Solutions for Discovering Mathematics A Quantitative Reasoning Approach 1st Edition by Aufmann

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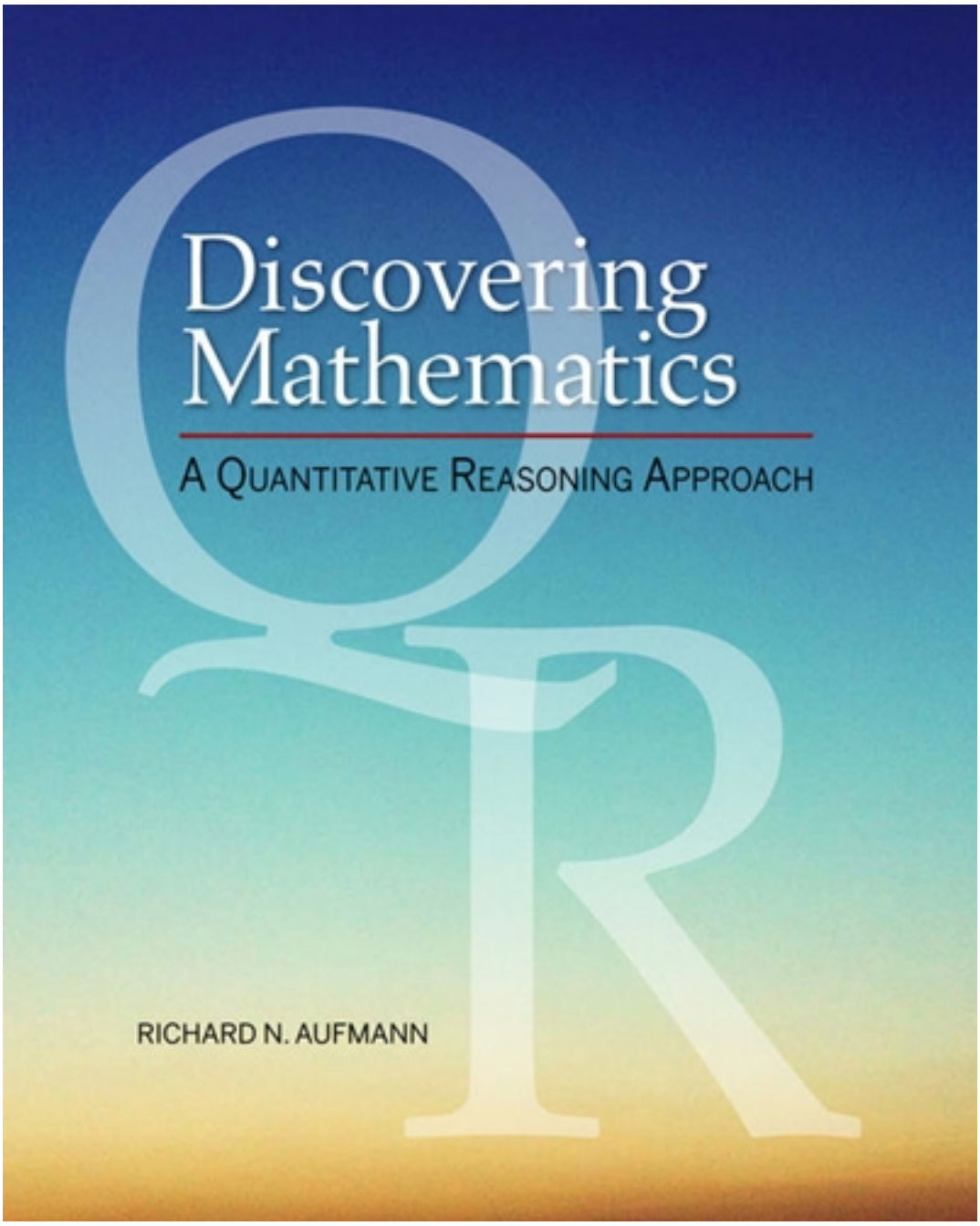

Solutions

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Chapter 2: Sets and Logic

THINK ABOUT IT, SECTION 2.1

1. a. True
   b. True
   c. True
   d. False
   e. False
   f. True
   g. True
   h. True

2. a. No
   b. Yes

3. A and B are disjoint—that is, they have no elements in common.

4. $(A')' = A$

5. False negative

6. Correct outcome

EXERCISE SET 2.1

1. {penny, nickel, dime, quarter, 50 cent piece}

2. {January, February, May, July}

3. {Mercury, Mars}

4. The negative integers greater than –6 are –5, –4, –3, –2, –1. Using the roster method, write the set as {–5, –4, –3, –2, –1}.

5. {0, 1, 2, 3, 4, 5, 6, 7}

6. Adding 4 to each side of the equation produces $x = 7$. {7} is the solution set.

7. Solving:
   $2x - 1 = -11$
   $2x = -10$
   $x = -5$
   So {–5} is the solution set.

8. Solving:
   $x + 4 < 1$
   $x < -3$
   But any number less than –3 is not a natural number so the solution set is empty, Ø.

9. Because b is an element of the given set, the statement is true.

10. False; 0 is not a natural number.

11. True

12. False; the empty set has no elements.

13. True

14. True

15. False; although {5} $\{5\} \subset \{1, 2, 3, 4, 5\}$.

16. False; although $\{a, b, c\} = \{a, b, c\}$, $\{a, b, c\} \not\subset \{a, b, c\}$.

17. The complement of {2, 4, 6, 7} contains elements in U but not in the set: {0, 1, 3, 5, 8}.

18. $\{3, 6\}' = \{0, 1, 2, 4, 5, 7, 8\}$

19. $\emptyset' = U = \{0, 1, 2, 3, 4, 5, 6, 7, 8\}$

20. $\{0, 1, 2, 3, 4, 5, 6, 7, 8\}' = U' = \emptyset$

21. {prime numbers}′ = {0, 1, 4, 6, 8}

22. {composite numbers}′ = {0, 1, 2, 3, 5, 7}

23. Ø, {a}, {z}, {a, z}

24. Ø, {1}, {2}, {3}, {1, 2}, {1, 3}, {2, 3}, {1, 2, 3}

25. Ø, {I}, {II}, {III}, {IV}, {I, II}, {I, III}, {I, IV}, {II, III}, {II, IV}, {III, IV}, {I, II, III}, {I, II, IV}, {I, III, IV}, {II, III, IV}, {I, II, III, IV}

26. Ø

27. Since there are 5 elements in the set {a, e, i, o, u}, there are $2^5 = 32$ subsets.

28. Since there are 7 elements in the set {Monday, Tuesday, Wednesday, Thursday, Friday, Saturday, Sunday}, there are $2^7 = 128$ subsets.

29. $2^{12} = 4{,}096$ different versions

30. a. $2^{10} = 1{,}024$ types of omelets
    b. Solve $2^x > 4{,}000$ by guessing and checking.
    $2^{11} = 2{,}048$
    $2^{12} = 4{,}096$
    At least 12 ingredients must be available.

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31. $A \cup B = \{2, 4, 6\} \cup \{1, 2, 5, 8\}$
$= \{1, 2, 4, 5, 6, 8\}$

32. $A \cap B = \{2, 4, 6\} \cap \{1, 2, 5, 8\} = \{2\}$

33. $A \cap B' = \{2, 4, 6\} \cap \{3, 4, 6, 7\} = \{4, 6\}$

34. $B \cap C' = \{1, 2, 5, 8\} \cap \{2, 4, 5, 6, 8\}$
$= \{2, 5, 8\}$

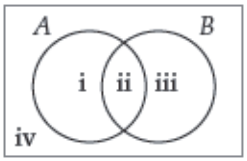
35. $(A \cup B)' = (\{1, 2, 4, 5, 6, 8\})' = \{3, 7\}$

36. $A' = \{1, 3, 5, 7, 8\}$.
$B' = \{3, 4, 6, 7\}$
$A' \cup B' = \{1, 3, 5, 7, 8,\} \cup \{3, 4, 6, 7\}$
$= \{1, 3, 4, 5, 6, 7, 8\}$.

37. $B \cap C = \{1, 2, 5, 8\} \cap \{1, 3, 7\} = \{1\}$.
$A \cap (B \cap C) = \{2, 4, 6\} \cap \{1\} = \emptyset$

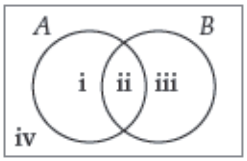
38. $C \cap C' = \{1, 3, 7\} \cap \{2, 4, 5, 6, 8\} = \emptyset$

39. True



$A \cap B$: ii
Since ii $\subseteq A$, then $A \cap B \subseteq A$ is true.

40. True

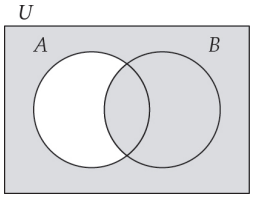


$A \cup B$: i, ii, iii
Since $A \subseteq$ i, ii, iii, then $A \subseteq A \cup B$ is true.

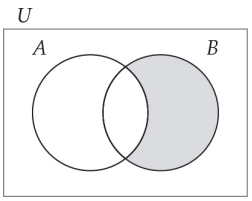
41. True
Since $A \subseteq U$, then $A \cap U = A$ is true.

42. False
Since $B \subseteq U$, then $B \cup U = U$.

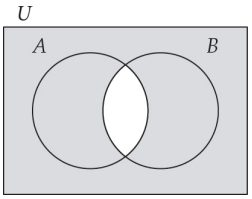
43. $A' \cup B$



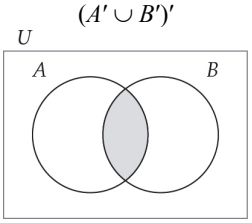
44. $A' \cap B$



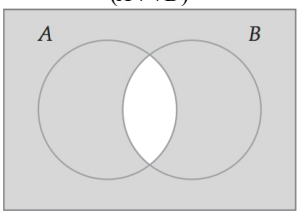
45. $A' \cup B'$



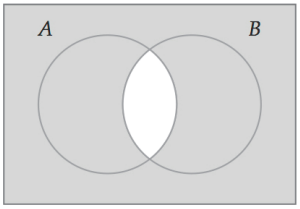
46. $(A' \cup B')'$



47. $(A \cap B)'$

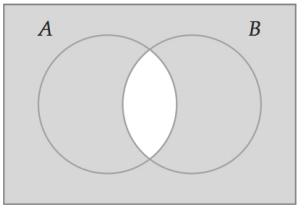


$A' \cup B'$



Therefore, $(A \cap B)' = A' \cup B'$.

48. $A' \cup B'$



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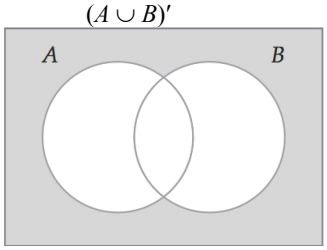
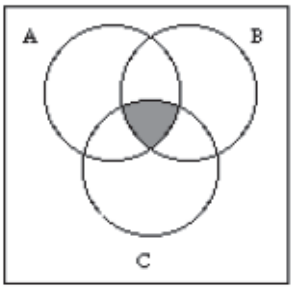
$(A \cup B)'$

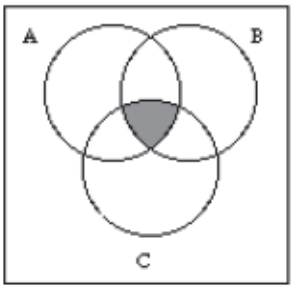


Because the sets $A' \cup B'$ and $(A \cup B)'$ are represented by different regions, $A' \cup B' \neq (A \cup B)'$.

49. $A \cap (B \cap C)$

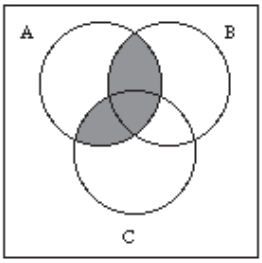


$(A \cap B) \cap C$

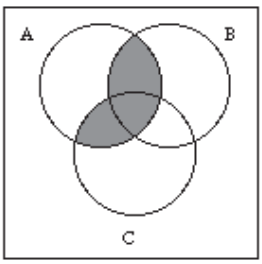


Therefore, $A \cap (B \cap C) = (A \cap B) \cap C$.

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



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



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

51. a. S = {investors in stocks} and let B = {investors in bonds}. Since 75 had not invested in either stocks or bonds, $n(S \cup B) = 600 - 75 = 525$.

$$\begin{aligned} n(S \cup B) &= n(S) + n(B) - n(S \cap B) \\ 525 &= 380 + 325 - n(S \cap B) \\ 525 &= 705 - n(S \cap B) \\ -180 &= -n(S \cap B) \\ n(S \cap B) &= 180 \end{aligned}$$

$n(S \cap B) = 180$ represents the number of investors in both stocks and bonds.

b. $n(S \text{ only}) = 380 - 180 = 200$

52. a. Let S = {commuters taking the subway} and let B = {commuters taking the bus}. Since 120 commuters do not take either the subway or the bus, $n(S \cup B) = 1500 - 120 = 1380$.

$$\begin{aligned} n(S \cup B) &= n(S) + n(B) - n(S \cap B) \\ 1380 &= 1140 + 680 - n(S \cap B) \\ 1380 &= 1820 - n(S \cap B) \\ -440 &= -n(S \cap B) \\ n(S \cap B) &= 440 \end{aligned}$$

$n(S \cap B) = 440$ commuters take both the subway and the bus.

b. Using the formula:

$$\begin{aligned} n(S \text{ only}) &= n(S) - n(S \cap B) \\ &= 1140 - 440 = 700 \end{aligned}$$

53. a. 1785 + 1219 + 831 = 3835 people

b. 245 people

c. 755 + 700 + 275 = 1730 people

d. 1785+755+700+245+1219+275+831=5810
6000 – 5810 = 190 people

54. a. 305 + 290 + 390 = 985 people

b. 85 people

c. 110 + 135 + 150 = 395 people

d. 305+110+135+85+290+150+390 = 1465
2000 – 1465 = 535 people

55. a. 101 people

b. 124 + 82 + 65 + 51 + 48 = 370 people

c. 124 + 82 + 133 + 41 = 380 people

d. 124 + 82 + 101 + 66 = 373 people

e. 124 + 82 + 101 + 66 = 373 people

f. 124 + 82 + 65 + 101 + 66 + 51 + 41
= 530 people

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56. a. 175 students

b. 180+162+190+110+86 = 728 students

c. 114 +175 +162 +126 +190 +110 + 86 = 963 students

d. 210 +175 = 385 students

e. 110 students

f. 210 + 175 + 180 + 162 = 727 students

57. a.

	File Is Infected	File Is Not Infected
Found	813	15
Did Not Find	27	42

b. 15

c. The virus software did not find 27 files that were infected.

58. a.

	Reduced BP	No BP Reduction
New Drug	750	250
Placebo	238	12

b. 250

c. After receiving a placebo, 238 had a decrease in blood pressure.

59. a. 5

b. There were 5 cases in which the test was positive but the child did not have the genetic marker.

c. 12

d. There were 12 cases in which the test was negative but the child had the genetic marker.

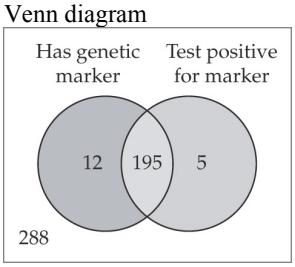
e. 195

f. There were 195 cases in which the test was positive and the child had the genetic marker.

g. 288

h. There were 288 cases in which the test was negative and the child did not have the genetic marker.

i. Venn diagram



60. a. 4

b. There were 4 tests in which the test was positive but the person does not have Rh–.

c. 21

d. There were 21 tests in which the test was negative but the person has Rh–.

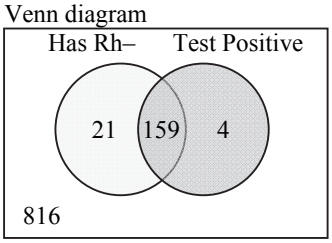
e. 159

f. There were 159 tests in which the test was positive and the person has Rh–.

g. 816

h. There were 816 tests in which the test was negative and the person does not have Rh–.

i. Venn diagram



THINK ABOUT IT, SECTION 2.2

1. All humans are mammals. No cat is a dog.

2. Some pets are small. Some pets are not dogs.

3. No. The negation is: “Some Ferraris are not red.”

4. Yes. For instance, “If I like ice cream, all numbers are positive. I like ice cream. Therefore, all numbers are positive.” is a valid argument but the conclusion is false.

EXERCISE SET 2.2

1. No lions are playful.

2. All dogs are friendly.

3. Some classic movies were not first produced in black and white.

4. Some people did not enjoy the dinner.

5. Some even numbers are odd numbers.

6. All actors are not rich.

7. Some cars do not run on gasoline.

8. Some of the students took my advice.

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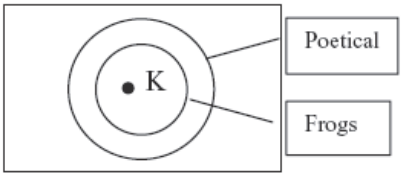
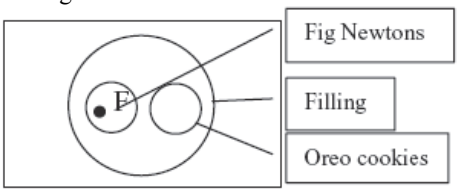
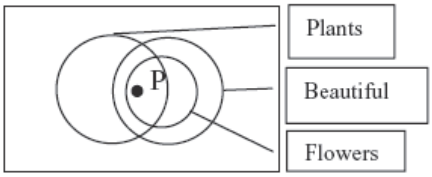
9. The argument is valid.



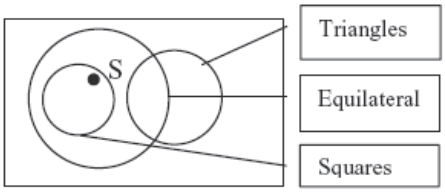
10. The argument is invalid.



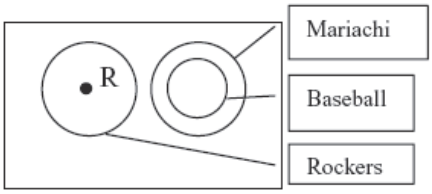
11. The argument is valid.



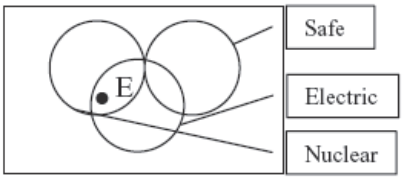
12. The argument is invalid.



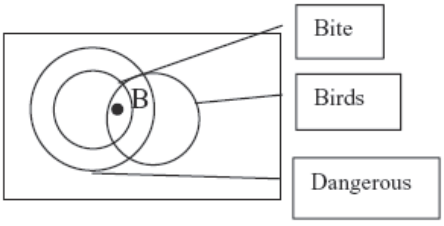
13. The argument is valid.



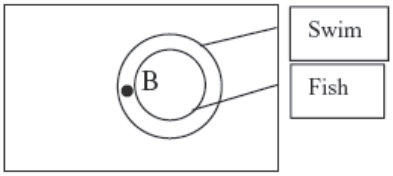
14. The argument is invalid.



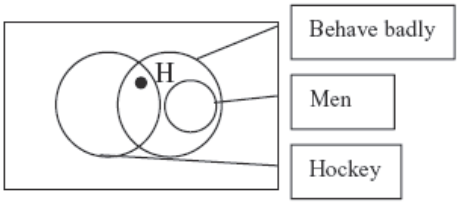
15. The argument is valid.



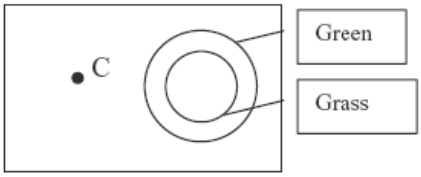
16. The argument is invalid.



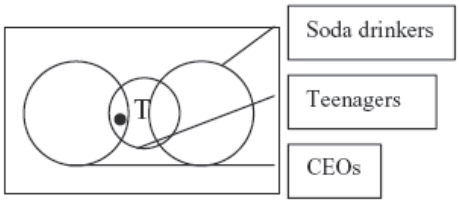
17. The argument is invalid.



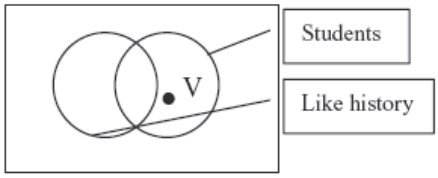
18. The argument is valid.



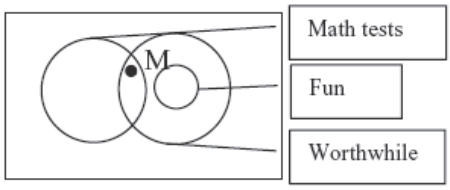
19. The argument is invalid.



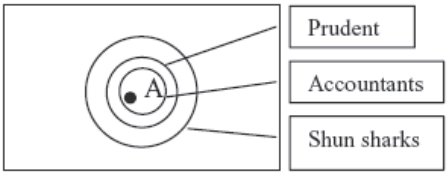
20. The argument is invalid.



21. The argument is invalid.



22. The argument is valid.



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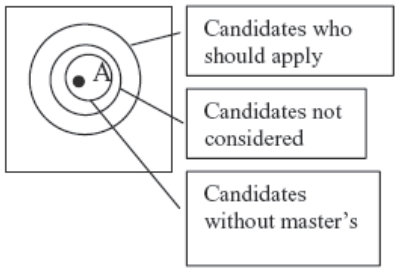
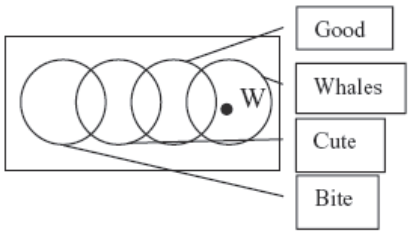
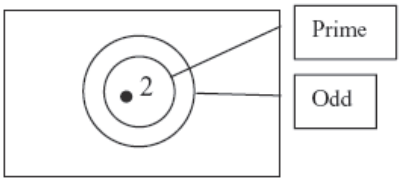
23. The argument is valid.



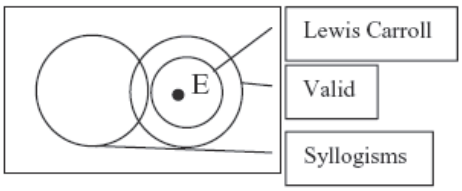
24. The argument is invalid.



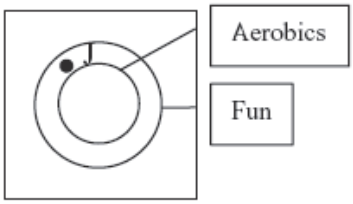
25. The argument is valid.



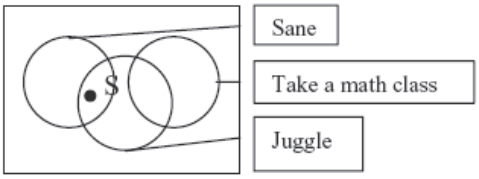
26. The argument is invalid.



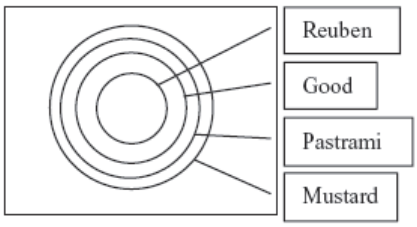
27. The argument is invalid.



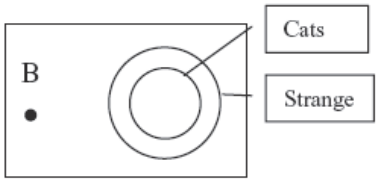
28. The argument is invalid.



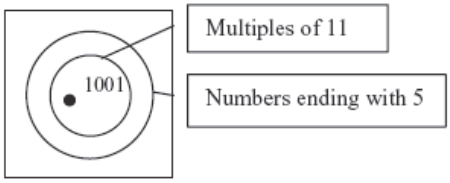
29. All Reuben sandwiches need mustard.



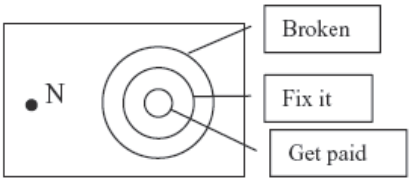
30. Boomer is not a cat.



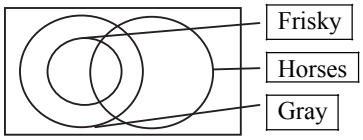
31. 1001 ends with a 5.



32. If it isn't broken, then I don't get paid.



33. Some horses are gray.



34. Label the statements

s: We like to ski.
v: We move to Vail.
h: We buy a house.
c: We buy a condo.

In symbolic form the argument is:

$s \rightarrow v$ Premise 1
$v \rightarrow \sim h$ Premise 2
$\sim c \rightarrow h$ Premise 3
$\therefore ?$

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Applying the law of syllogism to Premise 1 and Premise 2 produces

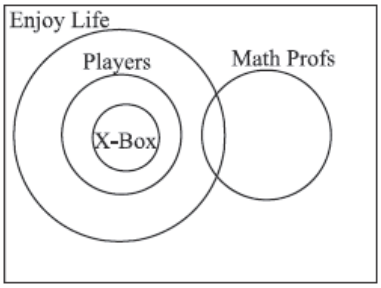
$s \to v$ Premise 1
$v \to \sim h$ Premise 2
$\therefore s \to \sim h$ Law of Syllogism

Premise 3 can be written as $\sim h \to c$ using the contrapositive form. Combining Premise 3 with the conclusion from above gives

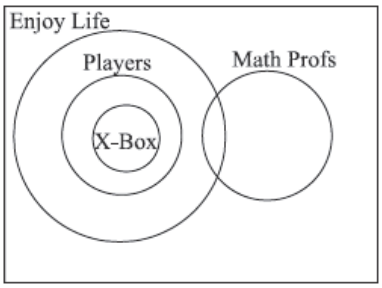
$s \to \sim h$
$\sim h \to c$
$\therefore s \to c$

If we like to ski, then we will buy a condo.

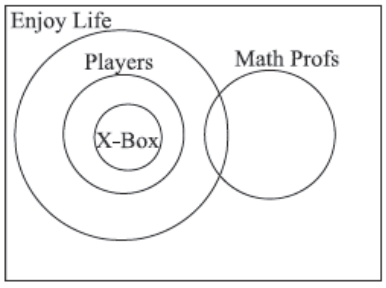
35. a. Invalid



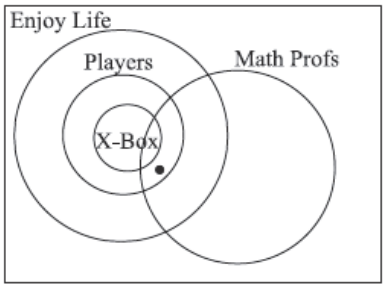
b. Invalid



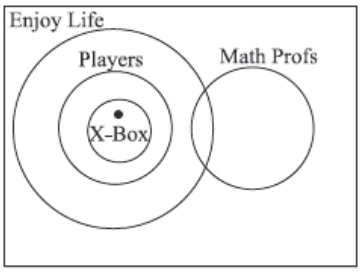
c. Invalid



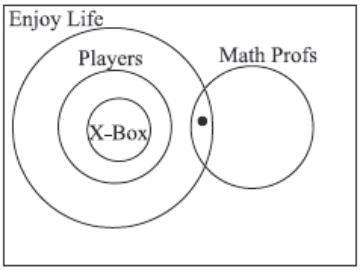
d. Invalid



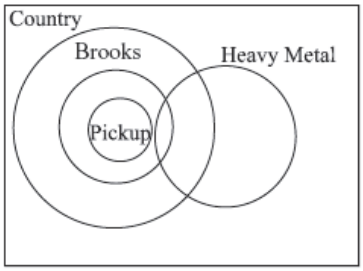
e. Valid



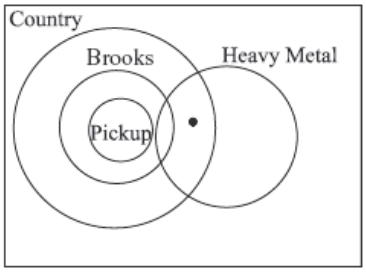
f. Valid



36. a. Invalid



b. Valid



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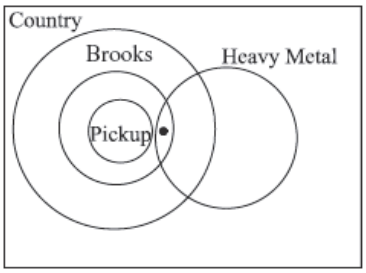
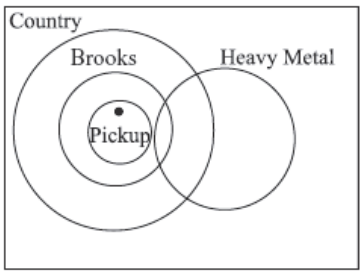
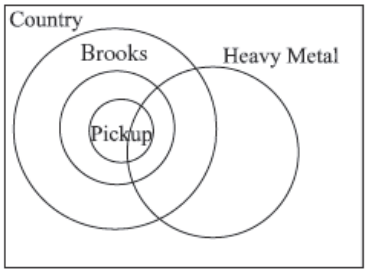
c. Valid



d. Valid



e. Invalid



THINK ABOUT IT, SECTION 2.3

1. Or
2. And
3. If–then
4. True
5. False
6. True

EXERCISE SET 2.3

1. The sentence is an opinion. It can be true for one person and false for another person. Since it can be both true and false, it is not a statement.

2. You may not know if Harvey Mudd College is in Oregon or not; however, you do know that it is either in Oregon or it is not in Oregon. The sentence is either true or false, and it is not both true and false, so it is a statement.

3. You may not know the area code for Storm Lake, Iowa; however, you do know that it is either 512 or it is not 512. The sentence is either true or it is false, and it is not both true and false, so it is a statement.

4. You may not know if January 1, 2024 will be on a Sunday or not; however, you do know that it is either on Sunday or not. The sentence is either true or false, and it is not both true and false, so it is a statement.

5. The sentence "Have a fun trip," is a command, so it is not a statement.

6. The sentence "Do you like to read?" is a question, not a declarative sentence. Thus it is not a statement.

7. The Giants did not lose the game.

8. The lunch was not served at noon.

9. The game did go into overtime.

10. The game was shown on television.

11. $w \rightarrow t$

12. $p \wedge s$

13. $d \rightarrow f$

14. $p \rightarrow t$

15. $m \vee c$

16. $p \rightarrow s$

17. I can play the piano and the violin.

18. I ride a bicycle or take the bus to work.

19. If the painting is a watercolor, then James will not buy it.

20. If you cannot count your money, then you don't have less than a million dollars.

21. If Carmella gets an A in mathematics, then she will major in physics or astronomy.

22. If the car does not get less than 25 miles per gallon and has a collision avoidance system, then Jordan will buy the car.

23. Let p represent the statement "It rained." Let q represent the statement "It snowed." In symbolic form, the original sentence is $\sim(p \vee q)$. One of De Morgan's laws states that this is

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equivalent to $\sim p \wedge \sim q$. Thus an equivalent sentence is "It did not rain and it did not snow."

24. Let p represent the statement "I passed the test." Let q represent the statement "I completed the course." In symbolic form, the original sentence is $\sim p \wedge \sim q$. One of De Morgan's laws states that this is equivalent to $\sim(p \vee q)$. Thus an equivalent sentence is "It is not true that I passed the test or completed the course."

25. Let p represent the statement "She visited France." Let q represent the statement "She visited Italy." In symbolic form, the original sentence is $\sim p \wedge \sim q$. One of De Morgan's laws states that this is equivalent to $\sim(p \vee q)$. Thus an equivalent sentence is "She did not visit either France or Italy."

26. Let p represent the statement "I bought a new car." Let q represent the statement "I moved to Florida." In symbolic form, the original sentence is $\sim(p \wedge q)$. One of De Morgan's laws states that this is equivalent to $\sim p \vee \sim q$. Thus an equivalent sentence is "I did not buy a new car or I did not move to Florida."

27. *Antecedent:* I had the money.
Consequent: I would buy the painting.

28. *Antecedent:* Shelly goes on the trip.
Consequent: She will not be able to take part in the graduation ceremony.

29. *Antecedent:* She would go to the movies.
Consequent: Her friend would go.

30. *Antecedent:* I will fly to San Francisco.
Consequent: I can afford the airfare.

31. *Antecedent:* Cameron gets a raise.
Consequent: She will buy a new tablet computer.

32. *Antecedent:* She will get into medical school.
Consequent: Nuntiya passes biology.

33. False. The antecedent is true and the consequent is false.

34. True. A false antecedent yields a true statement whether the consequent is true or false.

35. True. A false antecedent yields a true statement whether the consequent is true or false.

36. True. A false antecedent yields a true statement whether the consequent is true or false.

37. False. The antecedent is true and the consequent is false.

38. True. A false antecedent yields a true statement whether the consequent is true or false.

39. Converse: If I quit this job, then I would be rich.
Inverse: If I were not rich, then I would not quit this job.
Contrapositive: If I did not quit this job, I would not be rich.

40. Converse: If we were able to take the class, we would have a car.
Inverse: If we did not have a car, then we would not be able to take the class.
Contrapositive: If we were not able to take the class, we would not have a car.

41. Converse: If we are not able to attend the party, she will not return soon.
Inverse: If she returns soon, then we will be able to attend the party.
Contrapositive: If we are able to attend the party, she will return soon.

42. Converse: If you need to move to Denver, you get the promotion.
Inverse: If you do not get the promotion, you will not need to move to Denver.
Contrapositive: If you do not need to move to Denver, you will not get the promotion.

43. Converse: If we will take the train, we will be able to take the entire family.
Inverse: If we do not take the entire family, we can't take the train.
Contrapositive: If we do not take the train, we can't take the entire family.

44. Converse: If she saves for the vacation, she will visit Kauai.
Inverse: If she does not visit Kauai, she does not save for the vacation.
Contrapositive: If she does not save for the vacation, she will not visit Kauai.

45. In symbolic form:
$h \rightarrow r$
$\underline{\sim h}$
$\therefore \sim r$

h	r	First premise $h \rightarrow r$	Second premise $\sim h$	Conclusion $\sim r$
T	T	T	F	F
T	F	F	F	T
F	T	T	T	F
F	F	T	T	T

The premises are true in rows 3 and 4. Because the conclusion in row 3 is false and the premises are both true, we know the argument is invalid.

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46. In symbolic form:
$\sim b \rightarrow d$
$b \vee d$
$\therefore b$

b	d	First premise $\sim b \rightarrow d$	Second premise $b \vee d$	Conclusion b
T	T	T	T	T
T	F	T	T	T
F	T	T	T	F
F	F	F	F	F

The premises are true in rows 1, 2, and 3. Because the conclusion in row 3 is false and the premises are both true, we know the argument is invalid.

47. In symbolic form:
$e \rightarrow \sim s$
$\sim s$
$\therefore e$

e	s	First premise $e \rightarrow \sim s$	Second premise $\sim s$	Conclusion e
T	T	F	F	T
T	F	T	T	T
F	T	T	F	F
F	F	T	T	F

The premises are true in rows 2 and 4. Because the conclusion in row 4 is false and the premises are both true, we know the argument is invalid.

48. In symbolic form:
$c \rightarrow t$
t
$\therefore c$

c	t	First premise $c \rightarrow t$	Second premise t	Conclusion c
T	T	T	T	T
T	F	F	F	T
F	T	T	T	F
F	F	T	F	F

The premises are true in rows 1 and 3. Because the conclusion in row 3 is false and the premises are both true, we know the argument is invalid.

49. Label the statements
f: You take Art 151 in the fall.
s: You will be eligible to take Art 152 in the spring.
In symbolic form:
$f \rightarrow s$
$\sim s$
$\therefore \sim f$
The argument is valid using modus tollens.

50. Label the statements
n: I had a nickel for every logic problem I have solved.
r: I would be rich.
In symbolic form:
$n \rightarrow r$
$\sim n$
$\therefore \sim r$
The argument is invalid using the fallacy of the inverse.

51. Label the statements
d: It is a dog.
f: It has fleas.
In symbolic form the argument is:
In symbolic form:
$d \rightarrow f$
f
$\therefore d$
The argument is invalid using the fallacy of the converse.

52. Label the statements
n: Rita buys a new car.
c: Rita will not go on a cruise.
In symbolic form:
$n \rightarrow c$
$\sim c$
$\therefore \sim n$
The argument is valid using modus tollens.

53. Label the statements
s: We serve salmon.
v: Vicky will join us for lunch.
m: Marilyn will join us for lunch.
In symbolic form:
$s \rightarrow v$
$v \rightarrow \sim m$
$\therefore s \rightarrow \sim m$
The argument is valid using transitive reasoning.

54. Label the statements
c: My cat is left alone in the apartment.
s: She claws the sofa.
In symbolic form:
$c \rightarrow s$
c
$\therefore s$
The argument is valid using modus ponens.

55. In symbolic form the argument is

$s \rightarrow \sim r$	Premise 1
$\sim r \rightarrow c$	Premise 2
$\sim t \rightarrow \sim c$	Premise 3
$\therefore s \rightarrow t$	Conclusion

Applying transitive reasoning to Premise 1 and

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Premise 2 produces:

$s \rightarrow \sim r$ Premise 1
$\sim r \rightarrow c$ Premise 2
$\therefore s \rightarrow c$

Premise 3 can be written as $c \rightarrow t$ using the contrapositive form. Combining Premise 3 with the conclusion from above gives

$s \rightarrow c$ Conclusion from above
$c \rightarrow t$ Equivalent form of Premise 3
$\therefore s \rightarrow t$

This sequence of valid arguments has produced the desired conclusion. Thus the original argument is valid.

56. In symbolic form the argument is

$a \rightarrow c$ Premise 1
$\sim m \rightarrow \sim c$ Premise 2
$m \rightarrow s$ Premise 3
$\therefore a \rightarrow s$ Conclusion

Premise 2 can be written as $c \rightarrow m$ using the contrapositive form. Applying transitive reasoning to Premise 1 and Premise 2 produces

$a \rightarrow c$ Premise 1
$c \rightarrow m$ Equivalent form of Premise 2
$\therefore a \rightarrow m$

Combining Premise 3 with the conclusion from above gives

$a \rightarrow m$ Conclusion from above
$m \rightarrow s$ Equivalent form of Premise 3
$\therefore a \rightarrow s$

This sequence of valid arguments has produced the desired conclusion. Thus the original argument is valid.

57. In symbolic form the argument is

$\sim o \rightarrow \sim f$ Premise 1
$c \rightarrow \sim o$ Premise 2
$\therefore f \rightarrow \sim c$ Conclusion

Premise 1 can be written as $f \rightarrow o$ using the contrapositive form. Premise 2 can be written as $o \rightarrow \sim c$ using the contrapositive form. Applying the equivalent forms and transitive reasoning to Premise 1 and Premise 2 produces

$f \rightarrow o$ Equivalent form of Premise 1
$o \rightarrow \sim c$ Equivalent form of Premise 2
$\therefore f \rightarrow \sim c$

This sequence of valid arguments has produced the desired conclusion. Thus the original argument is valid.

58. In symbolic form the argument is

$r \rightarrow l$ Premise 1
$l \rightarrow p$ Premise 2
$p \rightarrow m$ Premise 3
$\sim m$ Premise 4
$\therefore \sim r$ Conclusion

Applying transitive reasoning to Premise 1 and Premise 2 produces

$r \rightarrow l$ Premise 1
$l \rightarrow p$ Premise 2
$\therefore r \rightarrow p$

Applying transitive reasoning to the conclusion from above and Premise 3 produces

$r \rightarrow p$ Conclusion from above
$p \rightarrow m$ Premise 3
$\therefore r \rightarrow m$

The second conclusion, $r \rightarrow m$, can be written as $\sim m \rightarrow \sim r$ using the contrapositive form. Combining Premise 4 with this equivalent form gives

$\sim m \rightarrow \sim r$ Conclusion from above
$\sim m$ Equivalent form of Premise 3
$\therefore \sim r$ Modus ponens

This sequence of valid arguments has produced the desired conclusion. Thus the original argument is valid.

59. Label the statements
m: The moon is made of green cheese.
a: Apples are bananas.
In symbolic form the argument is:

$m \rightarrow a$ Premise 1
$\sim a$ Premise 2
$\therefore ?$

Applying modus tollens gives

$m \rightarrow a$ Premise 1
$\sim a$ Premise 2
$\therefore \sim m$ Modus tollens

Therefore, the moon is not made of green cheese.

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60. Label the statements
f: Colin joins the Foreign Service.
s: He will be stationed in France.
In symbolic form the argument is:

$f \rightarrow s$ Premise 1
f Premise 2
$\therefore ?$

Applying modus podens gives

$f \rightarrow s$ Premise 1
f Premise 2
$\therefore s$ Modus ponens

Therefore, Colin is stationed in France.

61. Label the statements
f: I pass the final exam.
p: I will get a passing grade in the course.
In symbolic form the argument is:

$p \rightarrow f$ Premise 1
f Premise 2
$\therefore ?$

The tempting conclusion is *p*, but this is the fallacy of the converse.

Therefore, a valid conclusion is not possible.

62. Label the statements
s: Orla studies hotel management.
j: She will get a job at the Historia Hotel.
In symbolic form the argument is:

$s \rightarrow j$ Premise 1
$\sim s$ Premise 2
$\therefore ?$

Applying fallacy of the inverse gives

$s \rightarrow j$ Premise 1
$\sim s$ Premise 2
$\therefore \sim j$

Therefore, a valid conclusion is not possible.

63. Label the statements
t: It is a theropod.
h: It is a herbivorous.
s: It is a sauropod.
In symbolic form the argument is:

$t \rightarrow \sim h$ Premise 1
$\sim h \rightarrow \sim s$ Premise 2
s Premise 3
$\therefore ?$

Applying transitive reasoning to Premise 1 and Premise 2 gives

$t \rightarrow \sim h$ Premise 1
$\sim h \rightarrow \sim s$ Premise 2
$\therefore t \rightarrow \sim s$

Write the conclusion from above in its equivalent contrapositive form, $s \rightarrow \sim t$. Use the equivalent form of the conclusion from above and Premise 3 to give

$s \rightarrow \sim t$ Equivalent form of conclusion
s Premise 3
$\therefore \sim t$ Modus ponens

Therefore, it is not a theropod.

64. Label the statements
f: The weather is fair.
g: Jean will play golf.
c: She will rent a golf cart.
In symbolic form the argument is:

$f \rightarrow g$ Premise 1
$g \rightarrow \sim c$ Premise 2
c Premise 3
$\therefore ?$

Applying transitive reasoning to Premise 1 and Premise 2 gives

$f \rightarrow g$ Premise 1
$g \rightarrow \sim c$ Premise 2
$\therefore f \rightarrow \sim c$

Use the conclusion from above and Premise 3 to give

$f \rightarrow \sim c$ Conclusion from above
c Premise 3
$\therefore \sim f$ Modus tollens

Therefore, the weather is not fair.

THINK ABOUT IT, SECTION 2.4

1. Appeal to popularity fallacy.

2. Appeal to common practice fallacy.

3. Loaded question fallacy.

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EXERCISE SET 2.4

1. Ad hominem
   Premise: He doesn't believe in equal rights.
   Conclusion: Don't listen to him.
   This is an ad hominem fallacy because the premise is an attack on someone's character rather than the issue.

2. Ad hominem
   Premise: She is mean.
   Conclusion: Don't let her use your computer.
   This is an ad hominem fallacy because the premise is an attack on someone's character rather than the issue.

3. Black or white
   Premise: Either you buy me a car or I will lose my job.
   Conclusion: You must buy me a car so I don't lose my job.
   This is a black-or-white fallacy because the premise offers only two choices when in reality there are more.

4. Black or white
   Premise: Either you're with me or you're against me.
   Conclusion: You must be with me so that you're not against me.
   This is a black-or-white fallacy because the premise offers only two choices when in reality there are more.

5. Post Hoc
   Premise: Immigration increased, and the economy improved.
   Conclusion: Immigration improved the economy.
   This is a post hoc fallacy; it reasons that because one event occurred before the other, it caused the second. Correlation does not always indicate causation.

6. Post Hoc
   Premise: I took flu medication yesterday and feel better today.
   Conclusion: Flu medication made me better.
   This is a post hoc fallacy; it reasons that since one event occurred before the other, the first event caused the second. Correlation does not always indicate causation.

7. Hasty generalization
   Premise: My cab driver was rude.
   Conclusion: Everyone in this country must be rude.
   This is a hasty generalization because it assumes that if something is true for one, then it is true for all.

8. Hasty generalization
   Premise: My Ford gets bad gas mileage.
   Conclusion: All Fords get bad gas mileage.
   This is a hasty generalization because it assumes that if something is true for one, then it is true for all.

9. Slippery slope
   Premise: Without college you won't get a good job.
   Conclusion: You will be on the streets begging for change.
   This is a slippery slope because it assumes many factors in the premise are directly connected when the connection between each factor is actually weak. As the connection between factors weakens, so does the argument.

10. Slippery slope
    Premise: Kids playing outside will wander the neighborhood.
    Conclusion: They will be held for ransom.
    This is a slippery slope because it assumes many factors in the premise are directly connected when, actually, the connection between each factor is weak. As the connection between factors weakens, so does the argument.

11. Appeal to emotion
    Premise: He lost his wife a year ago.
    Conclusion: Therefore, if he asks you on a date, you have to say yes.
    This is an appeal to emotion because the argument attempts to connect an emotion, pity, to its conclusion.

12. Appeal to emotion
    Premise: My parents donate a lot of money to the school.
    Conclusion: Therefore, you should consider giving me a better grade on the test.
    This is an appeal to emotion because the argument attempts to connect an emotion, fear, to its conclusion.

13. Appeal to popularity
    Premise: More than 100,000 people believe that astrology affects people's lives.
    Conclusion: There must be some truth to it.
    This is an appeal to popularity because the arguer is attempting to connect a popular idea to the reason for the conclusion.

14. Appeal to popularity
    Premise: 99% of the people at my school have smartphones.
    Conclusion: They must be the best.
    This is an appeal to popularity because the arguer is attempting to connect a popular trend to the reason for the conclusion. This is also a

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fallacy because of the ambiguity of the word "they." Does it refer to the students or the smartphones?

15. Straw man
Premise: Going out of your way is an inconvenience.
Conclusion: There are more important things than convenience.
This is a straw man fallacy because the premise is an attempt to distract the audience from the original statement.

16. Straw man
Premise: You need to finish your chores.
Conclusion: You never let me do anything fun with my friends.
This is a straw man fallacy because a new premise was built to distract the audience from the original premise.

17. Red herring
Premise: Teachers don't get paid enough.
Conclusion: Teachers need to be paid extra for new programs.
This is a red herring fallacy because the premise is an attempt to distract the audience from the original statement.

18. Red herring
Premise: My opponent has misled us about how to fix the economy.
Conclusion: My opponent is misleading us about tax cuts.
This is a red herring fallacy because the premise is an attempt to distract the audience from the original statement.

19. Loaded questions
No premise or conclusion
This is a loaded question because a "yes" or a "no" answer both imply a false or deniable statement.

20. Loaded question
No premise or conclusion.
This is a loaded question because a "yes" or a "no" answer both imply a false or deniable statement.

21. Circular reasoning
Premise: You have human parents.
Conclusion: You are a human being.
This is a circular reasoning because the conclusion is the same as the premise, just reworded.

22. Circular reasoning
Premise: Electrolytes are vital to our bodies.
Conclusion: Electrolytes are important to drink.
This is circular reasoning because the conclusion is the same as the premise, just reworded.

23. Appeal to common practice
Premise: Everyone drives 75 mph in a 65-mph zone.
Conclusion: Driving 75 mph in a 65-mph zone is acceptable.
This is an appeal to common practice because it relies on general acceptance in its premise rather than logic.

24. Appeal to common practice
Premise: Everyone steals office supplies.
Conclusion: Stealing office supplies is allowed.
This is an appeal to common practice because it relies on general acceptance in its premise rather than logic.

25. Appeal to authority
Premise: The actor stated that tight monetary policy is the best way to shorten a recession.
Conclusion: Tight monetary policy is the best way to shorten a recession.
This is an appeal to authority because it is drawing on expertise from an irrelevant authority.

26. Appeal to authority
Premise: My doctor told me that my car isn't starting because my alternator needs to be replaced.
Conclusion: My alternator needs to be replaced.
This is an appeal to authority because it is drawing on expertise from an irrelevant authority.

27. Ad hominem
Premise: You are not a mother.
Conclusion: You don't know what's best for children.
This is an ad hominem fallacy because the premise is an attack on someone's character rather than the issue.

28. Ad hominem
Premise: She dropped out of high school.
Conclusion: Don't let her borrow your car.
This is an ad hominem fallacy because the premise is an attack on someone's character rather than the issue.

29. Slippery slope
Premise: I should make an exception for you.
Conclusion: I will have to make an exception for everyone.
This is a slippery slope because it assumes many factors in the premise are directly connected, when actually, the connection

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between each factor is actually weak. As the connection between factors weakens, so does the argument.

30. Slippery slope
Premise: Eating one cookie will make you eat more.
Conclusion: You will gain 50 pounds.
This is a slippery slope because it assumes many factors in the premise are directly connected when, actually, the connection between each factor is weak. As the connection between factors weakens, so does the argument.

31. Appeal to ignorance
Premise: The police could not prove that the strange activity was not from a ghost.
Conclusion: The strange activity was from a ghost.
This is an appeal to ignorance because it is drawing a conclusion based on lack of evidence for the converse of the premise.

32. Appeal to ignorance
Premise: You cannot prove that you are smarter than most people.
Conclusion: You are not smarter than most people.
This is an appeal to ignorance because it is drawing a conclusion based on lack of evidence for the converse of the premise.

33. Red herring
Premise: Students need a greater say in curriculum changes.
Conclusion: Teachers need a greater voice overall.
This is a red herring fallacy because the premise is an attempt to distract the audience from the original statement.

34. Red herring
Premise: We should be able to wear whatever we want.
Conclusion: Therefore, I am not in violation of dress code:
This is a red herring fallacy because the premise is an attempt to distract the audience from the original statement.

35. Black or white
Premise: Either you love America or you leave.
Conclusion: You must love America so that you don't have to leave.
This is a black-or-white fallacy because the premise offers only two choices when in reality there are more.

36. Black or white
Premise: Either you get a job or you will end up in the streets.
Conclusion: You must get a job so you don't end up in the streets.
This is a black-or-white fallacy because the premise offers only two choices when in reality there are more.

37. Appeal to emotion
Premise: My sister is beautiful and intelligent.
Conclusion: Therefore, she should give me a ride to school.
This is an appeal to emotion because the argument attempts to connect an emotion, flattery, to its conclusion.

38. Appeal to emotion
Premise: We are all in trouble.
Conclusion: Therefore, we should switch to solar power.
This is an appeal to emotion because the argument attempts to connect an emotion, fear, to its conclusion.

39. Appeal to common practice
Premise: Most universities compensate athletes.
Conclusion: Compensating athletes is acceptable.
This is an appeal to common practice because it relies on general acceptance in its premise rather than logic.

40. Appeal to common practice
Premise: Embezzling happens in every company.
Conclusion: It is acceptable for us to embezzle.
This is an appeal to common practice because it relies on general acceptance in its premise rather than logic.

41. Appeal to popularity
Premise: All of my friends have trucks, not cars.
Conclusion: Trucks are better than cars.
This is an appeal to popularity because the arguer is attempting to connect a popular opinion to the reason for the conclusion.

42. Appeal to popularity
Premise: Everyone I know watches this TV show.
Conclusion: It must be good.
This is an appeal to popularity because the arguer is attempting to connect a popular opinion to the reason for the conclusion.

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CHAPTER 2 REVIEW EXERCISES

1. The negative integers greater than –6 are –5, –4, –3, –2, –1. Using the roster method, write the set as {–5, –4, –3, –2, –1}.

2. The set of composite numbers less than 17 is {4, 6, 8, 9, 10, 12, 14, 15, 16}.

3. The set of letters in the name Tennessee is {T, e, n, s}.

4. {April, June, September, November}

5. Adding 4 to each side of the equation produces $x = 7$. {7} is the solution set.

6. Solving:
$x - 1 < 4$
$x < 5$
The set of whole numbers less than 5 is {0, 1, 2, 3, 4}.

7. $\{2, 4, 6, 7\}' = \{0, 1, 3, 5, 8\}$

8. $\{3, 6\}' = \{0, 1, 2, 4, 5, 7, 8\}$

9. $\varnothing' = U = \{0, 1, 2, 3, 4, 5, 6, 7, 8\}$

10. $\{0, 1, 2, 3, 4, 5, 6, 7, 8\}' = U' = \varnothing$

11. True; every element of F is an element of D.

12. False; r and s are not elements of F.

13. True; s is an element of E and $G \neq E$.

14. True; p and t are elements of D and $F \neq D$.

15. $G' = \{p, q, r, t\}$. Since q is not an element of D, the statement is false.

16. $F' = \{q, r, s\} \neq E$ so the statement is false.

17. False; $\varnothing = \varnothing$ so cannot be a proper subset of itself.

18. False; E does not contain sets, only letters.

19. False; D has 4 elements, $2^4 = 16$ subsets and $2^4 - 1 = 15$ proper subsets.

20. False; {0} has 1 element but Ø has no elements.

21. $A \cup B = \{2, 4, 6\} \cup \{1, 2, 5, 8\}$
$= \{1, 2, 4, 5, 6, 8\}$

22. $A \cap B = \{2, 4, 6\} \cap \{1, 2, 5, 8\} = \{2\}$

23. $A \cap B' = \{2, 4, 6\} \cap \{3, 4, 6, 7\} = \{4, 6\}$

24. $B \cap C' = \{1, 2, 5, 8\} \cap \{2, 4, 5, 6, 8\}$
$= \{2, 5, 8\}$

25. $(A \cup B)' = (\{1, 2, 4, 5, 6, 8\})' = \{3, 7\}$

26. $A' = \{1, 3, 5, 7, 8\}$.
$A' \cap B = \{1, 3, 5, 7, 8,\} \cap \{1, 2, 5, 8\}$
$= \{1, 5, 8\}$.
$(A' \cap B)' = (\{1, 5, 8\})' = \{2, 3, 4, 6, 7\}$

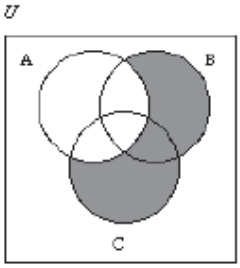
27. $B \cap C = \{1, 2, 5, 8\} \cap \{1, 3, 7\} = \{1\}$.
$A \cup (B \cap C) = \{2, 4, 6\} \cup \{1\}$
$= \{1, 2, 4, 6\}$

28. $A \cap (B \cup C) = \{2, 4, 6\} \cap \{1, 2, 3, 5, 7, 8\}$
$= \{2\}$

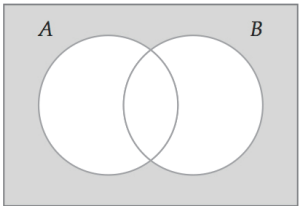
29. $A \cup A' = \{2, 4, 6\} \cup \{1, 3, 5, 7, 8\}$
$= \{1, 2, 3, 4, 5, 6, 7, 8\} = U$

30. $A \cap A' = \{2, 4, 6\} \cap \{1, 3, 5, 7, 8\} = \varnothing$

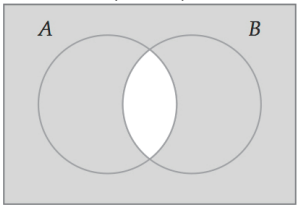
31. $A' \cap (B \cup C)$



32. $A' \cap B'$



$(A \cap B)'$



Therefore, they are not equal.

33. There are 5 different ingredients.
$2^5 = 32$ different smoothies

34. $2^9 = 512$ different versions of this sedan

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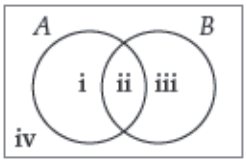
35. Let M = {students taking math} and
let B = {students who are business majors}
$n(M \cup B) = n(M) + n(B) - n(M \cap B)$
$= 841 + 525 - 202$
$= 1164$
Therefore, 1164 students are taking math or are business majors.

36. Use a Venn diagram to represent the survey results.



ii: both aerobics and weight training: 97
i: aerobics only: 208 – 97 = 111
iii: weight training only: 145 – 97 = 48
iv: neither: 135
Total the numbers from each region to find the number of members surveyed:
111 + 97 + 48 + 135 = 391

37. a. 148 + 97 + 225 = 470 people

b. 20 people

c. 62 + 78 + 50 = 190 people

d. 148 +62 +78 +20 +97 +50 +225 = 680
750 – 680 = 70 people

38. a. 342 people

b. 78 people

c. 126 + 257 + 198 = 581 people

d. 342+126+257+78+256+198+398=1655
2000 – 1655 = 345 people

39. a. 48+64+58+65+73 = 308 people

b. 72+64+54+56+73 = 319 people

c. 64+72+58+64+65+56+73 = 452 people

d. 65+73 = 138 people

e. 64+(64+72+58+54+56+73)=441 people

40. a.

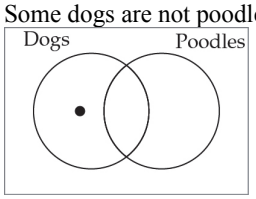
	Positive Test	Negative Test
Has Mumps Antigen	179	21
Does Not Have Mumps Antigen	83	717

b. 21

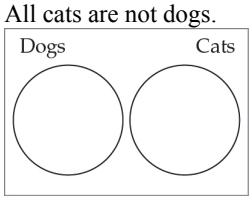
c. A person does not have the mumps antigen but tested positive for it.

d. 717

41. a. Some dogs are not poodles.



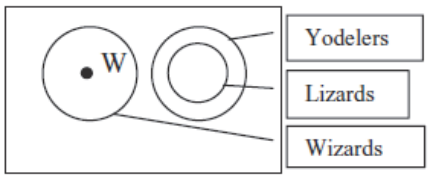
b. All cats are not dogs.



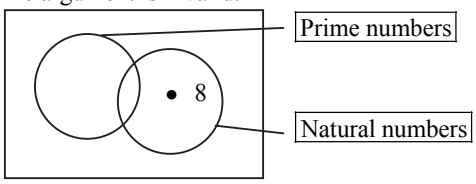
42. a. All cars are fuel efficient.

b. Some parakeets are not birds.

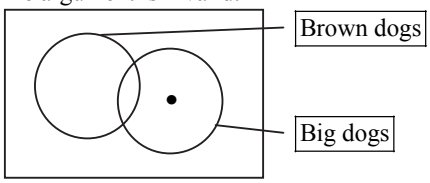
43. The argument is valid.



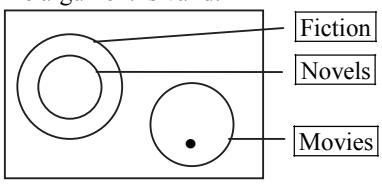
44. The argument is invalid.



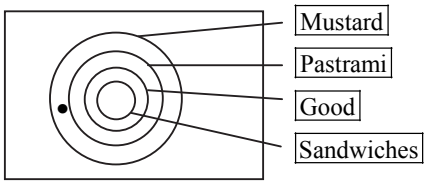
45. The argument is invalid.



46. The argument is valid.



47. The argument is invalid.



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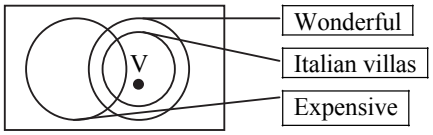
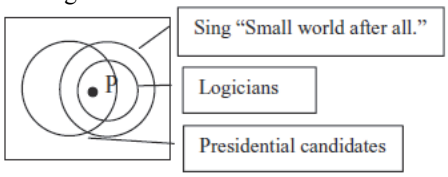
48. The argument is invalid.



49. The argument is valid.



50. Proposition

51. Not a proposition

52. Not a proposition

53. The concert music was not too loud.

54. $p \wedge q$

55. $r \wedge \sim q$

56. $q \rightarrow \sim p$

57. $p \vee q \vee r$

58. The football game will be played on Friday and the football game will be played at home.

59. If the football game is played on Friday, then the visiting team is not from Boston.

60. The football game will be played at home, or the visiting team is from Boston, and the football game will be played on Friday.

61. This is not the time for action, and do not hold your peace.

62. I am not committed to this fine state or will seek the presidential nomination.

63. a. *Antecedent:* I practice my accent.
Consequent: I will sound more like a native speaker.

b. *Antecedent:* Secure a loan on this house.
Consequent: You make a 20% down payment.

64. True. A false antecedent yields a true statement whether the consequent is true or false.

65. False. The antecedent is true and the consequent is false.

66. Both components are always true, so this statement is true.

67. True. A false antecedent yields a true statement whether the consequent is true or false.

68. Converse: If I can ride in the HOV lane, then I have an electric car.
Inverse: If I do not have an electric car, then I cannot ride in the HOV lane.
Contrapositive: If I cannot ride in the HOV lane, then I do not have an electric car.

69. Converse: If I lose some weight, then I start exercising.
Inverse: If I do not start exercising, then I will not lose some weight.
Contrapositive: If I do not lose some weight, then I did not start exercising.

70. Label the statements
f: The shoe fits.
w: Wear the shoe.
In symbolic form the argument is:
In symbolic form:
$f \rightarrow w$
w
$\therefore f$
The argument is invalid using the fallacy of the converse.

71. Label the statements
c: I cut my afternoon class.
p: I will go to the party.
In symbolic form:
$c \rightarrow p$
$\sim p$
$\therefore \sim c$
The argument is valid using modus tollens.

72. Label the statements
t: I don't watch television.
s: I will fall asleep
w: I will wake up at 3 A.M.
In symbolic form:
$t \rightarrow s$
$s \rightarrow w$
$\therefore \sim w \rightarrow \sim t$
The contrapositive of $\sim w \rightarrow \sim t$ is $t \rightarrow w$
The argument is valid using transitive reasoning.

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73. Label the statements
    w: I win the lottery.
    b: I will buy a Maserati.
    In symbolic form:
    $w \rightarrow b$
    $\underline{w \quad}$
    $\therefore b$
    The argument is valid using modus ponens.

74. This is an ad hominem (personal attack) fallacy.

75. This is circular reasoning.

76. This is a slippery slope fallacy.

77. This is an appeal to emotion fallacy.

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