Problem 2.1
Given a program $\mathcal{P}$. Show that $\Phi_{\mathcal{P}}$ is monotonic.

Problem 2.2
Given a program $\mathcal{P}$. Show that if $I \models \text{wc}\mathcal{P}$ then $I \models \mathcal{P}$.
Does the other direction also hold?

Problem 2.3
Given a program $\mathcal{P}$. Show that if $I$ is a fixed point of $\Phi_{\mathcal{P}}$ then $I$ is a model of $\text{wc}\mathcal{P}$.
Does the other direction also hold?

Problem 2.4
Show that the following proposition holds:

**Proposition 19** Let $\mathcal{P}$ be a program, $\ell$ a (total) level mapping for $\mathcal{P}$, $\mathcal{I}$ the set of (three-valued) interpretations for $\mathcal{P}$, and $I, J \in \mathcal{I}$. The function $d_\ell : \mathcal{I} \times \mathcal{I} \rightarrow \mathbb{R}$ defined as

$$d_\ell(I, J) = \begin{cases} (\frac{1}{2})^n & I \neq J \text{ and } I(A) = J(A) \neq U \text{ for all } A \text{ with } \ell(A) < n \text{ and,} \\ 0 & \text{for some } A \text{ with } \ell(A) = n, I(A) \neq J(A) \text{ or } I(A) = J(A) = U \end{cases}$$

is a metric.

Problem 2.5
Show that the deduction theorem is not satisfied under Łukasiewicz and Kleene logic.