

Problem 1

p	q	$(p \rightarrow q)$	$\neg q$	$\neg p$	$(\neg q \rightarrow \neg p)$	$((p \rightarrow q) \leftrightarrow (\neg q \rightarrow \neg p))$
T	T	T	F	F	T	T
T	F	F	T	F	F	T
F	T	T	F	T	T	T
F	F	T	T	T	T	T

Problem 2

Consider the following set of worlds:

$$W_1 = \{r\}$$

$$W_2 = \{\neg r\}$$

In this configuration, in W_1 , both $\Diamond r$ and $\Diamond \neg r$ are true. In W_2 , both $\Diamond r$ and $\Diamond \neg r$ are also true. Thus access restrictions are not necessary.

Problem 3

Yes it is true. $F(b)$ is false according to our model. By the definition of implication, a false antecedent yields a true expression regardless of the value of consequent.

Problem 4

It is not true. For example, let $x = a$ and let $y = b$. As is shown in the model, $G(a, b)$ is false.