Logic, First Course, Winter 2020. Week 1, Practice Problems. Back to course website

# Practice problems

The practice problems fall into four groups:

- Memorizing truth-tables

- More memorizing truth-tables

- Finding the main connectives

- More complex truth-tables

## Memorizing truth-tables

The following practice problems are intended to help you memorize the truth-tables for the propositional connectives. Only one of the rows are given, and this is designed to help you memorize the truth-tables row-by-row, and to make sure that your recall of this is not tied to the particular order we happened to enumerate the rows in.
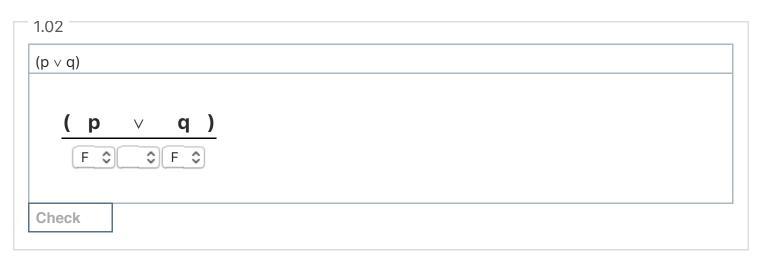
These problems only presuppose Week 1, Lecture 1.

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1.01

(p ∧ q)

( **p** ∧ **q** )
[F ⇕] [⇕] [F ⇕]

Check

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## 1.02

(p ∨ q)

( p ∨ q )

[ F ↕ ] [ ↕ ] [ F ↕ ]

Check

## 1.03

(p → q)

( p → q )

[ F ↕ ] [ ↕ ] [ F ↕ ]

Check

## 1.04

(p ∧ q)

( p ∧ q )

[ T ↕ ] [ ↕ ] [ T ↕ ]

Check

## 1.05

(p ∨ q)

( **p**  ∨  **q** )

[T ⇕] [⇕] [T ⇕]

Check

## 1.06

(p → q)

( **p**  →  **q** )

[T ⇕] [⇕] [T ⇕]

Check

## 1.07

(p ∧ q)

( **p**  ∧  **q** )

[F ⇕] [⇕] [T ⇕]

Check

## 1.08

(p ∨ q)

**( p ∨ q )**

F ⇕  | ⇕ | T ⇕

Check

## 1.09

(p → q)

**( p → q )**

F ⇕ | ⇕ | T ⇕

Check

## 1.10

(p ∧ q)

**( p ∧ q )**

T ⇕ | ⇕ | F ⇕

Check

## 1.11

(p ∨ q)

**( p ∨ q )**

[ T ⇕ ] [ ⇕ ] [ F ⇕ ]

Check

## 1.12

(p → q)

**( p → q )**

[ T ⇕ ] [ ⇕ ] [ F ⇕ ]

Check

# More memorizing truth-tables

In the following, we introduce a minor variation on the previous problems by having one fill in two rows of a truth-table. We further add on biconditional and negation, and use different propositional letters.

These problems only presuppose Week 1, Lecture 1.

## 1.13

(a ∧ z)

| a | z | ( | a | ∧ | z | ) |
|---|---|---|---|---|---|---|
| T | T | | [T ↕] | [T ↕] | [T ↕] | |
| T | F | | [T ↕] | [↕] | [F ↕] | |
| F | T | | [F ↕] | [F ↕] | [T ↕] | |
| F | F | | [F ↕] | [↕] | [F ↕] | |

Check

## 1.14

(b ∨ y)

| b | y | ( | b | ∨ | y | ) |
|---|---|---|---|---|---|---|
| T | T | | [T ↕] | [↕] | [T ↕] | |
| T | F | | [T ↕] | [T ↕] | [F ↕] | |
| F | T | | [F ↕] | [T ↕] | [T ↕] | |
| F | F | | [F ↕] | [↕] | [F ↕] | |

Check

## 1.15

¬c

| c | ¬ | c |
|---|---|---|
| T | [↕] | [T ↕] |
| F | [T ↕] | [F ↕] |

Check

## 1.16

(d → k)

| d k | ( d | → | k ) |
|-----|-----|---|-----|
| T T | T ⬍  T ⬍ | T ⬍ |     |
| T F | T ⬍   ⬍ | F ⬍ |     |
| F T | F ⬍  T ⬍ | T ⬍ |     |
| F F | F ⬍   ⬍ | F ⬍ |     |

Check

## 1.17

(u ⬌ v)

| u v | ( u | ⬌ | v ) |
|-----|-----|---|-----|
| T T | T ⬍   ⬍ | T ⬍ |     |
| T F | T ⬍  F ⬍ | F ⬍ |     |
| F T | F ⬍  F ⬍ | T ⬍ |     |
| F F | F ⬍   ⬍ | F ⬍ |     |

Check

## 1.18

(m ∧ n)

| m | n | ( | m | ∧ | n | ) |
|---|---|---|---|---|---|---|
| T | T |  | T ↕ |  ↕ | T ↕ |  |
| T | F |  | T ↕ | F ↕ | F ↕ |  |
| F | T |  | F ↕ | F ↕ | T ↕ |  |
| F | F |  | F ↕ |  ↕ | F ↕ |  |

Check

Before you try the next problem, note that the *j* column is listed before the *z* column, even though we are considering the formula *z* ∨ *j*.

## 1.19

(z ∨ j)

| j | z | ( | z | ∨ | j | ) |
|---|---|---|---|---|---|---|
| T | T |  | T ↕ | T ↕ | T ↕ |  |
| T | F |  | F ↕ |  ↕ | T ↕ |  |
| F | T |  | T ↕ |  ↕ | F ↕ |  |
| F | F |  | F ↕ | F ↕ | F ↕ |  |

Check

## 1.20

¬r

| r | ¬ | r |
|---|---|---|
| T | F ◊ | T ◊ |
| F | ◊ | F ◊ |

Check

Before you try the next problem, note that the e column is listed before the w column, even though we are considering the formula w → e.

## 1.21

(w → e)

| e | w | ( w | → | e | ) |
|---|---|---|---|---|---|
| T | T | T ◊ | ◊ | T ◊ | |
| T | F | F ◊ | T ◊ | T ◊ | |
| F | T | T ◊ | ◊ | F ◊ | |
| F | F | F ◊ | T ◊ | F ◊ | |

Check

## 1.22

(f ↔ d)

| d f | ( f | ↔ | d ) |
|-----|-----|-----|-----|
| T T | [T ↕] | [↕] | [T ↕] |
| T F | [F ↕] | [F ↕] | [T ↕] |
| F T | [T ↕] | [↕] | [F ↕] |
| F F | [F ↕] | [T ↕] | [F ↕] |

Check

# Finding the main connectives

These next problems only presuppose Week 1, Section Meeting.

Prior to starting the next set of problems, perhaps consider reviewing how to type the connectives on the keyboard.

In the following problems we successively find the main connectives of the formulas, starting with the big formulas and 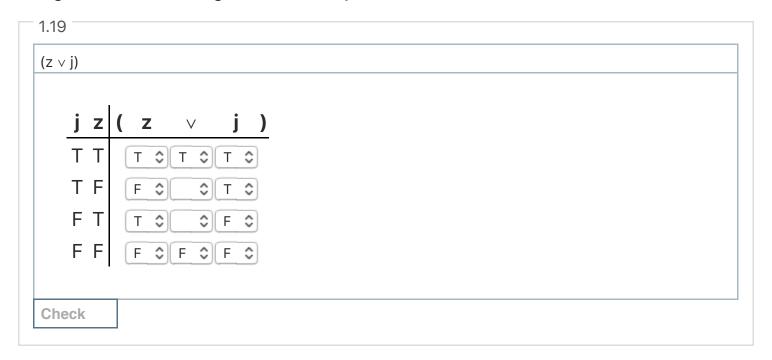breaking them into smaller parts. Press return after you have entered in the main connective to get to the next level. Ignore the "You may now submit your solution" remark after you finish. In the actual homeworks, there will actually be a "submit your solution" button- this is just practice.

## 1.23

(¬p → (q ∧ r))

**1.24**

(p ∨ (q ∧ r))

**1.25**

(p ↔ (q ∧ r))

**1.26**

¬(p → (q ∧ r))

**1.27**

((p → ¬q) ∨ r)

**1.28**

((p ∨ q) ∧ r)

**1.29**

((p ∧ q) ∨ ¬(q ∧ r))

**1.30**

(¬p ↔ ¬(q ∨ r))

**1.31**

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

**1.32**

$(((p \lor \neg q) \rightarrow (r \leftrightarrow s)) \rightarrow \neg t)$

**1.33**

$((w \land \neg t) \rightarrow (t \rightarrow (w \lor u)))$

**1.34**

$(\neg\neg v \rightarrow \neg\neg u)$

# More complex truth-tables

Now we focus on completing the truth-tables of more complex propositions. These problems presuppose .

## 1.35

$(p \to (q \land r))$

| p q r | ( | p | → | ( | q | ∧ | | r | )) |
|-------|---|---|---|---|---|---|---|---|----|
| T T T | | T | ↕ | | T | ↕ | | T | ↕ |
| T T F | | T | ↕ | | T | ↕ | | F | ↕ |
| T F T | | T | ↕ | | F | ↕ | | T | ↕ |
| T F F | | T | ↕ | | F | ↕ | | F | ↕ |
| F T T | | F | ↕ | | T | ↕ | | T | ↕ |
| F T F | | F | ↕ | | T | ↕ | | F | ↕ |
| F F T | | F | ↕ | | F | ↕ | | T | ↕ |
| F F F | | F | ↕ | | F | ↕ | | F | ↕ |

Check

## 1.36

$((p \land q) \to r)$

| p q r | (( | p | ∧ | | q | ) | → | r | ) |
|-------|----|---|---|---|---|---|---|---|---|
| T T T | | T | ↕ | | T | ↕ | | T | ↕ |
| T T F | | T | ↕ | | T | ↕ | | F | ↕ |
| T F T | | T | ↕ | | F | ↕ | | T | ↕ |
| T F F | | T | ↕ | | F | ↕ | | F | ↕ |
| F T T | | F | ↕ | | T | ↕ | | T | ↕ |
| F T F | | F | ↕ | | T | ↕ | | F | ↕ |
| F F T | | F | ↕ | | F | ↕ | | T | ↕ |
| F F F | | F | ↕ | | F | ↕ | | F | ↕ |

Check

## 1.37

((p ∨ q) → r)

| p q r | (( | p | ∨ | q | ) → | r | ) |
|---|---|---|---|---|---|---|---|
| T T T | | T | | T | | T | |
| T T F | | T | | T | | F | |
| T F T | | T | | F | | T | |
| T F F | | T | | F | | F | |
| F T T | | F | | T | | T | |
| F T F | | F | | T | | F | |
| F F T | | F | | F | | T | |
| F F F | | F | | F | | F | |

Check

## 1.38

((¬p ∨ ¬q) → r)

| p q r | (( | ¬ | p | ∨ | ¬ | q | ) → | r | ) |
|---|---|---|---|---|---|---|---|---|---|
| T T T | | | T | | | T | | T | |
| T T F | | | T | | | T | | F | |
| T F T | | | T | | | F | | T | |
| T F F | | | T | | | F | | F | |
| F T T | | | F | | | T | | T | |
| F T F | | | F | | | T | | F | |
| F F T | | | F | | | F | | T | |
| F F F | | | F | | | F | | F | |

Check

## 1.39

$((\neg p \wedge q) \to \neg r)$

| p | q | r | (( | ¬ | p | ∧ | q | ) | → | ¬ | r | ) |
|---|---|---|----|---|---|---|---|---|---|---|---|---|
| T | T | T | | ◇ | T | ◇ | T | | ◇ | ◇ | T | |
| T | T | F | | ◇ | T | ◇ | T | | ◇ | ◇ | F | |
| T | F | T | | ◇ | T | ◇ | F | | ◇ | ◇ | T | |
| T | F | F | | ◇ | T | ◇ | F | | ◇ | ◇ | F | |
| F | T | T | | ◇ | F | ◇ | T | | ◇ | ◇ | T | |
| F | T | F | | ◇ | F | ◇ | T | | ◇ | ◇ | F | |
| F | F | T | | ◇ | F | ◇ | F | | ◇ | ◇ | T | |
| F | F | F | | ◇ | F | ◇ | F | | ◇ | ◇ | F | |

Check

## 1.40

$((p \wedge q) \leftrightarrow (p \vee q))$

| p | q | (( | p | ∧ | q | ) | ↔ | ( | p | ∨ | q | )) |
|---|---|----|---|---|---|---|---|---|---|---|---|----|
| T | T | | T | ◇ | T | | ◇ | | T | ◇ | T | |
| T | F | | T | ◇ | F | | ◇ | | T | ◇ | F | |
| F | T | | F | ◇ | T | | ◇ | | F | ◇ | T | |
| F | F | | F | ◇ | F | | ◇ | | F | ◇ | F | |

Check

## 1.41

(¬¬p ↔ q)

| p | q | ( | ¬ | ¬ | p | ↔ | q | ) |
|---|---|---|---|---|---|---|---|---|
| T | T |   | [▾] | [▾] | T | [▾] | T |   |
| T | F |   | [▾] | [▾] | T | [▾] | F |   |
| F | T |   | [▾] | [▾] | F | [▾] | T |   |
| F | F |   | [▾] | [▾] | F | [▾] | F |   |

Check

## 1.42

(¬¬p → ¬¬q)

| p | q | ( | ¬ | ¬ | p | → | ¬ | ¬ | q | ) |
|---|---|---|---|---|---|---|---|---|---|---|
| T | T |   | [▾] | [▾] | T | [▾] | [▾] | [▾] | T |   |
| T | F |   | [▾] | [▾] | T | [▾] | [▾] | [▾] | F |   |
| F | T |   | [▾] | [▾] | F | [▾] | [▾] | [▾] | T |   |
| F | F |   | [▾] | [▾] | F | [▾] | [▾] | [▾] | F |   |

Check

# 1.43

(¬(¬p ∧ ¬q) ↔ ¬¬q)

| p q | ( | ¬ | ( | ¬ | p | ∧ | ¬ | q | ) | ↔ | ¬ | ¬ | q | ) |
|-----|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| T T |   |   |   | T |   |   |   | T |   |   |   |   | T |   |
| T F |   |   |   | T |   |   |   | F |   |   |   |   | F |   |
| F T |   |   |   | F |   |   |   | T |   |   |   |   | T |   |
| F F |   |   |   | F |   |   |   | F |   |   |   |   | F |   |

Check

# 1.44

(p ∧ (q ∧ r))

| p q r | ( | p | ∧ | ( | q | ∧ | r | )) |
|-------|---|---|---|---|---|---|---|----|
| T T T |   | T |   |   | T |   | T |    |
| T T F |   | T |   |   | T |   | F |    |
| T F T |   | T |   |   | F |   | T |    |
| T F F |   | T |   |   | F |   | F |    |
| F T T |   | F |   |   | T |   | T |    |
| F T F |   | F |   |   | T |   | F |    |
| F F T |   | F |   |   | F |   | T |    |
| F F F |   | F |   |   | F |   | F |    |

Check

1.43

(¬(¬p ∧ ¬q) ↔ ¬¬q)

## 1.45

(p ∨ (q ∧ r))

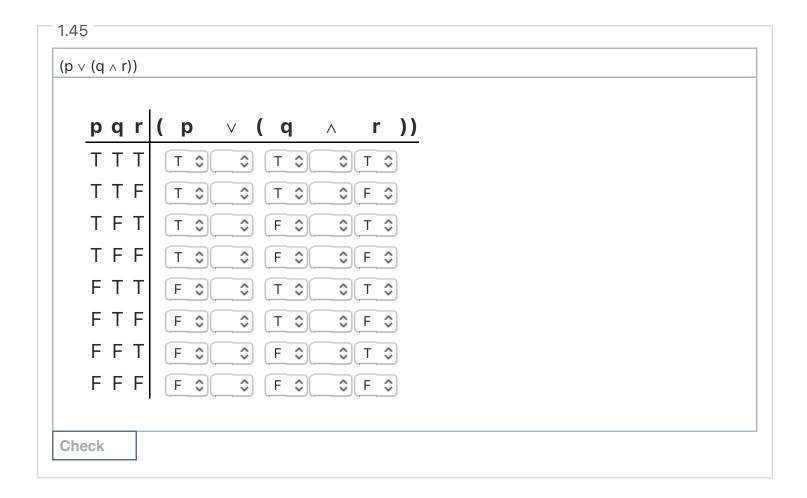| p q r | ( p |  | ∨ | ( q |  | ∧ | r | )) |
|-------|-----|-----|-----|-----|-----|-----|-----|-----|
| T T T | T | | | T | | | T | |
| T T F | T | | | T | | | F | |
| T F T | T | | | F | | | T | |
| T F F | T | | | F | | | F | |
| F T T | F | | | T | | | T | |
| F T F | F | | | T | | | F | |
| F F T | F | | | F | | | T | |
| F F F | F | | | F | | | F | |

Check

These are practice problems for this course. It is run on the Carnap software, which is an:

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