

### Exercise 1 (0,5 × 4)

1) e) If  $v$  is a node of arity 2, then one of the following holds:

(i)  $v$  has right-hand label ( $\rightarrow E$ ), and there are formulas  $\phi$  and  $\psi$  such that  $v$  has the left label  $\psi$ , and the left labels on the daughters of  $v$  are, from left to right,  $\phi$  and  $(\phi \rightarrow \psi)$ .

2) (ii)  $v$  has right-hand label ( $\wedge I$ ), and there are formulas  $\phi$  and  $\psi$  such that  $v$  has the left label  $(\phi \wedge \psi)$ , and the left labels on the daughters of  $v$  are, from left to right,  $\phi$  and  $\psi$ .

(iii)  $v$  has right-hand label ( $\neg E$ ), and there is a formula  $\phi$  such that  $v$  has the left label  $\perp$ , and the left labels on the daughters of  $v$  are, from left to right,  $\phi$  and  $(\neg \phi)$ .

(iv)  $v$  has right-hand label ( $\leftrightarrow I$ ), and there are formulas  $\phi$  and  $\psi$  such that  $v$  has the left label  $(\phi \leftrightarrow \psi)$ , and the left labels on the daughters of  $v$  are, from left to right,  $(\phi \rightarrow \psi)$  and  $(\psi \rightarrow \phi)$ .