

Predicate calculus practice  $\forall E$  and  $\forall I$ .

Derive the following using the predicate calculus. Use any of the rules of propositional logic, as well as  $\forall E$  and  $\forall I$ .

1.  $\forall xFx \vee \exists yGy, \sim\exists yGy \vdash (Fa \ \& \ Fb) \vee P$
2.  $\forall x\forall y( Fxy \vee Fyx) \vdash \forall zFzz$
3.  $\vdash \forall xFx \rightarrow \forall y\forall z(Fy \ \& \ Fz)$
4.  $\forall xFx \vee \forall x\sim Fx \vdash Fa \rightarrow Fb$
5.  $\forall x\forall y( Gyx \rightarrow Gxy) \vdash Gab \leftrightarrow Gba$
6.  $\forall xGx \vee \forall yFy \vdash \forall x\forall y(Gx \vee Fy)$