524 In the program

new $c?$ $int\cdot$ $c?$

(a) add the time spent waiting for input according to the transit time measure.

(b) including the time (from part (a)), rewrite the program without using $?$, and simplify as much as possible.

After trying the question, scroll down to the solution.

(a) add the time spent waiting for input according to the transit time measure.

§ **new** $c?$ *int*$\cdot$ $t := t\uparrow(\mathcal{T}_r + 1).\ c?$

(b) including the time (from part (a)), rewrite the program without using ? , and simplify as much as possible.

§ **new** $c?$ *int*$\cdot$ $t := t\uparrow(\mathcal{T}_r + 1).\ c?$

$=$ $\exists \mathcal{M}, \mathcal{T}, r, r', w, w' \cdot\ r{=}w{=}0\ \wedge\ (t := t\uparrow(\mathcal{T}_r + 1).\ r := r{+}1)$ replace final assignment

$=$ $\exists \mathcal{M}, \mathcal{T}, r, r', w, w' \cdot\ r{=}w{=}0\ \wedge\ (t := t\uparrow(\mathcal{T}_r + 1).\ r'{=}r{+}1 \wedge w'{=}w \wedge t'{=}t)$ substitution law

$=$ $\exists \mathcal{M}, \mathcal{T}, r, r', w, w' \cdot\ r{=}w{=}0\ \wedge\ r'{=}r{+}1 \wedge w'{=}w \wedge t' = t\uparrow(\mathcal{T}_r + 1)$ one-point law twice

$=$ $\exists \mathcal{M}, \mathcal{T}, r', w' \cdot\ r'{=}0{+}1 \wedge w'{=}0 \wedge t' = t\uparrow(\mathcal{T}_0{+}1)$ one-point and unused quantifiers

$=$ $\exists \mathcal{T} \cdot\ t' = t\uparrow(\mathcal{T}_0 + 1)$

$=$ $t' \geq t$