SECTION 2.1

Ex. 2 Recall the definition of a primitive statement. Which statements cannot be broken down into simpler statements?

Ex. 4 When we write $a \to b$, we mean "if a then b", or "b is necessary for a", or "a is sufficient for b".

Ex. 11 We can think of a truth assignment in a truth table as a string of bits, similar to example 1.7

Ex. 12 There is an easier to do this than simply constructing the table. Remember that an implication $S_1 \to S_2$ for statements S_1, S_2, is false only when S_1 is true but S_2 is false. Therefore, the truth assignements of p, q and r are irrelevant.

SECTION 2.2

Ex. 4 The useful rules here are (in order)

(a) Distributive :the left side can be simplified to $(((p \wedge q) \wedge (r \vee \neg r)) \vee \neg q))$ using this rule.

(b) Inverse

(c) Identity

(d) Distributive

(e) Inverse

Ex. 6 (a) Once you've negated the statement and 'pushed' the negation in, the useful rules are -

(i) Associative

(ii) Distributive

(iii) Inverse

(iv) Distributive

(v) Associative

(vi) Inverse

(b)-(c) Remember that $(a \to b) \iff (\neg a \vee b)$

(b) Once you've negated the statement and 'pushed' the negation in, the useful rules are -

(i) Distributive

(ii) Associative

(iii) Inverse (twice)

(iv) Domination (twice)

(v) Identity (twice)

Ex. 8 Use the definition of the dual and the equivalent form of implication. You use the fact that any compound proposition can be transformed to an equivalent proposition using the connectives $\vee, \wedge and \neg$.

Ex. 12 Use a truth table, or notice that $\neg(p \leftrightarrow q) \iff \neg[(p \to q) \wedge (q \to p)] \iff \neg[(\neg p \vee q) \wedge (\neg q \vee p)]$

Ex. 15 The question is asking you to find statements that are equivalent (as far as truth tables go) to the original statements, but that have no symbols other than $\uparrow$. Notice that once you've figured out (a), you can reuse it in other, more complicated statements. To understand nand, we use the definition given: $p \uparrow q \iff \neg(a \wedge b)$. So for example for $\neg p$, we want to construct a statement of the form $? \uparrow ?$ that is equivalent to $\neg p$:

(a)

p	$\neg p$	$? \uparrow ?$
0	1	1
1	0	0

Notice that $p \iff p \wedge p$

(b)

p	q	$p \vee q$	$\neg(p \vee q) \iff \neg p \wedge \neg q$	$? \uparrow ? \iff \neg(? \wedge ?)$
0	0	0	1	
0	1	1	0	
1	0	1	0	
1	1	1	0	

What does $\neg(\neg p \wedge \neg q)$ look like?

(c)

p	q	$p \wedge q$	$\neg(p \wedge q) \iff \neg p \vee \neg q$
0	0	0	1
0	1	0	1
1	0	0	1
1	1	1	0

From part (a) we know how to do $\neg p$ and $\neg q$. From part (b) we now how to do $\neg p \vee \neg q$ and we know how to do $\neg(\neg p \vee \neg q) \iff p \wedge q$

(d) $p \to q \iff \neg p \vee q$

(e) $p \leftrightarrow q \iff (p \to q) \wedge (q \to p)$

Ex. 16 Similar to Exercise 15.