

Section 2.8 : The Biconditional

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biconditional:

"If you get 90% or higher in Math 155,
then you will get an A+ and
vice versa."

"If and only if you get 90% or higher
in Math 155, then you will get an A+."

what does it mean?

"if p , then q and if q , then p "

or "if p , then q and if $\neg p$, then $\neg q$ "

or "either p and q are both true or
they are both false"

notation:

$$p \Leftrightarrow q$$

"if and only if p , then q " (iff p , then q)

"if p , then q and vice versa"

example: Consider the following conditional statements. Do they still make sense when written as a biconditional?

① If you eat at Joe's, you will have a good meal.
No

② If two lines are perpendicular, then they meet at a right angle.
Yes

③ If today is February 14th, then today is Valentine's Day.
Yes

④ If the car battery is drained, then the car will not start.
No

truth table:

p	q	$p \leftrightarrow q$
0	0	1
0	1	0
1	0	0
1	1	1

example: Is the biconditional $p \leftrightarrow q$ logically equivalent to $(p \rightarrow q) \wedge (q \rightarrow p)$?
 Use a truth table to justify your answer.

p	q	$p \leftrightarrow q$	$p \rightarrow q$	$q \rightarrow p$	$(p \rightarrow q) \wedge (q \rightarrow p)$
0	0	1	1	1	1
0	1	0	1	0	0
1	0	0	0	1	0
1	1	1	1	1	1

Yes

$$(p \leftrightarrow q) \Leftrightarrow ((p \rightarrow q) \wedge (q \rightarrow p))$$

example: The following statement is true:

If and only if Snarks ^{p} are Boojms, then the Bellman _{q} is incorrect.

a) Snarks are Boojms. Is the Bellman correct? **No**
 p is true so q is also true

b) Snarks are not Boojms. Is the Bellman correct? **Yes**
 p is false so q is also false

c) The Bellman is correct. Are Snorks Boojms? No
q is false so p is also false

d) The Bellman is incorrect. Are Snorks Boojms? Yes
q is true so p is true

rule: either p and q are both true or they are both false