①

Let $R(x)$ be the relation that holds iff x is the code of a sequence of length n.

$R(x) \Leftrightarrow Seq(x) \wedge lh(x) = n$

$Seq(x)$ which checks if x is a sequence code is a recursive relation.
$lh(x)$ is a recursive total function.
$\wedge$ is recursive.

Case 1

If $x = \langle x_0, \dots, x_{n-1} \rangle$, then $g(x) = f(x_0, \dots, x_{n-1})$. Let $x_i = (x)_i$ (projection function, I forgot the π notation). Define

$$h(x) = f((x)_0, (x)_1, \dots, (x)_{n-1}).$$

Recursive by substitution

Case 2

$g(x) = 0$, let $h(x) = 0$. which is the zero constant function (recursive)

② x in R_0, 0 in R_1, 0 in R_2, ...

$I_0 = J(0,1,4)$

$r_0 = r_1 \Rightarrow I_4$, I_4 DNE $\Rightarrow$ halt

$r_0 \neq r_1 \Rightarrow I_1$

$I_1 = S(1)$, R_1 += 1

$I_2 = S(1)$, R_1 += 1

$I_3 = J(0,0,0)$ (always true, jumps to I_0 always)

If x is even, R_1 will eventually equal x (because of I_1 and I_2 combined. They always add 2).

If x is odd, R_1 will skip over x.

$f_P^{(1)}(x)\downarrow \Leftrightarrow x$ is even

$f_P^{(1)}(x) = x$, when defined. output is in R_0. $S(1)$ only modifies R_1, R_0 is always x throughout the trace

function undefined for odd numbers.