①

$$\{ x = m \land y = n \land 0 \leq n \}$$
$\{I\}$
while $\quad 0 < y$
$\qquad \{I \land 0 < y\} \Rightarrow$
$\qquad \{P_2\}$
$\qquad x := x + 1 ;$
$\qquad \{P_1\}$
$\qquad y := y - 1$
$\qquad \{I\}$
$\{I \land \neg 0 < y\} \Rightarrow$
$\{x = m + n\}$

$\qquad\qquad\qquad x + y = m + n$

$\qquad\qquad\qquad x = m + n - y$

$$I ::= (x = m + n - y) \land 0 \leq y$$

$$P_1 ::= I[y - 1 / y]$$
$$= (x = m + n - (y - 1)) \land (0 \leq y - 1)$$
$$P_2 ::= P_1[x + 1 / x]$$
$$= (x + 1 = m + n - y + 1) \land (0 \leq y - 1)$$

$P = \cancel{x = 0} \quad \text{true}$
$Q = x = 0$

$\{true\}$
$\{true\}$
while $\quad x \neq 0 \quad$ do
$\qquad \{true \land x \neq 0\} \Rightarrow \cdots\cdots$
$\qquad x := x - \cancel{x} \, 0$
$\qquad \{true\}$
$\{true \land x = 0\} \Rightarrow$
$\{x = 0\}$

$\qquad\qquad\qquad\qquad \{true\}$

$\qquad\qquad\qquad\qquad \times 27$

②

$\{x = n \;\wedge\; 0 \le n\}$ ⟹

$\{I[1/y]\}$

$y := 1$

$\{I\}$
while $(0 < x)$ do

$\{I \wedge 0 < x\}$ ⟹
$\{I[y*2/y][x-1/x]\}$

$x := x - 1;$

$\{I[y*2/y]\}$

$y := y * 2$

$\{I\}$

$\{I \wedge 0 \not< x\}$ ⟹

$\{y = 2^n\}$

$I ::= y = 2^n / 2^x \;\wedge\; 0 \le x \wedge y \ge 1$
$ = y = 2^{n-x} \;\wedge\; 0 \le x \wedge y \ge 1$