1a. Not, there is no propositional atom in front of '$\leftrightarrow p$'

1b. Yes.

1c. The whole formula is not covered by brackets on either side. It is not.

1d Yes

1e. No. 4, 3, and 5 are not propositional atoms

1f. No. Not covered by brackets on both sides and "implies" is not a connective.

1g. No. There are no brackets

1h. No. $\neg r$ has no brackets around it.

1i. $(\neg(P))$. No. (P) should not have brackets around it.

1j. No. $(\neg\neg T)$. $\neg T$ should be bracketed.

1k. There is no propositional atom inside. this.

1l. Yes.

1m. No propositional atom inside.

1n. No. Because Φ is a meta variable that already has brackets

1b. No. A propositional atom cannot be surrounded by brackets when written alone.

1p. No.

2a. $(p \vee (q \to r))$

$p \vee (q \to r)$

2b. $((p \vee q) \wedge (\neg r))$

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

2c. $(\neg (p \leftrightarrow q))$

$\neg (p \leftrightarrow q)$

2d. $(p \to (\neg (q \to r)))$

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

2e. $(((\neg p) \wedge q) \to r)$

$\neg p \wedge q \to r$

2f. $((\neg (p \wedge q)) \to r)$

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

2g. $\neg \neg p'$

2h. $((\neg p) \wedge (\neg (q \to (s \leftrightarrow (t \vee r)))))$

$\neg p \wedge \neg (q \to (s \leftrightarrow (t \vee r)))$

$\neg p \wedge \neg(q \rightarrow (s \leftrightarrow (t \vee r)))$ This is the answer

3a. $p \vee (q \rightarrow r)$

3b. $(p \vee q) \wedge \neg r$

3f. $\neg(p \wedge q) \rightarrow r$

4a. $(p' \leftrightarrow p) \wedge p''$

$p' \leftrightarrow (p \wedge p'')$

4b. $p_1 \rightarrow \neg p_2 \wedge p_3 \leftrightarrow \neg p$

$(p_1 \rightarrow \neg p_2) \wedge (p_3 \leftrightarrow \neg p)$

$p_1 \rightarrow (\neg p_2 \wedge (p_3 \leftrightarrow \neg p))$

$p_1 \rightarrow ((\neg p_2 \wedge p_3) \leftrightarrow \neg p)$

5.a. $p' \leftrightarrow p \wedge p''$

$(p' \leftrightarrow (p \wedge p''))$

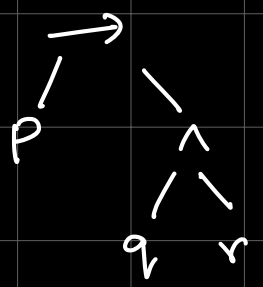
5b. $p_1 \rightarrow \neg p_2 \wedge p_3 \leftrightarrow \neg p$

$(p_1 \rightarrow (\neg p_2) \wedge p_3) \leftrightarrow (\neg p)$

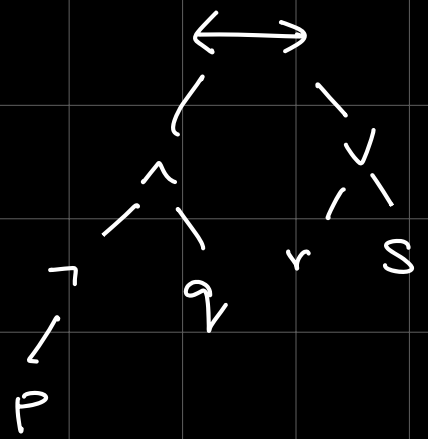
5c. $s \rightarrow \neg\neg s' \vee r$

$S \rightarrow ((\neg(\neg S')) \vee r)$

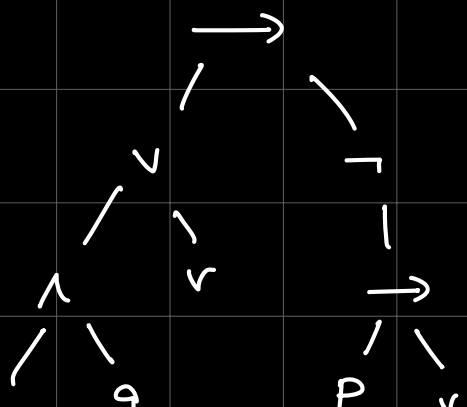
6a. $p \rightarrow q \wedge r$



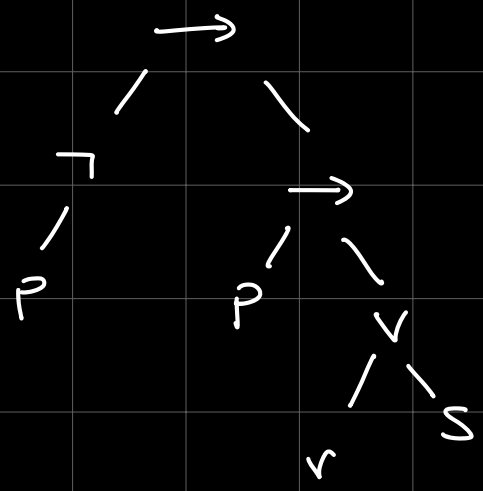
6b. $\neg p \wedge q \leftrightarrow r \vee s$



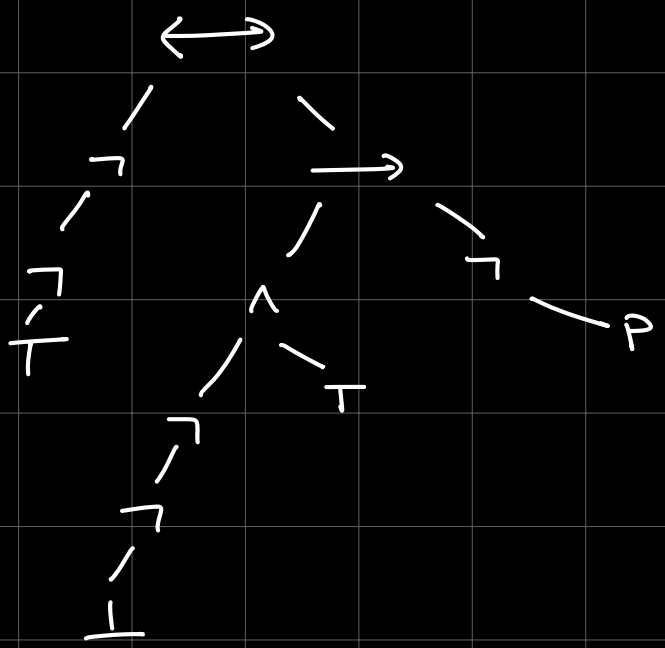
6c. $p \wedge q \vee r \rightarrow \neg(p \rightarrow r)$



6d. $\neg p \rightarrow (p \rightarrow r \vee s)$



6e. $\neg\neg \top \leftrightarrow \neg\neg \bot \wedge \top \rightarrow \neg p$



6f. $\neg\neg\neg\neg\bot$

7a. $\phi \rightarrow \psi$

7b. $\phi \leftrightarrow \psi$

7c. $\phi \rightarrow \psi$

7d. $\phi \rightarrow \psi$

7e. $\phi \leftrightarrow \psi$

7f. ϕ

8a. p, q, r are literals. No clauses.

8b. p, q, r, s are literals.

$r \vee s$ is a clause

8c. p, q, r, p, r are literals.

No clauses

8d. p, p, r, s are literals.

$r \vee s$ is a clause

8e. p is a literal.

No clauses.

8f. No literals.

No clauses.

9. $v(p) = tt$

$v(q) = tt$

$v(s) = ff$.

9a. $|\neg p \vee \neg s|_v = tt$

p	s	$\neg p$	$\neg s$	$\neg p \vee \neg s$
tt	ff	ff	tt	tt

9b $|\neg\neg(p \to q \leftrightarrow p)|_v = tt$

p	q	$p \to q$	$p \to q \leftrightarrow p$	$\neg(p \to q \leftrightarrow p)$	$\neg\neg(p \to q \leftrightarrow p)$
tt	tt	tt	tt	ff	tt

9c $|\neg p \wedge (p \to (q \to p))|_v = ff$

p	q	$\neg p$	$q \to p$	$(p \to (q \to p))$	$\neg p \wedge (p \to (q \to p))$
tt	tt	ff	tt	tt	ff

10a. $p \to p \leftrightarrow q$

p	q	$p \to p$	$(p \to p) \leftrightarrow q$

t	t	t	t
t	f	t	f
f	t	t	t
f	f	t	f

10b. $\neg(p \vee \neg q)$

p	q	$\neg q$	$p \vee \neg q$	$\neg(p \vee \neg q)$
t	t	f	t	f
t	f	t	t	f
f	t	f	f	t
f	f	t	t	f

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