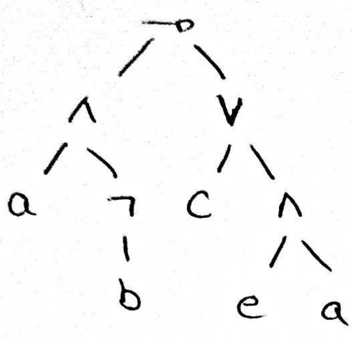
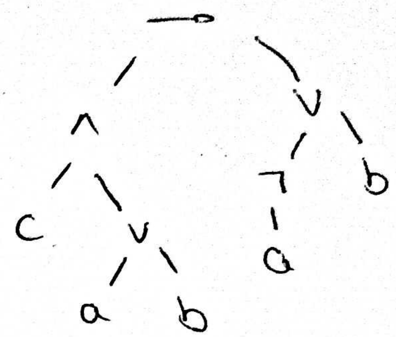
4.2

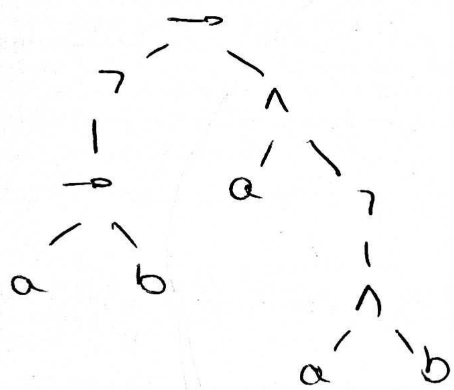
1. $a \wedge \neg b \to c \vee (e \wedge a)$



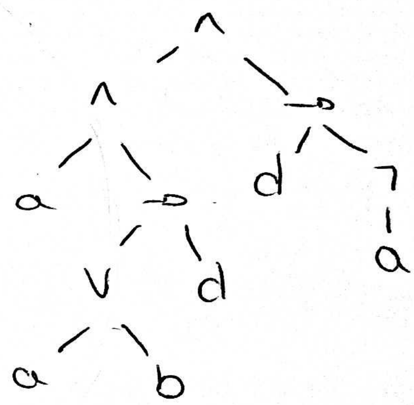
2. $c \wedge (a \vee b) \to \neg a \vee b$



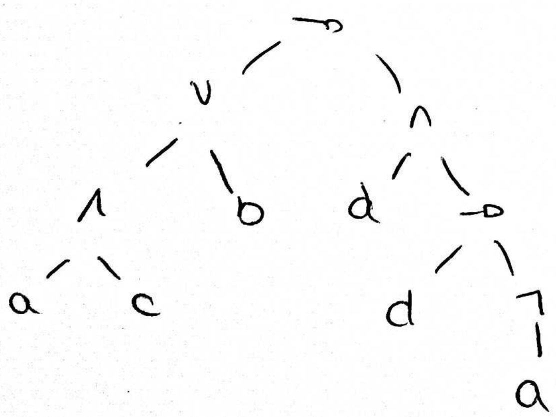
3. $\neg(a \to b) \to a \wedge \neg(a \wedge b)$



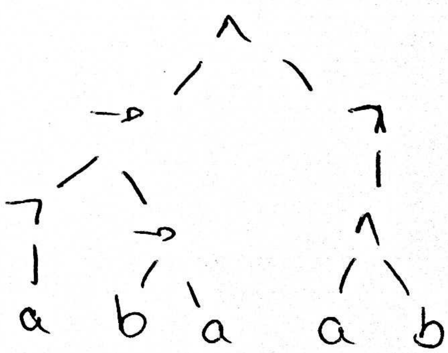
4. $a \wedge (a \vee b \to d) \wedge (d \to \neg a)$



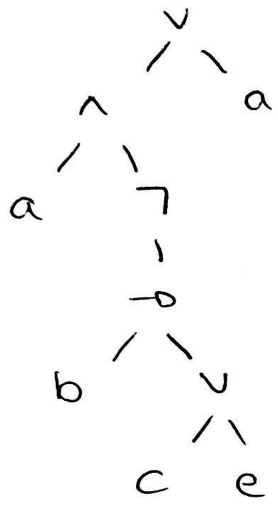
5. $(a \wedge c) \vee b \to d \wedge (d \to \neg a)$



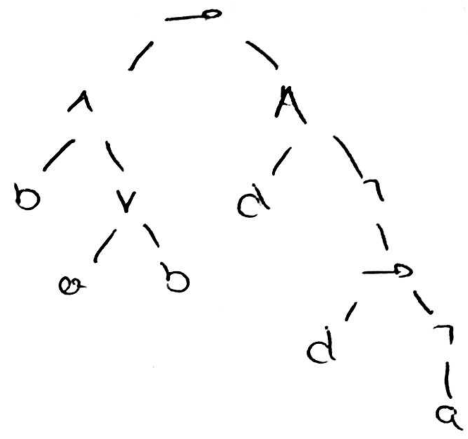
6. $\neg a \to (b \to a) \wedge \neg(a \wedge b)$



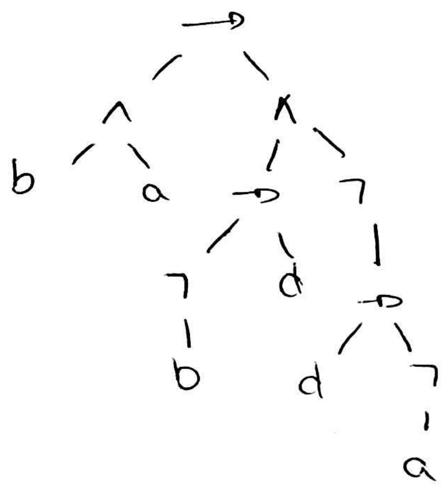
7. $(a \wedge \neg(b \to c \vee e)) \vee a$



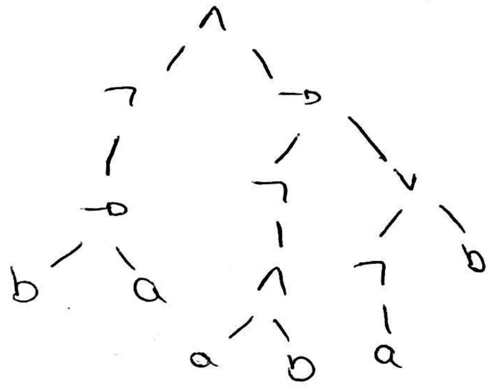
8 $b \wedge (a \vee b) \to d \wedge \neg(d \to \neg a)$



9 $b \wedge a \to (\neg b \to d \wedge \neg(d \to \neg a))$



10. $\neg(b \to a) \wedge \neg(a \wedge b) \to \neg a \vee b$



4.3

① $\alpha \vee \gamma = \alpha + \gamma + \alpha \cdot \gamma = 1 + 0 + 1 \cdot 0 = 1$

② $\alpha \wedge \gamma = \alpha \cdot \gamma = 1 \cdot 0 = 0$

③ $\neg \alpha \wedge \neg \gamma = \neg \alpha \cdot \neg \gamma = 0 \cdot 1 = 0$

④ $\alpha \leftrightarrow \neg \beta \vee \gamma = 1 + \alpha + (\neg \beta \vee \gamma) = 1 + \alpha + (\neg \beta + \gamma + \neg \beta \cdot \gamma) =$

$= 1 + 1 + (0 + 0 + 0 \cdot 0) = 0$

⑤. $\beta \vee \neg\gamma \to \alpha = 1 + \beta \vee \neg\gamma + \beta \vee \neg\gamma \cdot \alpha = 1 + \beta + (1+\gamma) +$
$+ \beta\cdot(1+\gamma) + (\beta + 1 + \gamma + \beta(1+\gamma))\cdot\alpha = 1+1+1+1+0+(1+1+0+1))=$
$= 1$

⑥ $\beta \vee \alpha \to (\beta \to \neg\gamma) = 1 + \beta\vee\alpha + \beta\vee\alpha \cdot (\beta \to \neg\gamma) =$
$= 1 + \beta + \alpha + \beta\cdot\alpha + (\beta + \alpha + \beta + \alpha)((1+\beta) + (\beta)(1+\gamma)) =$
$= 1 + 0 + 1 + 1\cdot(0+1) = 1+1+1 = 1$

⑦ $(\beta \leftrightarrow \neg\alpha) \leftrightarrow (\alpha \leftrightarrow \gamma) = 1 + (\beta \leftrightarrow \neg\alpha) + (\alpha \leftrightarrow \gamma) =$
$= 1 + (1 + (\beta + 1 + \alpha) + (1 + \alpha + \gamma) = 1 + (1+1+1+1) + (1+1+0) =$
$= 1$

⑧ $(\beta \to \alpha) \to ((\alpha \to \neg\gamma) \to (\neg\gamma \to \beta)) =$
$= 1 + (\beta \to \alpha) + (\beta \to \alpha)((\alpha \to \neg\gamma) \to (\neg\gamma \to \beta)) = 1 + (1+\beta+\beta\alpha) +$
$+ (1 + \beta + \beta\cdot\alpha)(1 + (\alpha \to \neg\gamma) + (\alpha \to \neg\gamma)(\neg\gamma \to \beta)) =$
$= 0 + 1(1 + (1 + \alpha + \alpha(1+\gamma)) + (\alpha + (1+\gamma))(1 + \gamma + 1 + (1+\gamma)\cdot\beta)) =$
$= 0 + 1(1 + (1) + 0(1)) = 0$.

4.4

① $\alpha \vee \gamma \to \beta \vee \gamma$

α	β	γ	$\alpha \to \beta$	$\alpha \vee \gamma$	$\beta \vee \gamma$	$\alpha\vee\gamma \to \beta\vee\gamma$
0	0	0	1	0	0	1
0	0	1	1	1	1	1
0	1	0	1	0	1	1
0	1	1	1	1	1	1
1	0	0	0	1	1	1
1	0	1	0	1	1	1
1	1	0	1	1	1	1
1	1	1	1	1	1	1

$\alpha \vee \gamma \to \beta \vee \gamma$ consecuencia de $\alpha \to \beta$

(2) $\alpha \wedge \gamma \rightarrow \beta \wedge \gamma$

α	β	γ	$\alpha \rightarrow \beta$	$\alpha \wedge \gamma$	$\beta \wedge \gamma$	$\alpha \wedge \gamma \rightarrow \beta \wedge \gamma$
0	0	0	1	0	0	1
0	0	1	1	0	0	1
0	1	0	1	0	0	1
0	1	1	1	0	1	1
1	0	0	0	-	-	-
1	0	1	0	-	-	-
1	1	0	1	0	0	1
1	1	1	1	1	1	1

$\alpha \wedge \gamma \rightarrow \beta \wedge \gamma$ consecuencia de $\alpha \rightarrow \beta$

(3) $\neg \alpha \wedge \beta \leftrightarrow \alpha \vee \beta$

α	β	γ	$\alpha \rightarrow \beta$	$\neg \alpha \wedge \beta$	$\neg \alpha$	$\alpha \vee \beta$	$\neg \alpha \wedge \beta \leftrightarrow \alpha \vee \beta$
0	0	0	1	0	1	0	1
0	0	1	1	0	1	0	1
0	1	0	1	1	1	1	1
0	1	1	1	1	1	1	1
1	0	0	0	-	0	-	-
1	0	1	0	-	0	-	-
1	1	0	1	0	0	1	0
1	1	1	1	0	0	1	0

En un mundo en el que $\alpha \rightarrow \beta$ es verdadera no podemos deducir el valor de $\neg \alpha \wedge \beta \leftrightarrow \alpha \vee \beta$

4.5

① $\alpha \wedge \beta$

α	β	$\alpha \wedge \beta$	$\alpha \leftrightarrow \beta$
0	0	0	1
0	1	0	0
1	0	0	0
1	1	1	1

En un mundo en el que $\alpha \leftrightarrow \beta$ es falsa $\alpha \wedge \beta$ también es falsa.

② $\alpha \vee \beta$

α	β	$\alpha \vee \beta$	$\alpha \leftrightarrow$
0	0	0	1
0	1	1	0
1	0	1	0
1	1	0	1

En un mundo en el que $\alpha \leftrightarrow \beta$ es falsa $\alpha \vee \beta$ siempre es verdadera

③ $\alpha \to \beta$

α	β	$\alpha \to \beta$	$\alpha \leftrightarrow \beta$
0	0	1	1
0	1	1	0
1	0	0	0
1	1	1	1

No se puede deducir el valor de $\alpha \to \beta$

④ $\alpha \wedge \gamma \leftrightarrow \beta \wedge \gamma$

α	β	γ	$\alpha \leftrightarrow \beta$	$\alpha \wedge \gamma$	$\beta \wedge \gamma$	$\alpha \wedge \gamma \leftrightarrow \beta \wedge \gamma$
0	0	0	1			
0	0	1	1			
0	1	0	0	0	0	1
0	1	1	0	0	1	0
1	0	0	0	0	0	1
1	0	1	0	1	0	0
1	1	0	1			
1	1	1	1			

1

(4.11) $\Gamma = \{ c \leftrightarrow (a \vee b),\ b \to (c \to a)\ \ d \wedge \neg(c \to a) \}$

a	b	c	d	$a \vee b$	$c \to (a \vee b)$	$c \to a$	$b \to (c \to a)$	$\neg(c \to a)$	$d \wedge \neg(c \to a)$
0	0	0	0	0	1	1	1	0	0
0	0	0	1	0	1	1	1	0	0
0	0	1	0	0	0	0	1	1	0
0	0	1	1	0	0	0	1	1	1
0	1	0	0	1	1	1	1	0	0
0	1	0	1	1	1	1	1	0	0
0	1	1	0	1	1	0	0	1	0
0	1	1	1	1	1	0	0	1	1
1	0	0	0	1	1	1	1	0	0
1	0	0	1	1	1	1	1	0	0
1	0	1	0	1	1	1	1	0	0
1	0	1	1	1	1	1	1	0	0
1	1	0	0	1	1	1	1	0	0
1	1	0	1	1	1	1	1	0	0
1	1	1	0	1	1	1	1	0	0
1	1	1	1	1	1	1	1	0	0

No hay ningún modo en el que los conjuntos sean ciertos $\Rightarrow$ Γ es insatisfacible.