

**Practice with negation, contrapositive and proof:**

1. Write the negation of each of these statements.

- a. The number is a multiple of 6 and multiple of 9
  - **The number is not a multiple of both 6 and 9**
  - **The number is not a multiple of 6 or it is not a multiple of 9.**
- b. The triangle is isosceles or acute.
  - **The triangle is neither isosceles nor acute**
  - **The triangle is not isosceles and it is not acute**
- c. The line has a positive y-intercept and is not vertical.
  - **The line does not have a positive y-intercept or it is vertical**
  - **The line is vertical or it has a y-intercept that is 0 or negative.**
- d. All of the numbers in the set are prime
  - **Not all of the numbers in the set are prime**
  - **Some of the numbers in the set are not prime.**
- e. None of the triangles in the set are obtuse.
  - **Some of the triangles in the set are obtuse**
  - **At least one of the triangles in the set is obtuse.**

2. Write the contrapositive of each if-then statement:

- a. If a number in the set is prime, then it is odd
  - **If a number in the set is not odd, then it is not prime.**
  - **If a number is not odd, then it is not a prime number in the set.**
- b. If a quadrilateral in the set has 2 right angles then it does not have 4 equal sides
  - **If a quadrilateral in the set has 4 equal sides, then it does not have 2 right angles**
  - **If a quadrilateral does not have 4 equal sides, then it does not have 2 right angles. (This one was wrong!)**
- c. If point in the set has a positive x coordinate and a positive y coordinate then it lies inside the unit circle.
  - **If a point in the set does not lie inside the unit circle, then it does not have both a positive x-coordinate and a positive y-coordinate**
  - **If a point in the set does not lie in the unit circle, then it has a non-positive x-coordinate or a non-positive y-coordinate.**
- d. If a function in the set is a parabola, then the vertex has a positive x-coordinate or a positive y-coordinate.
  - **If a parabola has a vertex where neither the x-coordinate nor the y-coordinate are positive, then it is not a function in the set.**
  - **If a function in the set has a vertex where both the x-coordinate and the y-coordinate are not positive, then it is not a parabola.**

3. Show that this is a tautology:

$$((p \rightarrow q) \wedge (q \rightarrow r)) \rightarrow (p \rightarrow r)$$

$p$	$q$	$r$	$p \rightarrow q$	$q \rightarrow r$	$((p \rightarrow q) \wedge (q \rightarrow r))$	$p \rightarrow r$	$((p \rightarrow q) \wedge (q \rightarrow r)) \rightarrow (p \rightarrow r)$
T	T	T	T	T	T	T	T
T	T	F	T	F	F	F	T
T	F	T	F	T	F	T	T
T	F	F	F	T	F	F	T
F	T	T	T	T	T	T	T
F	T	F	T	F	F	T	T
F	F	T	T	T	T	T	T
F	F	F	T	T	T	T	T

I have made one on-purpose error in these statements: find it!

There are other versions that are also correct. Write one more version of one of these statements that you think is correct. (Write it on a piece of paper I can collect)