Assignment #1 Manesh Wijewardhana 2021/09/21

1a) Converse: The area of a circle is equal to π multiplied by its radius squared if then $2+2=4$. True

Contrapositive: The area of a circle is not equal to π multiplied by its radius squared if then $2+2 \neq 4$. True

b) Converse: If $10 \times 10 \neq 89$, then $\sqrt{2}$ is a rational number. False

Contrapositive: If $10 \times 10 = 89$, then $\sqrt{2}$ is not a rational number. True

c) converse: Consider two rectangles, A and B, with side lengths that are elements of the set N.
A and B are the same shape up to being a rotation of one another if they have the same perimeter and the same area. True

Contrapositive: Consider two rectangles, A and B, with side lengths that are elements of the set N.
A and B are not the same shape up to being a rotation of one another if they do not have the same perimeter or the same area. False

d) Converse: $\forall$ of functions, $f(x)$ and $g(x)$, that are both continuous and differentiable
If $f(x) = g(x)$, then $f'(x) = g'(x)$. True

Contrapositive: $\forall$ of functions, $f(x)$ and $g(x)$, that are both continuous and differentiable
If $f(x) \neq g(x)$, then $f'(x) \neq g'(x)$ False

e) converse: If $a > b$, then $a^2 > b^2$. False

Contrapositive: If $a \leq b$, then $a^2 \leq b^2$ False

2. $B \vee (\neg(A \vee \neg A) \wedge B) \vee \neg(A \wedge \neg B) \equiv \neg A \vee B$
$B \vee (\neg(T) \wedge B) \vee \neg(A \wedge \neg B) \equiv \neg A \vee B$ Identity Law
$B \vee (F \wedge B) \vee \neg(A \wedge \neg B) \equiv \neg A \vee B$ Negation
$B \vee F \vee \neg(A \wedge \neg B) \equiv \neg A \vee B$ Identity Law
$B \vee \neg(A \vee \neg B) \equiv \neg A \vee B$ Identity Law
$B \vee \neg A \vee \neg\neg B \equiv \neg A \vee B$ de morgans law
$B \vee \neg A \vee B \equiv \neg A \vee B$ Double negation Law
$\neg A \vee B \vee B \equiv \neg A \vee B$ Associative Law
$\neg A \vee B \equiv \neg A \vee B$ Idempotent Law

3a) For all x, where x is an element of the real numbers and x is greater than 0, then there exists y such that y is greater than 0 and y squared equals x

b) There does not exist x, where x is an element of the real numbers where x squared is greater than 1 but smaller than x.

4.

A	B	A OR B	A AND B	¬A	¬B	A → B	B → A	A ↔ B	¬(A → B)	¬(B → A)	A XOR B	A OR ¬A (T)	A AND ¬A (F)
F	F	F	F	T	T	T	T	T	F	F	F	T	F
F	T	T	F	T	F	T	F	F	F	T	T	T	F
T	F	T	F	F	T	F	T	F	T	F	T	T	F
T	T	T	T	F	F	T	T	T	F	F	F	T	F

5. $\exists y \forall x, F(x,y)$
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Lets define $F(x,y)$ as $x = y^2$

This means that:

$\exists y \forall x, x = y^2$. This statement is true $\forall x$ as there only needs to exist one y value for it to hold true. For example, $y = 49$ will have an x value of 7.

$\forall x \exists y, x = y^2$. This statement could either be true or false as for example, $x = 7$ does not have an equivalent y value depending on the universe we choose and therefore, The two statements are not logically equivalent.

The two statements could have different truth values which makes them not logically equivalent.