HW #2 (SECTION 2.2 SOLUTIONS) M325K SPRING 2024

Sec. 2.2

#2. IF I catch the 8:05 bus,
then I am on time for work.

#4 The statement:
"Fix my ceiling or I won't pay my rent"
has the form $r \vee s$. But to recognize it as the IF, THEN statement "IF p, Then q", we need to rewrite that statement in the form $\sim p \vee q$, so we need
$\sim p = r$ and $q = s$. Thus,

$\sim p$ is the statement "you fix my ceiling"
and q is the statement "I won't pay my rent."
Viewing things this way makes p mean = "you don't fix my ceiling".
So, "IF p, THEN q" represents

"IF you don't fix my ceiling,
THEN I won't pay my rent."

Sec 2.2

#6

p	q	~p	~p ∧ q	(p ∨ q)	(p ∨ q) ∨ (~p ∧ q)	(p ∨ q) ∨ (~p ∧ q) → q
T	T	F	F	T	T	T
T	F	F	F	T	T	F
F	T	T	T	T	T	T
F	F	T	F	F	F	T

#7 In the back of the book

#8,

p	q	r	~p	~p ∨ q	(~p ∨ q) → r
T	T	T	F	T	T
T	T	F	F	T	F
T	F	T	F	F	T
T	F	F	F	F	F
F	T	T	T	T	T
F	T	F	T	T	F
F	F	T	T	T	T
F	F	F	T	T	F

Sec 2.2 #13

13a was not assigned.

13a.

p	q	~p	p→q	~p∨q
T	T	F	T	T
T	F	F	F	F
F	T	T	T	T
F	F	T	T	T

SAME TRUTH TABLE

Since (p→q) and (~p∨q) have the same truth table, (p→q) ≡ (~p∨q).

13b.

p	q	~q	(p→q)	~(p→q)	p∧~q
T	T	F	T	F	F
T	F	T	F	T	T
F	T	F	T	F	F
F	F	T	T	F	F

SAME TRUTH TABLE.

Since ~(p→q) and (p∧~q) have the same Truth table,

$$\sim(p \to q) \equiv (p \wedge \sim q)$$

(See the next page for the words of explanation.)

Sec. 2.2, #136 (continued) Words of Explanation.

This shows that the negation of "IF p, THEN q" is not another IF-THEN statement.

The negation of "IF p, THEN q" is an AND statement, which states that "p is True and q is False," that is, "p AND NOT q."

Therefore, for the statement "If John lives in Austin, then John is bald," its negation is the statement "John lives in Austin, AND John is not bald."

#19 FALSE

Sec 22 #20, c.
The decimal expansion of r is terminating and r is not rational.

20, f. Tom is Ann's father and either Jim is not her uncle or Sue is not her aunt.

20 g. The number n is divisible by 6 and either n is not divisible by 2 OR n is not divisible by 6.

22, c. If r is not rational, then the decimal expansion of r is not terminating.

22, f. If Jim is not Ann's uncle OR Sue is not her aunt, then Tom is not Ann's father.

22 g If n is not divisible by 2 or n is not divisible by 3, then n is not divisible by 6.

23c Converse: If r is rational, then the decimal expansion of r is terminating.

Inverse: If the decimal expansion of r is not terminating, then r is not rational.

23f Converse:
If Jim is Ann's uncle and Sue is her aunt, then Tom is Ann's father.

Inverse: If Tom is not Ann's father, then either Jim is not her uncle OR Sue is not her aunt.

23g

Converse: If n is divisible by 2 and n is divisible by 3, then n is divisible by 6.

Inverse: If n is not divisible by 6, then either n is not divisible by 2 OR n is not divisible by 3.

Sec 2.2, #30 (Not assigned)

p	q	r	q∨r	p∧q	p∧r	p∧(q∨r)	(p∧q)∨(p∧r)	[p∧(q∨r)] ↔ [(p∧q)∨(p∧r)]
T	T	T	T	T	T	T	T	T
T	T	F	T	T	F	T	T	T
T	F	T	T	F	T	T	T	T
T	F	F	F	F	F	F	F	T
F	T	T	T	F	F	F	F	T
F	T	F	T	F	F	F	F	T
F	F	T	T	F	F	F	F	T
F	F	F	F	F	F	F	F	T

#35 "r only if s" means "If NOT s, then not r"

If Sam is not an expert sailor, then he will not be allowed on Signe's racing boat.

If Sam is allowed on Signe's racing boat, then he will have been an expert sailor.

#41 "r is sufficient for s" means "If r, then s."

If this triangle has two 45° angles, then it is a right triangle.

Sec 2.1.2

#43 "r is necessary for s" means "If NOT r, then NOT s!"

If Jim doesn't do homework regularly, then he won't pass the course.

If Jim passes the course, then he will have done homework regularly.

#45 "A necessary condition for t is w" means "If NOT w, then NOT t."

"NOT Producing error messages during translation is a necessary condition for this computer program to be correct."

If this computer program does produce error messages during translation, then this computer program is not correct.

If this computer program is correct, then it does not produce error messages during translation.

Sec 2.2 #46.

Let p = "compound X is boiling".

Let q = "its temperature is at least 150° C."

The statement which is given as TRUE has the form $p \to q$.

Since $p \to q$ is TRUE, any statement with an equivalent form is necessarily TRUE. Thus, since $p \to q \equiv \sim q \to \sim p \equiv \sim p \vee q$, statements with these forms are necessarily TRUE.

Since the conditional $p \to q$ is NOT equivalent to its converse $q \to p$, a statement with the form $q \to p$ is not necessarily TRUE. Similarly, since $q \to p \equiv \sim p \to \sim q \equiv \sim q \vee p$, statements with these forms are not necessarily TRUE.

TRUE FORMS	NOT NECESSARILY TRUE FORMS
$p \to q$	$q \to p$
$\sim q \to \sim p$	$\sim p \to \sim q$
$\sim p \vee q$	$\sim q \vee p$

(#4(b) a), b), c) were not assigned.

FORM	ANALYSIS
a) $q \to p$	NOT NECESSARILY TRUE
b) $\sim q \to \sim p$	TRUE
c) p, only if q $\equiv \sim q \to \sim p$ $\equiv p \to q$	TRUE
d) $\sim p \to \sim q$	NOT NECESSARILY TRUE
e) q is Necessary for p $\equiv \sim q \to \sim p$ $\equiv p \to q$	TRUE
f) q is sufficient for p $\equiv q \to p$	NOT NECESSARILY TRUE