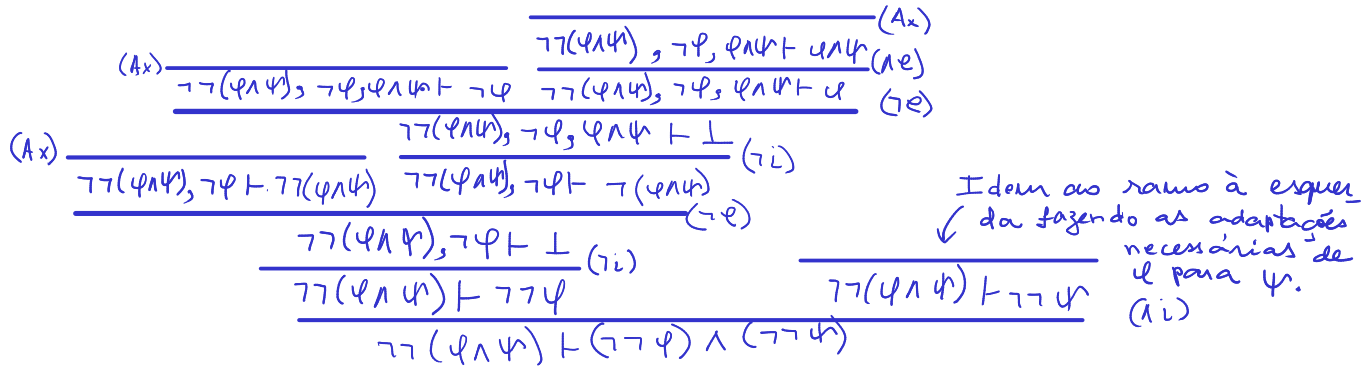
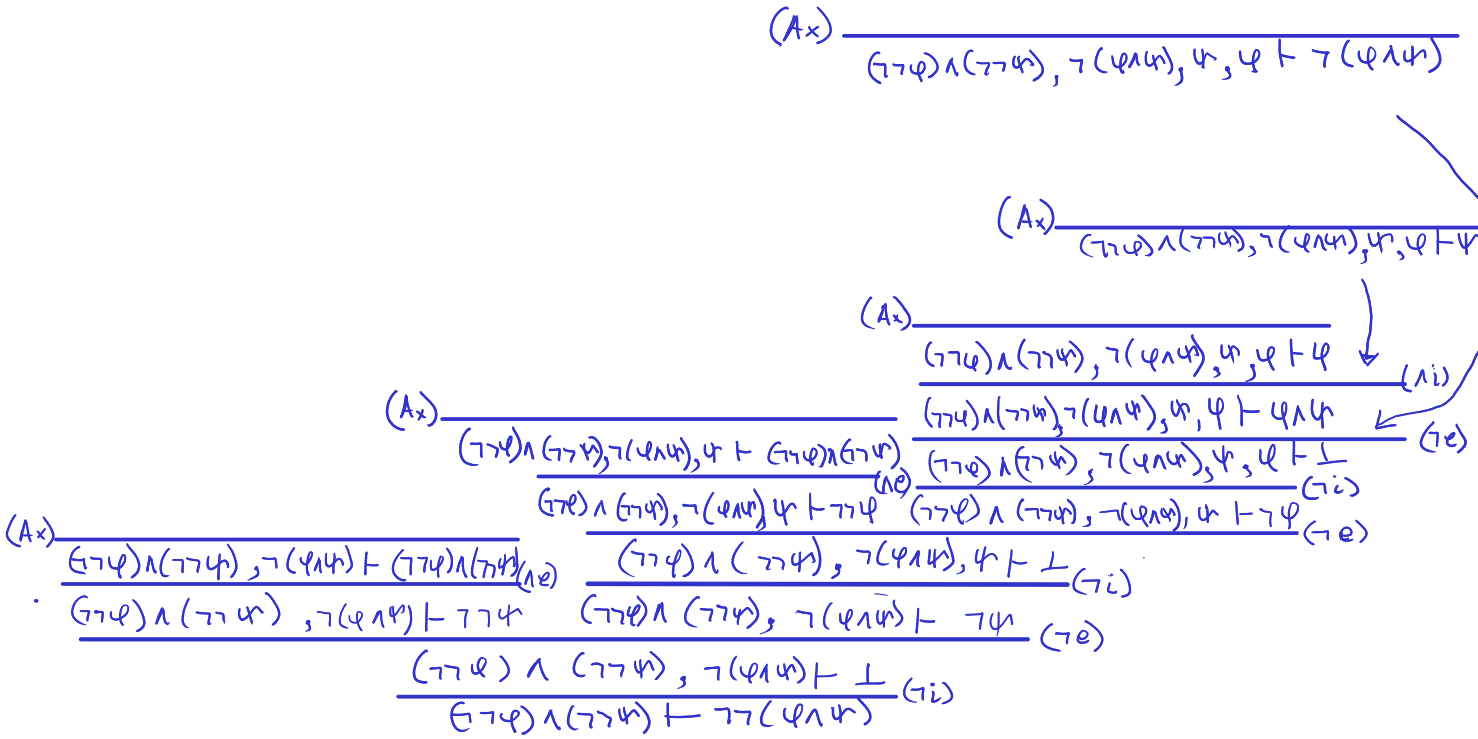
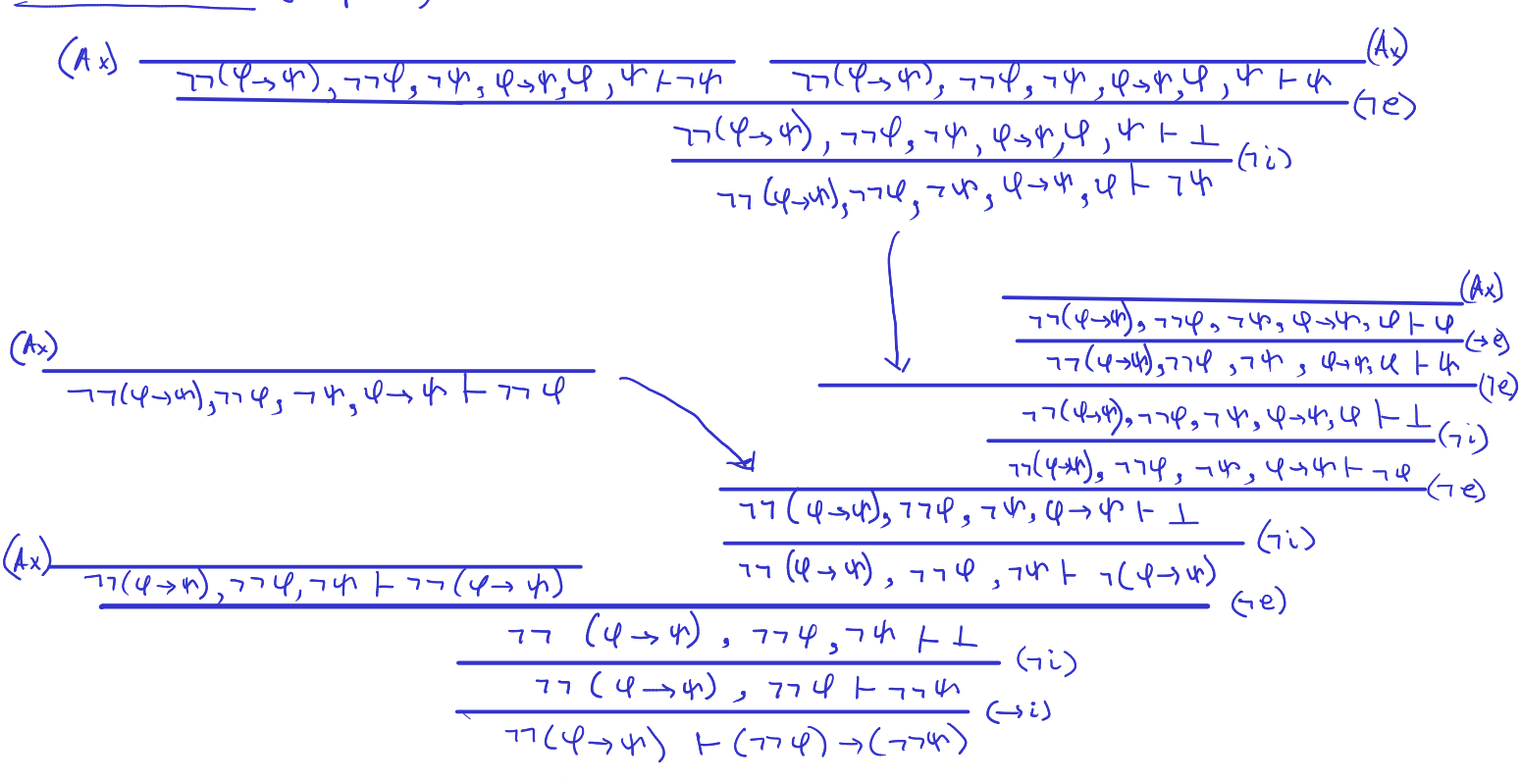
Exercício 17: (1 ponto)



Exercício 18: (1 ponto)



Exercício 19: (1.5 pontos)



Exercício 20: (1.5 pontos)

$$\dfrac{\dfrac{\dfrac{\dfrac{\dfrac{\dfrac{\dfrac{}{\neg(\varphi\vee\neg\varphi),\varphi\vdash\varphi}(Ax)}{\neg(\varphi\vee\neg\varphi),\varphi\vdash\varphi\vee\neg\varphi}(\vee i)}{\neg(\varphi\vee\neg\varphi),\varphi\vdash(\beta\wedge\neg\beta)\wedge\neg\beta}(\neg e)}{\varphi\vdash\neg(\neg(\varphi\vee\neg\varphi),(\beta\wedge\neg\beta))}(\neg i)}{\neg(\varphi\vee\neg\varphi)\vdash\neg\varphi}(\neg i)}{\beta\wedge\neg\beta\vdash\neg(\neg(\varphi\vee\neg\varphi),(\beta\wedge\neg\beta))}(\neg i)}{\neg(\varphi\vee\neg\varphi)\vdash\beta\wedge\neg\beta}(\neg e)}{\top\vdash\neg(\neg(\varphi\vee\neg\varphi),(\beta\wedge\neg\beta))}(\neg i)}{\vdash\neg\neg(\varphi\vee\neg\varphi)}(\neg i)$$

(Ax) $\neg(\varphi\vee\neg\varphi),\varphi\vdash\varphi$ (Ax) $\neg(\varphi\vee\neg\varphi),\varphi\vdash\beta\wedge\neg\beta$ (Ax) $\neg(\varphi\vee\neg\varphi)\vdash\neg(\varphi\vee\neg\varphi)$