**Lab 03 Propositional Equivalences**

**Objective**

Solving exercises from the textbook in chapter 1.3

**Current Lab Learning Outcomes (LLO)**

By completion of the lab, the students should be able to:

1. Understand propositional equivalences and .
2. prove the propositional equivalences using rules

**Lab Requirements**

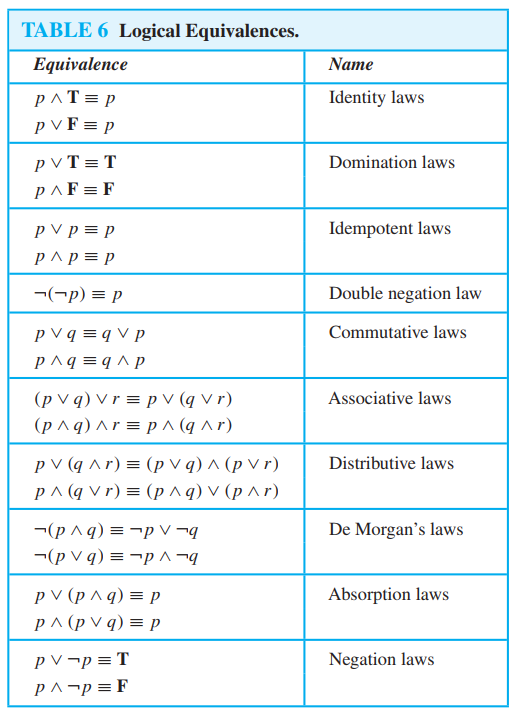
Students allowed using their lecture notes in the lab in order to solve the exercises.

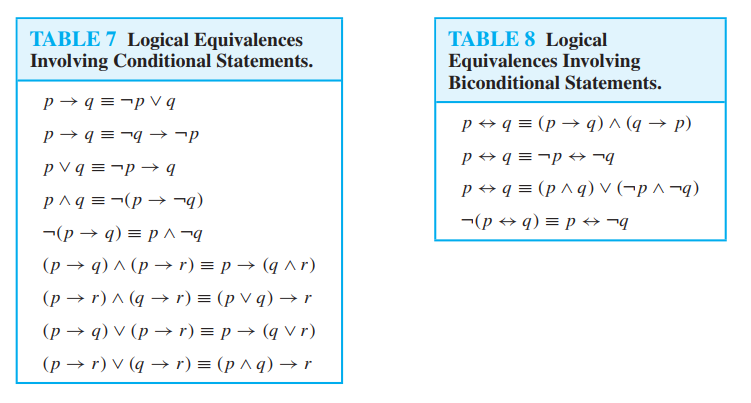
**Lab Assessment**

1- Divide students to groups and let them to solve the given example.

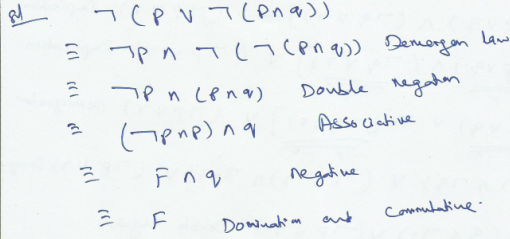
2- Discuss the answers with the groups and write on board the optimal solution.

**Lab Description**

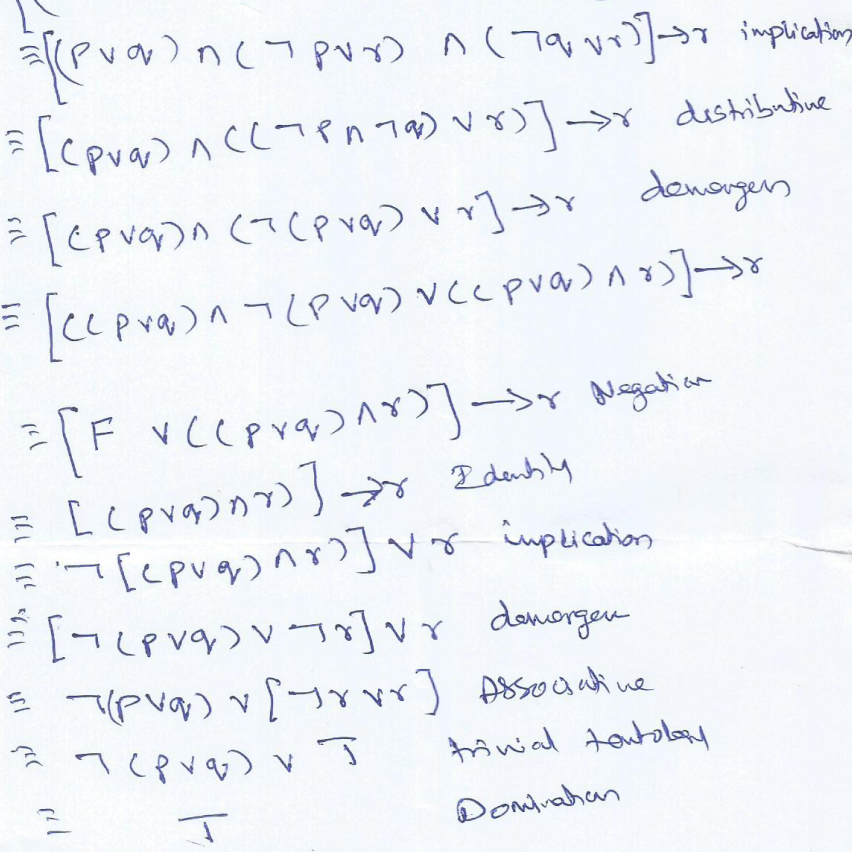




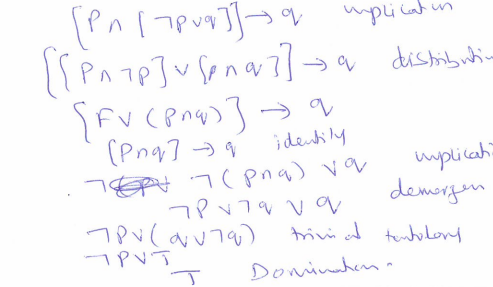
1. Show that ￢*(p* ∨ ￢(*p* ∧ *q))* is contradiction using rules.



1. show that [*(p* ∨ *q)* ∧ *(p* → *r)* ∧ *(q* → *r)*] → *r is a tautology using rules*

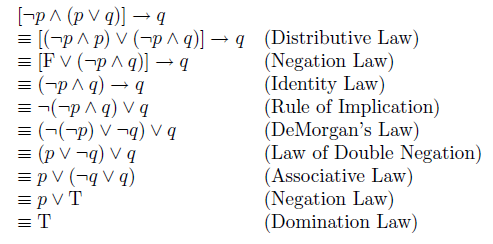


1. Show that *[p* ^ *(p* → *q)]* → *q* is a tautology using rules

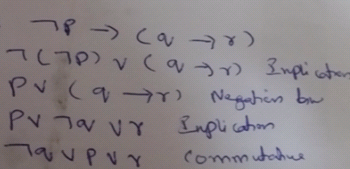


Negation Law

1. Show that [¬p ∧ (p ∨ q)] → q is a tautology using rules.



1. Show that ¬ p→ *(q* → *r) and q* →( p v r) are logically equivalent using rules.

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1. Show that ¬p ↔ q and p ↔ ¬q are logically equivalent using rules

¬p ↔ q ⇔ (¬p→q) ∧ (q→¬p) Biconditional

= (¬¬p∨q) ∧ (¬q∨¬p) Implication

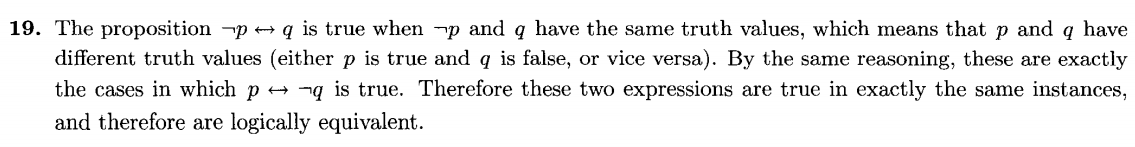
= (p∨q) ∧ (¬q∨¬p) Double Negation

= (q∨p) ∧ (¬p∨¬q) Commutative

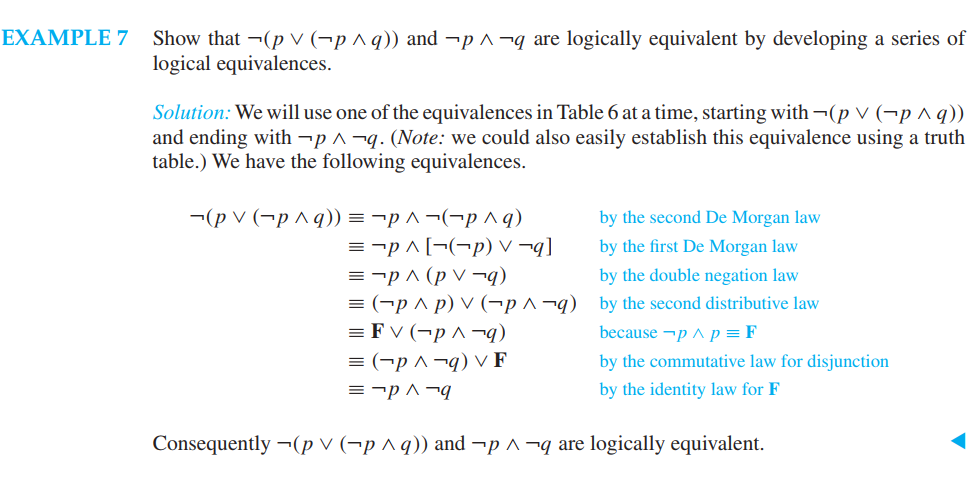
= (¬¬q∨p) ∧ (¬p∨¬q) Double Negation

= (¬q→p) ∧ (p→¬q) Implication

= p ↔ ¬q Biconditional



1. Determine whether¬(p∨(¬p∧q)) and (¬p ∧ ¬q) equivalent using rules?



¬(p∨(¬p∧q)) =¬p ∧ ¬(¬p∧q) DeMorgan

=¬p ∧ (¬¬p∨¬q) DeMorgan

=¬p ∧ (p∨¬q) Double Negation

=(¬p∧p)∨(¬p ∧¬q) Distribution

=(p∧¬p)∨(¬p ∧¬q) Commutative

=F ∨(¬p ∧¬q) Negation

= (¬p ∧¬q) ∨ F Commutative

= (¬p ∧¬q) Identity

¬(p∨(¬p∧q)) and (¬p ∧ ¬q) equivalent