Pergunta 1

1.6 $\vdash (\varphi \to (\psi \to \gamma)) \to ((\varphi \to \psi) \to (\varphi \to \gamma))$

$$\dfrac{\dfrac{\dfrac{\dfrac{\dfrac{\dfrac{\varphi^{1} \quad (\varphi \to \psi)^{3}}{\psi}\to E \quad \dfrac{(\varphi \to (\psi \to \gamma))^{2} \quad \varphi^{1}}{\psi \to \gamma}\to E}{\gamma}\to I,1}{\varphi \to \gamma}\to I,3}{((\varphi \to \psi) \to (\varphi \to \gamma))}\to I,2}{(\varphi \to (\psi \to \gamma)) \to ((\varphi \to \psi) \to (\varphi \to \gamma))}$$

1.10 $\vdash (\varphi \to \gamma) \to ((\varphi \wedge \psi) \to (\varphi \wedge \gamma))$

$$\dfrac{\dfrac{\dfrac{(\varphi \wedge \psi)^{4}}{\varphi}\wedge E_d \quad \dfrac{(\varphi \to \gamma)^{2} \quad \dfrac{(\varphi \wedge \psi)^{4}}{\psi}\wedge E_e}{\gamma}\to E}{\varphi \wedge \gamma}\to I, 1}{(\varphi \wedge \psi) \to (\varphi \wedge \gamma)}\to I, 2$$

$$(\varphi \to \gamma) \to ((\varphi \wedge \psi) \to (\varphi \wedge \gamma))$$

2.5 $\vdash \bot \to \varphi$

$$\dfrac{\dfrac{\bot^{1}}{\varphi}\,\bot,10}{\bot \to \varphi}\,\to I,1$$

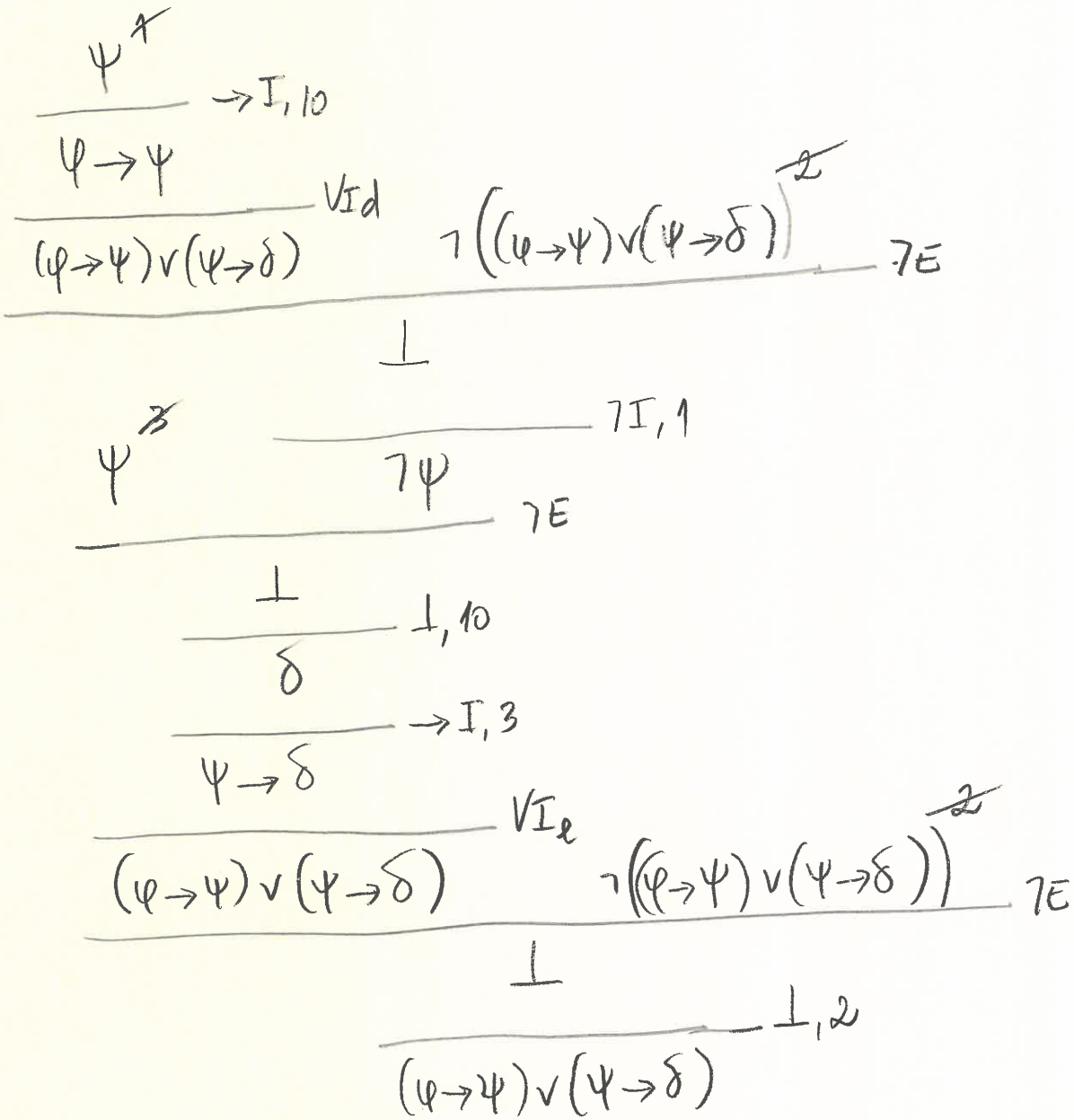
2.6 $\vDash \top$ gnar dizn $\vDash \neg\bot$

$$\dfrac{\dfrac{\bot^{1}}{\neg\bot}\,\neg I,1}{}$$

2.9 $\vDash \varphi \vee (\varphi \to \psi)$

$$\dfrac{\dfrac{\dfrac{\dfrac{\dfrac{\varphi^{1}}{\varphi \vee (\varphi\to\psi)}\,\vee Id \qquad \neg(\varphi\vee(\varphi\to\psi))^{2}}{\bot}\,\neg E}{\neg\varphi}\,\neg I,1 \qquad \varphi^{3}}{\bot}\,\neg E}{\psi}\,\bot,10}{\varphi\to\psi}\,\to I,3}{\varphi\vee(\varphi\to\psi)}\,\vee I,e \qquad \neg(\varphi\vee(\varphi\to\psi))^{2}}{\bot}\,\neg E}{\varphi\vee(\varphi\to\psi)}\,\bot,2$$

2.10 $\vdash (\varphi \to \psi) \vee (\psi \to \delta)$



Pergunta 2

2.8

$$\dfrac{\dfrac{\dfrac{\dfrac{\varphi^{1} \quad \neg\varphi^{2}}{\bot}\,\neg E}{\psi}\,\bot,10}{\varphi \to \psi}\,\to I,4 \qquad \big((\varphi \to \psi) \to \varphi\big)^{3}}{\varphi}\,\to E \qquad \dfrac{\dfrac{\varphi \qquad \neg\varphi^{2}}{\bot}\,\neg E}{\varphi}\,\bot,2}{((\varphi \to \psi) \to \varphi) \to \varphi}\,\to I,3$$