

1	0
$\alpha \wedge \beta$	
α	
β	

1	0
$\alpha \wedge \beta$	
#1: α	
#2: β	

1	0
$\alpha \vee \beta$	
#1: α	
#2: β	

1	0
$\alpha \vee \beta$	
α	
β	

1	0
$\alpha \rightarrow \beta$	
#1: α	
#2: β	

1	0
$\alpha \rightarrow \beta$	
α	β

1	0
$\sim \alpha$	
α	

1	0
$\sim \alpha$	
α	

1	0
$\Box \alpha$	
α	

1	0
$\Diamond \alpha$	

1	0
$\Box \alpha$	

1	0
$\Diamond \alpha$	
α	

\Downarrow (for all)

\Downarrow (there is)

\Downarrow (there is)

\Downarrow (for all)

1	0
α	

1	0
α	

1	0
α	

1	0
α	

+reflexive +transitive

Check whether the following formulas are tautologies of $S4$.

1. $\Box p \vee \Box \sim p$
2. $p \rightarrow \Diamond p$
3. $\Box(p \vee \sim p)$
4. $\Diamond \Box p \rightarrow \Box \Diamond p$
5. $\Box p \rightarrow \Box \Box \Box p$
6. $\Box p \rightarrow \Box \Box \Diamond p$
7. $\Diamond \sim \sim p \rightarrow \Diamond p$

Show that

8. $\Diamond \Diamond p \vdash_{S4} \Diamond p$