

# Try it yourselves

Suppose you know  $p \rightarrow q$ ,  $\neg s \rightarrow \neg q$ , and  $p$ .  
Give an argument to conclude  $s$ .

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Activity Credit!

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# Inference Rules

Eliminate  $\wedge$

$$\frac{A \wedge B}{\therefore A, B}$$

Eliminate  $\vee$

$$\frac{A \vee B, \neg A}{\therefore B}$$

Intro  $\wedge$

$$\frac{A; B}{\therefore A \wedge B}$$

Intro  $\vee$

$$\frac{A}{\therefore A \vee B, B \vee A}$$

Direct Proof  
rule

$$A \Rightarrow B$$

$$A \rightarrow B$$

Modus  
Ponens

$$P \rightarrow Q; P$$

$$\therefore Q$$

You can still use all the propositional logic equivalences too!

# Properties of Logical Connectives

For every propositions  $p, q, r$  the following hold:

- **Identity**

- $p \wedge \text{T} \equiv p$
- $p \vee \text{F} \equiv p$

- **Domination**

- $p \vee \text{T} \equiv \text{T}$
- $p \wedge \text{F} \equiv \text{F}$

- **Idempotent**

- $p \vee p \equiv p$
- $p \wedge p \equiv p$

- **Commutative**

- $p \vee q \equiv q \vee p$
- $p \wedge q \equiv q \wedge p$

- **Associative**

- $(p \vee q) \vee r \equiv p \vee (q \vee r)$
- $(p \wedge q) \wedge r \equiv p \wedge (q \wedge r)$

- **Distributive**

- $p \wedge (q \vee r) \equiv (p \wedge q) \vee (p \wedge r)$
- $p \vee (q \wedge r) \equiv (p \vee q) \wedge (p \vee r)$

- **Absorption**

- $p \vee (p \wedge q) \equiv p$
- $p \wedge (p \vee q) \equiv p$

- **Negation**

- $p \vee \neg p \equiv \text{T}$
- $p \wedge \neg p \equiv \text{F}$

- **DeMorgan's Laws**

- $\neg(p \vee q) \equiv \neg p \wedge \neg q$
- $\neg(p \wedge q) \equiv \neg p \vee \neg q$

- **Double Negation**

$$\neg\neg p \equiv p$$

- **Law of Implication**

$$p \rightarrow q \equiv \neg p \vee q$$

- **Contrapositive**

$$p \rightarrow q \equiv \neg q \rightarrow \neg p$$