(**3.1**) Let $N = \{(1)\neg P_1 \vee \neg P_2, (2)P_3 \vee P_2 \vee P_4, (3)P_2 \vee \neg P_4, (4)\neg P_3 \vee P_2, (5)P_1 \vee P_2 \vee P_4\}$

$$
\begin{array}{ll}
(\epsilon; N; \emptyset; 0; \top) & \\
\Rightarrow^{\text{Decide}(P_4)}_{\text{CDCL}} & (P_4^1; N; \emptyset; 1; \top) \\
\Rightarrow^{\text{Propagate}(P_2)}_{\text{CDCL}} & (P_4^1 P_2^{(3)}; N; \emptyset; 1; \top) \\
\Rightarrow^{\text{Propagate}(\neg P_1)}_{\text{CDCL}} & (P_4^1 P_2^{(3)} \neg P_1^{(1)}; N; \emptyset; 1; \top) \\
\Rightarrow^{\text{Decide}(P_3)}_{\text{CDCL}} & (P_4^1 P_2^{(3)} \neg P_1^{(1)} P_3^2; N; \emptyset; 2; \top)
\end{array}
$$

All literals from N are assigned and $M \models N$, hence N is satisfiable (M is already a partial model of N in the penultimate step).

(**3.2**) Let $N = \{(1)P_1 \vee P_2 \vee P_3, (2)P_4 \vee P_5 \vee P_6, (3)\neg P_3 \vee P_5, (4)\neg P_1 \vee \neg P_4, (5)\neg P_2 \vee \neg P_5, (6)\neg P_3 \vee \neg P_6, (7)\neg P_6, (8)\neg P_5 \vee P_2\}$

$$
\begin{array}{ll}
(\epsilon; N; \emptyset; 0; \top) & \\
\Rightarrow^{\text{Propagate}(\neg P_6)}_{\text{CDCL}} & (\neg P_6^{(7)}; N; \emptyset; 0; \top) \\
\Rightarrow^{\text{Decide}(\neg P_5)}_{\text{CDCL}} & (\neg P_6^{(7)} \neg P_5^1; N; \emptyset; 1; \top) \\
\Rightarrow^{\text{Propagate}(P_4)}_{\text{CDCL}} & (\neg P_6^{(7)} \neg P_5^1 P_4^{(2)}; N; \emptyset; 1; \top) \\
\Rightarrow^{\text{Propagate}(\neg P_1)}_{\text{CDCL}} & (\neg P_6^{(7)} \neg P_5^1 P_4^{(2)} \neg P_1^{(4)}; N; \emptyset; 1; \top) \\
\Rightarrow^{\text{Propagate}(\neg P_3)}_{\text{CDCL}} & (\neg P_6^{(7)} \neg P_5^1 P_4^{(2)} \neg P_1^{(4)} \neg P_3^{(3)}; N; \emptyset; 1; \top) \\
\Rightarrow^{\text{Propagate}(P_2)}_{\text{CDCL}} & (\neg P_6^{(7)} \neg P_5^1 P_4^{(2)} \neg P_1^{(4)} \neg P_3^{(3)} P_2^{(1)}; N; \emptyset; 1; \top)
\end{array}
$$

All literals from N are assigned and $M \models N$, hence N is satisfiable.

(**3.3**) I only show the first example. Consider the clauses $\neg Q_0 \vee \neg P_2 \vee Q_1, \neg Q_1 \vee Q_2, P_0 \vee Q_0, \neg Q_0 \vee P_1, Q_0 \vee P_1\}$ with ordering $Q_2 \succ P_2 \succ Q_1 \succ P_1 \succ Q_0 \succ P_0$ where maximal literals are marked with *.

D	N_D	δ_D	Comment
$P_0 \vee Q_0^*$	$\emptyset$	$\{Q_0\}$	
$Q_0 \vee P_1^*$	$\{Q_0\}$	$\emptyset$	clause is true
$\neg Q_0 \vee P_1^*$	$\{Q_0\}$	$\{P_1\}$	
$\neg Q_0 \vee \neg P_2^* \vee Q_1$	$\{Q_0, P_1\}$	$\emptyset$	negative literal maximal
$\neg Q_1 \vee Q_2^*$	$\{Q_0, P_1\}$	$\emptyset$	clause is true

(**3.4**) Show unsatisfiability of the below clause set N via the propositional superposition calculus based on the atom ordering $P_1 \succ P_4 \succ P_5 \succ P_2 \succ P_3$

where now maximal literals are marked with *.

(1)	$P_1^* \lor P_2 \lor P_3$	(2)	$\neg P_1^* \lor \neg P_2$	(3)	$\neg P_2^* \lor \neg P_3$
(4)	$\neg P_1^* \lor \neg P_3$	(5)	$P_4 \lor P_5 \lor P_1^*$	(6)	$\neg P_4 \lor P_1^*$
(7)	$\neg P_4^* \lor P_2$	(8)	$\neg P_5^* \lor P_2$	(9)	$\neg P_5^* \lor P_3$
(10)	$\neg P_1^* \lor P_4$				

Initial clause set $N_0 = N$ then incremented index refers to clause set from previous step.

$\Rightarrow_{\text{SUP}}^{(10)\text{SubRes}(5)} \quad N_0 \cup \{(12)\ P_4^* \lor P_5\}$

$\Rightarrow_{\text{SUP}}^{(6)\text{SubRes}(5)} \quad N_1 \cup \{(13)\ P_1^* \lor P_5\}$

$\Rightarrow_{\text{SUP}}^{(13)\text{Sup}(2)} \quad N_2 \cup \{(14)\ \neg P_2^* \lor P_5\}$

$\Rightarrow_{\text{SUP}}^{(12)\text{Sup}(7)} \quad N_3 \cup \{(15)\ P_2^* \lor P_5\}$

$\Rightarrow_{\text{SUP}}^{(14)\text{SubRes}(15)} \quad N_4 \cup \{(16)\ P_5\}$

$\Rightarrow_{\text{SUP}}^{(16)\text{SubRes}(8)} \quad N_5 \cup \{(17)\ P_2\}$

$\Rightarrow_{\text{SUP}}^{(16)\text{SubRes}(9)} \quad N_6 \cup \{(18)\ P_3\}$

$\Rightarrow_{\text{SUP}}^{(17)\text{SubRes}(3)} \quad N_7 \cup \{(19)\ \neg P_3\}$

$\Rightarrow_{\text{SUP}}^{(19)\text{SubRes}(18)} \quad N_8 \cup \{(20)\ \bot\}$

(**3.5**) Consider the folowing CDCL derivation:

$(\epsilon; N; \emptyset; 0; \top)$

$\Rightarrow_{\text{CDCL}}^{\text{Decide}(P_2)} \quad (P_2^1; N; \emptyset; 1; \top)$

$\Rightarrow_{\text{CDCL}}^{\text{Propagate}(P_1)} \quad (P_2^1 P_1^{(2)}; N; \emptyset; 1; \top)$

$\Rightarrow_{\text{CDCL}}^{\text{Conflict}(3)} \quad (P_2^1 P_1^{(2)}; N; \emptyset; 1; \neg P_1 \lor \neg P_2)$

$\Rightarrow_{\text{CDCL}}^{\text{Resolve}(P_1)} \quad (P_2^1; N; \emptyset; 1; \neg P_2)$

$\Rightarrow_{\text{CDCL}}^{\text{Backtrack}} \quad (\neg P_2^{(9)}; N; \{(9)\ \neg P_2\}; 0; \top)$

$\Rightarrow_{\text{CDCL}}^{\text{Restart}} \quad (\epsilon; N; U_1; 0; \top)$

$\Rightarrow_{\text{CDCL}}^{\text{Decide}^*(\neg P_1, \neg P_3)} \quad (\neg P_1^1 \neg P_3^2; N; U_1; 2; \top)$

$\Rightarrow_{\text{CDCL}}^{\text{Propagate}(\neg P_2)} \quad (\neg P_1^1 \neg P_3^2 \neg P_2^{(9)}; N; U_1; 2; \top)$

$\Rightarrow_{\text{CDCL}}^{\text{Conflict}(1)} \quad (\neg P_1^1 \neg P_3^2 \neg P_2^{(9)}; N; U_1; 2; P_1 \lor P_2 \lor P_3)$

$\Rightarrow_{\text{CDCL}}^{\text{Resolve}(P_2)} \quad (\neg P_1^1 \neg P_3^2; N; U_1; 2; P_1 \lor P_3)$

$\Rightarrow_{\text{CDCL}}^{\text{Backtrack}} \quad (\neg P_1^1 P_3^{(10)}; N; U_1 \cup \{(10)\ P_1 \lor P_3\}; 1; \top)$

$U_1 = \{(9)\ \neg P_2\}$