each association below, use these data to represent a relation
in different ways.
a) was born in
b) is the birth year of

10. a) As an arrow diagram:

was born in

Hayley Wickenheiser → 1978
Jennifer Botterill
Jonathan Cheechoo → 1979
Jordin Tootoo → 1980
Roberto Luongo → 1983

As a table:

Hockey Player	Birth Year
Hayley Wickenheiser	1978
Jennifer Botterill	1979
Jonathan Cheechoo	1980
Jordin Tootoo	1983
Roberto Luongo	1979

As a set of ordered pairs:
{(1978, Hayley Wickenheiser),
(1979, Jennifer Botterill),
(1979, Roberto Luongo),
(1980, Jonathan Cheechoo),
(1983, Jordin Tootoo)}

As a table:

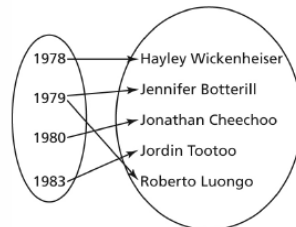| Birth Year	Hockey Player
1978	Hayley Wickenheiser
1979	Jennifer Botterill
1979	Roberto Luongo
1980	Jonathan Cheechoo
1983	Jordin Tootoo

As a set of ordered pairs:
{(Hayley Wickenheiser, 1978),
(Jennifer Botterill, 1979),
(Jonathan Cheechoo, 1980),
(Jordin Tootoo, 1983),
(Roberto Luongo, 1979)}

b) As an arrow diagram:
is the birth year of

1978 → Hayley Wickenheiser
1979 → Jennifer Botterill
1980 → Jonathan Cheechoo
→ Jordin Tootoo
1983 → Roberto Luongo

11. Choose five people in your class.
a) Use the association "is older than" to write a relation. Represent the
relation using a set of ordered pairs.
b) Create your own association for these five people, then describe the
relation in words. Represent this relation in different ways.

11. Answers may vary. For example:
a) Ordered pairs should be in the form: (older person,
younger person)
b) Other associations include: "is taller than"
"is involved in more school groups than"
"usually wakes up earlier than"

12. Two dice are rolled and the numbers that show are recorded.
　a) Use each association below to create a relation as a set of ordered pairs.
　　i) The sum of the numbers is even.
　　ii) The difference between the numbers is a prime number.
　b) In part a, does the order of the numbers
　　in each ordered pair matter? Explain.

12. a)　i) {(1, 1), (1, 3), (1, 5), (2, 2), (2, 4), (2, 6), (3, 1),
　　　　(3, 3), (3, 5), (4, 2), (4, 4), (4, 6), (5, 1), (5, 3),
　　　　(5, 5), (6, 2), (6, 4), (6, 6)}
　　ii) {(1, 3), (1, 4), (1, 6), (2, 4), (2, 5), (3, 1), (3, 5),
　　　　(3, 6), (4, 1), (4, 2), (4, 6), (5, 2), (5, 3), (6, 1),
　　　　(6, 3), (6, 4)}
　b) No

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13. The association "is the parent of" is shown in the diagram. Each dot represents a person and each arrow maps a parent to her or his child.
In this relation:
　a) How many children are shown?
　b) How many parents are shown?
　c) How many grandparents are shown?
Justify your answers.
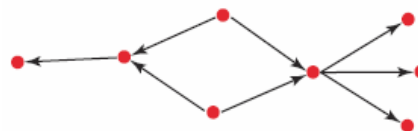
13. a) 6 children　　　　**b)** 4 parents
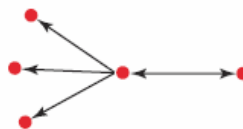　**c)** 2 grandparents

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14. The association "is the sister of" is shown in the diagram. Each dot represents a person and each arrow maps a sister to a sibling.

In this relation:

a) How many females are shown?

b) How many males are shown?

Justify your answers.

14. a) 2 females   **b)** 3 males

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