

- d) i)** The statement is true.  
**ii)** Converse: If a number can be expressed as a fraction, then it can be expressed as a terminating decimal.

The converse is false. For example,  $\frac{1}{3}$ , written as a decimal, is 0.333... This is a repeating decimal.

- iii)** Inverse: If a number cannot be expressed as a terminating decimal then it cannot be expressed as a fraction.

The inverse is false. For example, 0.333... is a repeating decimal. It is also  $\frac{1}{3}$ .

- iv)** Contrapositive: If a number cannot be expressed as a fraction, then it cannot be expressed as a terminating decimal. The contrapositive is true.

- e) i)** This statement is true

- ii)** Converse: If a graph is a parabola, then the equation of this parabola is  $f(x) = 5x^2 + 10x + 3$ .

This statement is false, because there are many parabolas that do not have that equation, such as  $f(x) = x^2$ .

- iii)** Inverse: If the equation of a function is not  $f(x) = 5x^2 + 10x + 3$ , then its graph is not a parabola. This statement is false. For example, a function can have the equation  $f(x) = x^2$ , yet it is a parabola.

- iv)** Contrapositive: If a graph is not a parabola, then the equation of this parabola is not  $f(x) = 5x^2 + 10x + 3$ . This statement is true, because only a parabola can have that equation.

- f) i)** This statement is false. For example,  $-1$  is an integer, but not a whole number.

- ii)** Converse: If a number is a whole number, then it is an integer.

This statement is true,

- iii)** Inverse: If a number is not an integer, then it is not a whole number.

This statement is true.

- iv)** Contrapositive: If a number is not a whole number, then it is not an integer.

This statement is false, for example  $-1$  is not a whole number, but it is an integer.

- 13. a)** e.g., The contrapositive assumes as its hypothesis that the original conclusion is false, which means that the original hypothesis must also not be true. If the original hypothesis is not true, then the conditional statement must be false.

- b)** e.g., The converse of a conditional statement is formed by stating the conclusion before the hypothesis. The inverse is formed by negating the hypothesis and conclusion of a conditional statement. Since negating both parts of the statement is the same as reversing them, the converse and inverse are logically equivalent. The inverse of a statement is the contrapositive of the statement's converse.

- 14. e.g., a)** Conditional statement: If you are tall, then you like chocolate.  
 Contrapositive statement: If you do not like chocolate, then you are not tall.

Counterexample: I am tall and do not like chocolate. Both the conditional statement and the contrapositive are false.

- b)** Conditional statement: If a traffic light is green, it is not red. Contrapositive: If a traffic light is red, it is not green. Both the conditional statement and the contrapositive are true.

- 15. e.g., a)** Conditional statement: If it is Saturday, then it is the weekend.

Inverse: If it is not Saturday, then it is not the weekend. The inverse is false. Counterexample: it could be Sunday and be the weekend.

- Converse: If it is the weekend, then it is Saturday. The converse is false. Counterexample: it could be the weekend and be Sunday.

- b)** Conditional statement: If a polygon has six sides, then it is a hexagon.

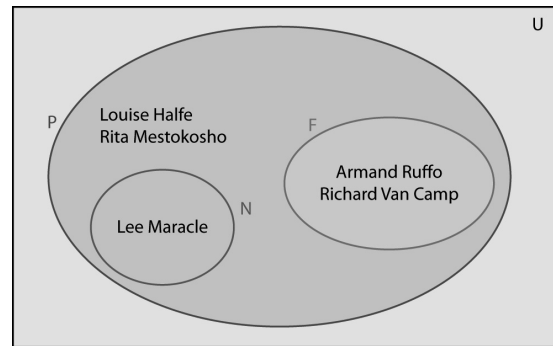
Inverse: If a polygon does not have six sides, then it is not a hexagon. The inverse is true by definition.

Converse: If a polygon is a hexagon, then it has six sides. The converse is true by definition.

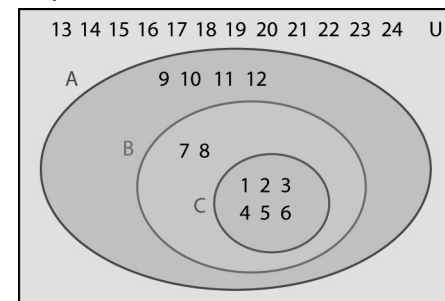
### Chapter Self-Test, page 217

- 1.** Let  $U$  represent the universal set of writers. Let  $P$  represent the set of poets. Let  $N$  represent the set of novelists, and let  $F$  represent the set of fiction writers.

Subset fiction writer,  $F = \{\text{Armand Ruffo, Richard Van Camp}\}$



- 2. a)**



Set  $C$  is inside set  $A$ , therefore  $C \subset A$ .

**b)**  $A = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12\}$

$B = \{1, 2, 3, 4, 5, 6, 7, 8\}$

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

$n(A \cup B) = 12$   
 $C = \{1, 2, 3, 4, 5, 6\}$   
 $A \cap C = \{1, 2, 3, 4, 5, 6\}$   
 $n(A \cap C) = 6$   
**c)**  $A \cap B = \{1, 2, 3, 4, 5, 6, 7, 8\}$   
 $A \cap B \setminus C = \{7, 8\}$   
**d)**  $A \cup B \cup C = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12\}$   
 $(A \cup B \cup C)'$  is all the elements not in  $A \cup B \cup C$ .  
 $(A \cup B \cup C)' = \{13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24\}$

**3.** Let  $U$  represent the universal set. Let  $W$  represent the students who drink bottled water. Let  $L$  represent the students who follow a low fat diet. Let  $F$  represent the students who eat fruit.  
 We know 15% of students do all three, so that number is the three-way intersection.  
 We know 22% drink bottled water and follow a low-fat diet, so  $n(L \cup W / F) = 22 - 15 = 7$ .  
 Similarly,  $n(W \cup F / L) = 27 - 15 = 12$  and  $n(L \cup F / W) = 23 - 15 = 8$ .

From here, I know 50% of the students drink bottled water, 56% eat fruit, and 43% follow a low-fat diet.  
 $W / L \cup F = 50 - 15 - 7 - 12 = 16$   
 $F / W \cup L = 56 - 15 - 12 - 8 = 21$   
 $L / W \cup F = 43 - 15 - 7 - 8 = 13$

To determine the percent of students who do not drink bottled water, eat fruit or follow a low-fat diet we need  $(W \cup F \cup L)'$ .  
 $(W \cup F \cup L) = 16 + 13 + 21 + 12 + 7 + 8 + 15 = 92$   
 $(W \cup F \cup L)' = 100 - 92 = 8$   
 Therefore, 8% of students do not drink bottled water, eat fruit or follow a low-fat diet.

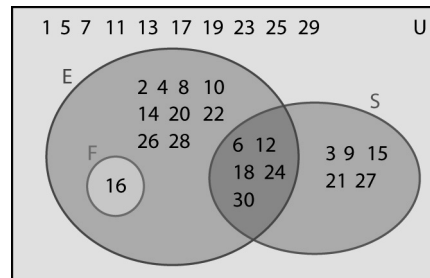
**4. a)** Conditional statement: If you want to win an election, then you must get the most votes.  
 Inverse: If you do not want to win an election, then you must not get the most votes.  
 The statement is not biconditional; e.g., in some electoral systems, you need a majority to win.  
**b)** Conditional statement: If the planet is Earth, then it is the third planet from the Sun.  
 Inverse: If the planet is not Earth, then it is not the third planet from the Sun.  
 The statement and inverse are true so this is a biconditional statement.  
 The planet is Earth if and only if it is the third planet from the Sun.  
**c)** Conditional statement: If a number is between 1 and 2, then it is not a whole number.  
 Inverse: If a number is not between 1 and 2, then it is a whole number.  
 The statement is true but the inverse is false.  
 Counterexample: 0.75 is not a whole number but it is less than one. The statement is not biconditional.

**5. a) i)** Conditional statement: If you are over 18, then you are an adult. This statement is false. e.g., The age of majority in British Columbia is 19.

**ii)** Converse: If you are an adult, then you are over 18. This statement is true.  
**iii)** Inverse: If you are not over 18, then you are not an adult. This statement is true.  
**iv)** Contrapositive: If you are not an adult, then you are not over 18. This statement is false, e.g., since the age of majority in British Columbia is 19 the statement would not hold true for an 18-year-old.  
**b) i)** Conditional statement: If you are 16, then you can drive. This statement is false, e.g., a 44-year-old may know how to drive.  
**ii)** Converse: If you can drive, then you are 16. This is false.  
**iii)** Inverse: If you are not 16, then you cannot drive. This statement is also false.  
**iv)** Contrapositive: If you cannot drive, then you are not 16. This statement is false, e.g., a 16-year-old may know how to drive.

## Chapter Review, page 220

1. a)



**b)** Sets  $F$  and  $S$  are disjoint sets.  
**c)** Yes, set  $F$  is a subset of set  $E$ .  
**d)**  $S = \{3, 6, 9, 12, 15, 18, 21, 24, 27, 30\}$   
 $S' = \{1, 2, 4, 5, 7, 8, 10, 11, 13, 14, 16, 17, 19, 20, 22, 23, 25, 26, 28, 29\} = \{\text{natural numbers from 1 to 30 not divisible by 3}\}$   
 Set  $S'$  is different from set  $E'$  because it includes numbers that are not divisible by two and set  $E'$  only includes numbers not divisible by two.  
**e)** e.g.,  $H = \{\text{multiples of 50}\}$

**2. a)** black hair or blue eyes:  $28 - 9 = 19$   
 Since 19 students have black hair, all students with blue eyes have black hair.  
 8 students have black hair and blue eyes.  
**b)** only black hair:  $19 - 8 = 11$   
 11 students have black hair  
**c)** only blue eyes:  $8 - 8 = 0$   
 No students have blue eyes but not black hair.

**3. a)**  $A = \{-12, -9, -6, -3, 0, 3, 6, 9, 12\}$   
 $B = \{x \mid -12 \leq x \leq 12, x \in \mathbb{I}\}$   
 $A \cup B = \{x \mid -12 \leq x \leq 12, x \in \mathbb{I}\}$   
 $= \{-12, -11, -10, -9, -8, -7, -6, -5, -4, -3, -2, -1, 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12\}$   
 $n(A \cup B) = 25$   
 $A \cap B = \{-12, -9, -6, -3, 0, 3, 6, 9, 12\}$   
 $n(A \cap B) = 9$