2.3:

 $\begin{array}{lllll} s_0 = [x \mapsto 17y \mapsto 5] \\ s_1 = [x \mapsto 17, \ y \mapsto 5; y \mapsto 0] \\ s_2 = [x \mapsto 17, \ y \mapsto 5; y \mapsto 1] \\ s_3 = [x \mapsto 12, \ y \mapsto 5; y \mapsto 1] \\ s_4 = [x \mapsto 12, \ y \mapsto 5; y \mapsto 2] \\ s_5 = [x \mapsto 7, \ y \mapsto 5; y \mapsto 2] \\ s_6 = [x \mapsto 7, \ y \mapsto 5; y \mapsto 3] \\ s_7 = [x \mapsto 2, \ y \mapsto 5; y \mapsto 3] \end{array}$   $\begin{array}{lll} b = & y \leq x \\ A = & z := 0; \ B \\ B = & \text{while } b \text{ do } C \\ C = & z := z + 1; \ D \\ D = & x := x - y \end{array}$ 

 $[comp_{ns}] = \begin{bmatrix} [ass_{ns}] \\ \hline [comp_{ns}] \end{bmatrix} \xrightarrow{[ass_{ns}]} \\ \hline [comp_{ns}] = \begin{bmatrix} [ass_{ns}] \\ \hline (z:=z+1, s_1) \rightarrow s_2 \\ \hline (z:=z+1, s_1) \rightarrow s_2 \\ \hline (comp_{ns}] \end{bmatrix} \xrightarrow{[ass_{ns}]} \\ \hline (ass_{ns}] \\ \hline (z:=z+1, s_3) \rightarrow s_4 \\ \hline (comp_{ns}] \xrightarrow{[ass_{ns}]} \\ \hline (comp_{ns}] \xrightarrow{[ass_{ns}]} \\ \hline (z:=z+1, s_3) \rightarrow s_4 \\ \hline (comp_{ns}] \xrightarrow{[ass_{ns}]} \\ \hline (comp_{ns}] \xrightarrow{[ass_{ns}]} \\ \hline (comp_{ns}] \xrightarrow{[ass_{ns}]} \\ \hline (z:=z+1, s_3) \rightarrow s_4 \\ \hline (comp_{ns}] \xrightarrow{[ass_{ns}]} \\ \hline (comp_{ns}] \xrightarrow$ 

2.4: Do the following statements terminate: while  $\neg(x = 1)$  do (y := y \* x; x := x - 1)

 $\begin{array}{lllll} s_0 = [x \mapsto 0y \mapsto 0] & & b & = & \neg(\mathbf{x} = 1) \\ s_1 = [x \mapsto 0, \ y \mapsto 0] & & A & = & \mathbf{while} \ b \ \mathbf{do} \ B \\ s_2 = [x \mapsto -1, \ y \mapsto 0] & & B & = & \mathbf{y} := y * x; \ C \\ s_3 = [x \mapsto -1, \ y \mapsto 0] & & B & = & \mathbf{y} := x + 1 \end{array}$ 

 $[\mathsf{comp}_\mathsf{ns}] = \frac{[\mathsf{ass}_\mathsf{ns}]}{\frac{\langle \mathsf{y} := \mathsf{y} * \mathsf{x}, \ s_0 \rangle \to s_1}{\langle \mathsf{y} := \mathsf{y} * \mathsf{x}, \ s_0 \rangle \to s_2}} = \frac{[\mathsf{ass}_\mathsf{ns}]}{\langle \mathsf{x} := \mathsf{x} - 1, \ s_1 \rangle \to s_2} = \frac{[\mathsf{comp}_\mathsf{ns}]}{\frac{\langle \mathsf{y} := \mathsf{y} * \mathsf{x}, \ s_2 \rangle \to s_3}{\langle \mathsf{y} := \mathsf{y} * \mathsf{x}, \ s_2 \rangle \to s_3}} = \frac{[\mathsf{ass}_\mathsf{ns}]}{\langle \mathsf{x} := \mathsf{x} - 1, \ s_3 \rangle \to s_4}} = \frac{\langle \mathsf{A}, \ s_4 \rangle \to s_7}{\langle \mathsf{A}, \ s_2 \rangle \to s_4} = \frac{\langle \mathsf{A}, \ s_4 \rangle \to s_7}{\langle \mathsf{A}, \ s_2 \rangle \to s_7}} = \mathsf{B}[b]_{s_0} = \mathsf{tt}$