

525 In the program

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

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

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

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

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

substitution law

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

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

= $\exists \mathcal{F} t' = t \uparrow (\mathcal{J}_0 + 1)$

= $t' \geq t$