DEDUCTIONS

1.   Show that the following propositions are derivable:

   (a) $\neg(\varphi \wedge \neg\psi) \rightarrow (\varphi \rightarrow \psi)$
   (b) $((\varphi \rightarrow \psi) \wedge (\varphi \rightarrow \neg\psi)) \rightarrow \neg\varphi$
   (c) $\neg(\varphi \rightarrow \psi) \rightarrow (\psi \rightarrow \varphi)$
   (d) $\neg(\varphi \rightarrow \psi) \rightarrow (\varphi \rightarrow \neg\psi)$

2.   Show that the following rules are derivable in our deduction system:

$$\frac{\neg\neg\varphi}{\varphi}\ \neg\neg E \qquad\qquad\qquad \frac{\varphi \rightarrow \psi}{\neg\psi \rightarrow \neg\varphi}\ CP$$

3.   Suppose we replaced RAA with $\neg\neg E$ for only atomic formulas. Show that the full $\neg\neg E$ would still be derivable.