1. Write each sentence in conditional ("If . . . , then . . .") form.

   a. Eighteen-year-olds may vote in federal elections.

      If a person is an eighteen-year-old, then he or she may vote in federal elections.

   b. Opposite angles of a parallelogram are congruent.

      If two angles are opposite angles of a parallelogram, then they are congruent.

2. Write the converse, the inverse, and the contrapositive of each statement. Determine the truth of each of the new statements.

   a. If each side of a triangle has a length of 10, then the triangle's perimeter is 30.

      Converse: If a Δ has a perimeter of 30, then each side has a length of 10. False
      Inverse: If each side length of a Δ is not 10, then the perimeter is not 30. False
      Contra: If the perimeter of a Δ is not 30, then each side length is not 10. True

   b. If an angle is acute, then it has a measure greater than 0 and less than 90.

      Converse: If an ∠ has measure > 0 & < 90, then it is acute. True
      Inverse: If an ∠ is not acute, then it does not have measure > 0 & < 90. True
      Contra: If an ∠ does not have measure > 0 & < 90, then it is not acute. True
3. If a conditional statement and its converse are both true, the statement is said to be **biconditional**. Which of these statements is biconditional?
   a. If two angles are congruent, then they have the same measure.

   If two angles have the same measure, then they are congruent.  **True!**

   b. If two angles are straight angles, then they are congruent.

   Contra: If two angles are congruent, then they are straight angles.

   False - the angles could both measure $82^\circ$!

   $\therefore$ a is the biconditional statement.

4. Draw a Venn diagram for the true conditional statement "If a person lives in Chicago, then the person lives in Illinois." Assuming that each of the following "Given . . ." statements is true, determine the truth of the conclusion.

      Conclusion: Penny lives in Illinois.  **True**

      Conclusion: Benny lives in Chicago.  **False**

   c. Given: Kenny does not live in Chicago.  
      Conclusion: Kenny must live in Illinois.  **False**

   d. Given: Denny does not live in Illinois.  
      Conclusion: Denny lives in Chicago.  **False**
5. Write a concluding statement for each of the following chains of reasoning.

   a. \( a \Rightarrow b \)
      
      \( d \Rightarrow \neg c \)
      
      \( d \Rightarrow \neg c \Rightarrow a \Rightarrow b \Rightarrow f \), so the conclusion is \( d \Rightarrow f \) !
      
      \( \neg c \Rightarrow a \)
      
      \( b \Rightarrow f \)

   b. \( p \Rightarrow \neg q \)
      
      \( r \Rightarrow q \)
      
      \( s \Rightarrow r \Rightarrow q \Rightarrow \neg p \), so the conclusion is \( s \Rightarrow \neg p \) !
      
      \( s \Rightarrow r \)

   c. If weasels walk wisely, the cougars call their cubs.
      If goats go to graze, then horses head for home.
      If cougars call their cubs, then goats go to graze.
      If bobcats begin to browse, then weasels walk wisely.

      If bobcats begin to browse, then horses head for home.

6. Write the converse, the inverse, and the contrapositive of the following statement. Determine the truth of each of the new statements.

   If M is the midpoint of \( \overline{AB} \), then M, A, and B are collinear.

   Converse: If M, A, and B are collinear, then M is the midpoint of \( \overline{AB} \). False
   Inverse: If M is not the midpoint of \( \overline{AB} \), then M, A, and B are noncollinear. False
   Contra: If M, A, and B are noncollinear, then M is not the midpoint of \( \overline{AB} \). True

7. Rewrite the following sentence in conditional form and find its converse, inverse, and contrapositive: "A square is a quadrilateral with four congruent sides."

   If a polygon is a square, then it is a quadrilateral with four congruent sides.

   Converse: If a quadrilateral has 4 \( \cong \) sides, then it is a square. False
   Inverse: If a polygon is not a square, then it is not a quad. with 4 \( \cong \) sides. False
   Contra: If a quadrilateral does not have 4 \( \cong \) sides, then it is not a square. True
9.

What conclusion can be drawn from the following?

Contrapositive

\[-c \Rightarrow -f \quad f \Rightarrow c\]

\[g \Rightarrow b \quad -b \Rightarrow -g\]

\[p \Rightarrow f \quad -f \Rightarrow -p\]

\[c \Rightarrow -b \quad b \Rightarrow -c\]

So, \( g \Rightarrow b \Rightarrow -c \Rightarrow -f \Rightarrow -p\)

\[\therefore g \Rightarrow -p \text{ (or } p \Rightarrow -g)\]