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Assignment 1 - Discrete Mathematics
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- Section 1.1
  - Problem 6
    - a) The election is not decided.
    - b) the election is decided or the votes have been counted.
    - c) The election is not decided and the votes have been counted.
    - d) the election is decided if the votes have been counted.
    - e) If the votes have not been counted then the election has not been decided.
    - f) If the election is not decided then the votes have not been counted.
    - g) The election is decided if and only if the votes have been counted.
    - h) The election is not decided and the votes have been counted, or the votes have not been counted.
  - Problem 10
    - a) $r \wedge \neg q$
    - b) $p \wedge q \wedge r$
    - c) $p \rightarrow r$
    - d) $p \wedge \neg q \wedge r$
    - e) $(p \wedge q) \rightarrow r$
    - f) $r \leftrightarrow (q \vee p)$
- Section 1.2
  - Problem 2
    - $\neg\neg p \equiv p$ by double negation law
  - Problem 4
    - a)

p	q	r	$p \vee q$	$q \vee r$	$(p \vee q) \vee r$	$p \vee (q \vee r)$
T	T	T	T	T	T	T
T	T	F	T	T	T	T
T	F	T	T	T	T	T
T	F	F	T	F	T	T
F	T	T	T	T	T	T
F	T	F	T	T	T	T
F	F	T	F	T	T	T
F	F	F	F	F	F	F

∗ b)

p	q	r	$p \wedge q$	$q \wedge r$	$(p \wedge q) \wedge r$	$p \wedge (q \wedge r)$
T	T	T	T	T	T	T
T	T	F	T	F	F	F
T	F	T	F	F	F	F
T	F	F	F	F	F	F
F	T	T	F	T	F	F
F	T	F	F	F	F	F
F	F	T	F	F	F	F
F	F	F	F	F	F	F

– Problem 10

∗ a)

p	q	$\neg p$	$p \vee q$	$\neg p \wedge (p \vee q)$	$[\neg p \wedge (p \vee q)] \rightarrow q$
T	T	F	T	F	T
T	F	F	T	F	T
F	T	T	T	T	T
F	F	T	F	F	T

∗ b)

p	q	r	$p \rightarrow q$	$q \rightarrow r$	$(p \rightarrow q) \wedge (q \rightarrow r)$	$p \rightarrow r$	$[(p \rightarrow q) \wedge (q \rightarrow r)] \rightarrow (p \rightarrow r)$
T	T	T	T	T	T	T	T
T	T	F	T	F	F	F	T
T	F	T	F	T	F	T	T
T	F	F	F	T	F	F	T
F	T	T	T	T	T	T	T
F	T	F	T	F	F	T	T
F	F	T	T	T	T	T	T
F	F	F	T	T	T	T	T

∗ c)

p	q	$p \rightarrow q$	$p \wedge (p \rightarrow q)$	$[p \wedge (p \rightarrow q)] \rightarrow q$
T	T	T	T	T
T	F	F	F	T
F	T	T	F	T
F	F	T	F	T

∗ d)

p	q	r	$p \vee q$	$p \rightarrow r$	$q \rightarrow r$	$(p \vee q) \wedge (p \rightarrow r) \wedge (q \rightarrow r)$
T	T	T	T	T	T	T
T	T	F	T	F	F	F
T	F	T	T	T	T	T
T	F	F	T	F	T	F
F	T	T	T	T	T	T
F	T	F	T	T	F	F
F	F	T	F	T	T	F
F	F	F	F	T	T	F

$[(p \vee q) \wedge (p \to r) \wedge (q \to r)] \to r$
T
T
T
T
T
T
T
T

- Problem 12
  - a)
    $[\neg p \wedge (p \vee q)] \to q$
    $\equiv [(\neg p \wedge p) \vee (\neg p \wedge q)] \to q$ Distributive Law
    $\equiv [\ \mathrm{F} \vee (\neg p \wedge q)] \to q$ Negation Law
    $\equiv (\neg p \wedge q) \to q$ Identity Law
    $\equiv \neg(\neg p \wedge q) \vee q$ Conditional Equivalence
    $\equiv p \vee \neg q \vee q$ De Morgan's Law
    $\equiv p \vee \mathrm{T}$ Negation Law
    $\equiv \mathrm{T}$ Domination Law
  - b)
    $[(p \to q) \wedge (q \to r)] \to (p \to r)$
    $\equiv [(p \vee q) \to r] \to (p \to r)$ Conditional Equivelence
    $\equiv \neg[\neg(p \vee q) \vee r] \vee (\neg p \vee r)$ Conditional Equivelences
    $\equiv [\neg(\neg p \wedge \neg q) \wedge \neg r] \vee (\neg p \vee r)$ De Morgan's Law
    $\equiv [(p \vee q) \wedge \neg r] \vee (\neg p \vee r)$ De Morgan's Law
    $\equiv [(\neg p \vee r) \vee (p \vee q)] \wedge [(\neg p \vee r) \vee \neg r]$ Distributive Law
    $\equiv [\ \mathrm{T} \vee r \vee q] \wedge [\ \mathrm{T} \vee \neg p]$ Negation Law
    $\equiv \mathrm{T} \wedge \mathrm{T}$ Domination Law
    $\equiv \mathrm{T}$
  - c)
    $[p \wedge (p \to q)] \to q$
    $\equiv \neg[p \wedge (\neg p \vee q)] \vee q$ Conditional Equivelence
    $\equiv [\neg p \vee (p \wedge \neg q)] \vee q$ De Morgan's Law
    $\equiv (\neg p \vee p \vee q) \wedge (\neg p \vee \neg q \vee q)$ Distributive Law
    $\equiv (\ \mathrm{T} \vee q) \wedge (\neg p \vee \mathrm{T}\ )$ Negation Law
    $\equiv \mathrm{T} \wedge \mathrm{T}$ Domination Law
    $\equiv \mathrm{T}$ Identity Law
  - d)
    $[(p \vee q) \wedge (p \to r) \wedge (q \to r)] \to r$
    $\equiv \neg[(p \vee q) \wedge (\neg p \vee r) \wedge (\neg q \vee r)] \vee r$ Conditional Equivelence
    $\equiv (\neg p \wedge \neg q) \vee (p \wedge \neg r) \vee (q \wedge \neg r) \vee r$ De Morgan's Law
    $\equiv [\neg p \vee (p \wedge \neg r)] \wedge [\neg q \vee (p \wedge \neg r)] \vee (q \wedge \neg r) \vee r$ Distr. Law
    $\equiv [(\neg p \vee p) \wedge (\neg p \vee \neg r)] \wedge [\neg q \vee (p \wedge \neg r)] \vee (q \wedge \neg r) \vee r$ Ds. Law
    $\equiv (\neg p \vee \neg r) \wedge [\neg q \vee (p \wedge \neg r)] \vee (q \wedge \neg r) \vee r$ Neg. & Id. Law
    $\equiv (\neg p \vee \neg r) \wedge [\neg q \vee (p \wedge \neg r)] \vee (q \vee r) \wedge (\neg r \vee r)$ Ds. Law
    $\equiv (\neg p \vee \neg r) \wedge [\neg q \vee (p \wedge \neg r)] \vee (q \vee r)$ Neg. & Id. Law

- Section 1.3

- Problem 2
  - a) True
  - b) False
  - c) False
  - d) True
- Problem 12
  - a) True
  - b) True
  - c) False
  - d) True
  - e) False
  - f) True
  - g) False
- Problem 16
  - a) True
  - b) False
  - c) True
  - d) False