The ILTP Library in Intuitionistic Linear Logic

October 14, 2018

Abstract

Here we present the results for the ILLTP-* and KLE-* benchamrks available at `https://github.com/meta-logic/lltp`.

Contents

1 General Information

- Test run on a QEMU Virtual CPU, 2GHz, 64 bits, 6GB of RAM running Ubuntu.

- Timeout: 5min.

- Maude version: 2.7.1 built: Oct 2 2017.

- The search procedure considers proofs using up to 10 times the copy rule (focusing on one of the formulas of the classical context). Since this procedure is not complete, failures cannot be considered as non-provable sequents. For this reason, we reprocessed the problems that returned "failed" with a prover where the copy rule can be used an unboundedly number of times. The sequents marked as **fail** here can be then considered as non-theorems (since the prover explored all the possibilities).

- In some sequents the classical context appear as 'Γ' due to LaTeX constraints on the size of the figures.

2 Translation 0/1

2.1 KLE Problems

file: KLE-01/KLE001+1.p (31 ms)

$$\dfrac{\dfrac{\overline{a:\ \cdot \vdash a}}{\cdot :\ \cdot \vdash !(a) \multimap a}\ \star}{\cdot :\ \cdot \vdash !(!(a) \multimap a)}\ !$$

file: KLE-01/KLE002+1.p (259 ms)

$$\dfrac{\dfrac{\dfrac{\dfrac{\dfrac{\overline{a, !(a) \multimap !(b), !(b) \multimap !(c):\ \cdot \vdash a}}{a, !(a) \multimap !(b), !(b) \multimap !(c):\ \cdot \vdash !(a)}\ !\quad \dfrac{\overline{a, b, !(a) \multimap !(b), !(b) \multimap !(c):\ \cdot \vdash b}}{a, !(a) \multimap !(b), !(b) \multimap !(c):\ !(b) \vdash b}\ \star}{a, !(a) \multimap !(b), !(b) \multimap !(c):\ !(a) \multimap !(b) \vdash b}\ \multimap}{a, !(a) \multimap !(b), !(b) \multimap !(c):\ \cdot \vdash b}\ D_C}{a, !(a) \multimap !(b), !(b) \multimap !(c):\ \cdot \vdash !(b)}\ !\quad \dfrac{\dfrac{\overline{a, c, !(a) \multimap !(b), !(b) \multimap !(c):\ \cdot \vdash c}}{a, !(a) \multimap !(b), !(b) \multimap !(c):\ !(c) \vdash c}\ \star}{a, !(a) \multimap !(b), !(b) \multimap !(c):\ !(b) \multimap !(c) \vdash c}}{a, !(a) \multimap !(b), !(b) \multimap !(c):\ !(b) \multimap !(c) \vdash c}\ \multimap \ D_C}{a, !(a) \multimap !(b), !(b) \multimap !(c):\ \cdot \vdash c}}{!(a) \multimap !(b), !(b) \multimap !(c):\ \cdot \vdash !(a) \multimap c}\ \star}{\dfrac{!(a) \multimap !(b), !(b) \multimap !(c):\ \cdot \vdash !(!(a) \multimap c)}{\cdot :\ !(!(a) \multimap !(b)), !(!(b) \multimap !(c)) \vdash !(!(a) \multimap c)}\ \star}\ !}$$

file: KLE-01/KLE003+1.p (321 ms)

file: KLE-01/KLE004+1.p (279 ms)

file: KLE-01/KLE005+1.p (449 ms)

2

$$\cfrac{\cfrac{\cfrac{\cfrac{\dfrac{a,b,!(!(a\,\&\,b))\multimap!(c):\ \cdot\vdash a \qquad a,b,!(!(a\,\&\,b))\multimap!(c):\ \cdot\vdash b}{a,b,!(!(a\,\&\,b))\multimap!(c):\ \cdot\vdash a\,\&\,b}\ \star}{a,b,!(!(a\,\&\,b))\multimap!(c):\ \cdot\vdash !(a\,\&\,b)}\ !}{a,b,!(!(a\,\&\,b))\multimap!(c):\ \cdot\vdash !(!(a\,\&\,b))}\ ! \qquad \cfrac{\dfrac{a,b,c,!(!(a\,\&\,b))\multimap!(c):\ \cdot\vdash c}{a,b,!(!(a\,\&\,b))\multimap!(c):\ !(c)\vdash c}\ \star}{}\ \multimap}{a,b,!(!(a\,\&\,b))\multimap!(c):\ !(!(a\,\&\,b))\multimap!(c)\vdash c}\ D_C}{\cfrac{\cfrac{\cfrac{\cfrac{a,b,!(!(a\,\&\,b))\multimap!(c):\ \cdot\vdash c}{a,!(!(a\,\&\,b))\multimap!(c):\ \cdot\vdash !(b)\multimap c}\ \star}{a,!(!(a\,\&\,b))\multimap!(c):\ \cdot\vdash !(!(b)\multimap c)}\ !}{!(!(a\,\&\,b))\multimap!(c):\ \cdot\vdash !(a)\multimap!(!(b)\multimap c)}\ \star}{!(!(a\,\&\,b))\multimap!(c):\ \cdot\vdash !(!(a)\multimap!(!(b)\multimap c))}\ !}{\cdot:\ !(!(!(a\,\&\,b))\multimap!(c))\vdash !(!(a)\multimap!(!(b)\multimap c))}\ \star}$$

$$\cfrac{\cfrac{\cfrac{\cfrac{\dfrac{a,!(a)\multimap!(b),!(b)\multimap!(c):\ \cdot\vdash a}{a,!(a)\multimap!(b),!(b)\multimap!(c):\ \cdot\vdash !(a)}\ ! \qquad \cfrac{\dfrac{a,b,!(a)\multimap!(b),!(b)\multimap!(c):\ \cdot\vdash b}{a,!(a)\multimap!(b),!(b)\multimap!(c):\ !(b)\vdash b}\ \star}{}\ \multimap}{a,!(a)\multimap!(b),!(b)\multimap!(c):\ !(a)\multimap!(b)\vdash b}\ D_C}{\dfrac{a,!(a)\multimap!(b),!(b)\multimap!(c):\ \cdot\vdash b}{a,!(a)\multimap!(b),!(b)\multimap!(c):\ \cdot\vdash !(b)}\ !} \qquad \cfrac{\dfrac{a,c,!(a)\multimap!(b),!(b)\multimap!(c):\ \cdot\vdash c}{a,!(a)\multimap!(b),!(b)\multimap!(c):\ !(c)\vdash c}\ \star}{}\ \multimap}{a,!(a)\multimap!(b),!(b)\multimap!(c):\ !(b)\multimap!(c)\vdash c}\ D_C}{\cfrac{\cfrac{\cfrac{\cfrac{a,!(a)\multimap!(b),!(b)\multimap!(c):\ \cdot\vdash c}{!(a)\multimap!(b),!(b)\multimap!(c):\ \cdot\vdash !(a)\multimap c}\ \star}{!(a)\multimap!(b),!(b)\multimap!(c):\ \cdot\vdash !(!(a)\multimap c)}\ !}{!(a)\multimap!(b):\ \cdot\vdash !(!(b)\multimap!(c))\multimap!(!(a)\multimap c)}\ \star}{!(a)\multimap!(b):\ \cdot\vdash !(!(!(b)\multimap!(c))\multimap!(!(a)\multimap c))}\ !}{\cdot:\ !(!(a)\multimap!(b))\vdash !(!(!(b)\multimap!(c))\multimap!(!(a)\multimap c))}\ \star}$$

$$\cfrac{\cfrac{\cfrac{\cfrac{\dfrac{c,!(a)\multimap!(b),!(c)\multimap!(a):\ \cdot\vdash c}{c,!(a)\multimap!(b),!(c)\multimap!(a):\ \cdot\vdash !(c)}\ ! \qquad \cfrac{\dfrac{a,c,!(a)\multimap!(b),!(c)\multimap!(a):\ \cdot\vdash a}{c,!(a)\multimap!(b),!(c)\multimap!(a):\ !(a)\vdash a}\ \star}{}\ \multimap}{c,!(a)\multimap!(b),!(c)\multimap!(a):\ !(c)\multimap!(a)\vdash a}\ D_C}{\dfrac{c,!(a)\multimap!(b),!(c)\multimap!(a):\ \cdot\vdash a}{c,!(a)\multimap!(b),!(c)\multimap!(a):\ \cdot\vdash !(a)}\ !} \qquad \cfrac{\dfrac{b,c,!(a)\multimap!(b),!(c)\multimap!(a):\ \cdot\vdash b}{c,!(a)\multimap!(b),!(c)\multimap!(a):\ !(b)\vdash b}\ \star}{}\ \multimap}{c,!(a)\multimap!(b),!(c)\multimap!(a):\ !(a)\multimap!(b)\vdash b}\ D_C}{\cfrac{\cfrac{\cfrac{\cfrac{c,!(a)\multimap!(b),!(c)\multimap!(a):\ \cdot\vdash b}{!(a)\multimap!(b),!(c)\multimap!(a):\ \cdot\vdash !(c)\multimap b}\ \star}{!(a)\multimap!(b),!(c)\multimap!(a):\ \cdot\vdash !(!(c)\multimap b)}\ !}{!(a)\multimap!(b):\ \cdot\vdash !(!(c)\multimap!(a))\multimap!(!(c)\multimap b)}\ \star}{!(a)\multimap!(b):\ \cdot\vdash !(!(!(c)\multimap!(a))\multimap!(!(c)\multimap b))}\ !}{\cdot:\ !(!(a)\multimap!(b))\vdash !(!(!(c)\multimap!(a))\multimap!(!(c)\multimap b))}\ \star}$$

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      \cfrac{a,c,!(a)\multimap!(b):\ \cdot\vdash a}{a,c,!(a)\multimap!(b):\ \cdot\vdash\,!(a)}\;!
      \qquad
      \cfrac{a,b,c,!(a)\multimap!(b):\ \cdot\vdash b}{a,c,!(a)\multimap!(b):\ !(b)\vdash b}\;\star
    }{
      \cfrac{a,c,!(a)\multimap!(b):\ !(a)\multimap!(b)\vdash b}{a,c,!(a)\multimap!(b):\ \cdot\vdash b}\;D_C
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    \cfrac{a,c,!(a)\multimap!(b):\ \cdot\vdash b\,\&\,c}{
      \cfrac{a,c,!(a)\multimap!(b):\ \cdot\vdash\,!(b\,\&\,c)}{
        \cfrac{!(a)\multimap!(b):\ \cdot\vdash\,!(!(a)\,\&\,!(c))\multimap!(b\,\&\,c)}{
          \cfrac{!(a)\multimap!(b):\ \cdot\vdash\,!(!(!(a)\,\&\,!(c))\multimap!(b\,\&\,c))}{\cdot:\ !(!(a)\multimap!(b))\vdash\,!(!(!(a)\,\&\,!(c))\multimap!(b\,\&\,c))}\;\star
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file: KLE-01/KLE009+1.p (228 ms)

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    \cfrac{a,c,!(a)\multimap!(b):\ \cdot\vdash a}{a,c,!(a)\multimap!(b):\ \cdot\vdash\,!(a)}\;!
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    \cfrac{
      \cfrac{a,b,c,!(a)\multimap!(b):\ \cdot\vdash c \qquad a,b,c,!(a)\multimap!(b):\ \cdot\vdash b}{a,b,c,!(a)\multimap!(b):\ \cdot\vdash c\,\&\,b}\;\star
    }{
      \cfrac{a,b,c,!(a)\multimap!(b):\ \cdot\vdash\,!(c\,\&\,b)}{a,c,!(a)\multimap!(b):\ !(b)\vdash\,!(c\,\&\,b)}\;\star
    }\;!
  }{
    \cfrac{a,c,!(a)\multimap!(b):\ !(a)\multimap!(b)\vdash\,!(c\,\&\,b)}{
      \cfrac{a,c,!(a)\multimap!(b):\ \cdot\vdash\,!(c\,\&\,b)}{
        \cfrac{!(a)\multimap!(b):\ \cdot\vdash\,!(!(c)\,\&\,!(a))\multimap!(c\,\&\,b)}{
          \cfrac{!(a)\multimap!(b):\ \cdot\vdash\,!(!(!(c)\,\&\,!(a))\multimap!(c\,\&\,b))}{\cdot:\ !(!(a)\multimap!(b))\vdash\,!(!(!(c)\,\&\,!(a))\multimap!(c\,\&\,b))}\;\star
        }\;!
      }\;\star
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file: KLE-01/KLE010+1.p (451 ms)

file: KLE-01/KLE011+1.p (301 ms)

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    \cfrac{c,!(c)\oplus!(a),!(a)\multimap!(b):\ \cdot\vdash c}{c,!(c)\oplus!(a),!(a)\multimap!(b):\ \cdot\vdash\,!(c)}\;!
  }{c,!(c)\oplus!(a),!(a)\multimap!(b):\ \cdot\vdash\,!(c)\oplus!(b)}\;\oplus_1
  \qquad
  \cfrac{
    \cfrac{a,!(c)\oplus!(a),!(a)\multimap!(b):\ \cdot\vdash a}{a,!(c)\oplus!(a),!(a)\multimap!(b):\ \cdot\vdash\,!(a)}\;!
    \qquad
    \cfrac{
      \cfrac{a,b,!(c)\oplus!(a),!(a)\multimap!(b):\ \cdot\vdash b}{a,b,!(c)\oplus!(a),!(a)\multimap!(b):\ \cdot\vdash\,!(b)}\;!
    }{
      \cfrac{a,b,!(c)\oplus!(a),!(a)\multimap!(b):\ \cdot\vdash\,!(c)\oplus!(b)}{a,!(c)\oplus!(a),!(a)\multimap!(b):\ !(b)\vdash\,!(c)\oplus!(b)}\;\star
    }\;\oplus_1
  }{
    \cfrac{a,!(c)\oplus!(a),!(a)\multimap!(b):\ !(a)\multimap!(b)\vdash\,!(c)\oplus!(b)}{a,!(c)\oplus!(a),!(a)\multimap!(b):\ \cdot\vdash\,!(c)\oplus!(b)}\;D_C
  }\;\multimap
}{
  \cfrac{!(c)\oplus!(a),!(a)\multimap!(b):\ !(c)\oplus!(a)\vdash\,!(c)\oplus!(b)}{
    \cfrac{!(c)\oplus!(a),!(a)\multimap!(b):\ \cdot\vdash\,!(c)\oplus!(b)}{
      \cfrac{!(a)\multimap!(b):\ \cdot\vdash\,!(!(c)\oplus!(a))\multimap!(c)\oplus!(b)}{
        \cfrac{!(a)\multimap!(b):\ \cdot\vdash\,!(!(!(c)\oplus!(a))\multimap!(c)\oplus!(b))}{\cdot:\ !(!(a)\multimap!(b))\vdash\,!(!(!(c)\oplus!(a))\multimap!(c)\oplus!(b))}\;\star
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            }{a, !(a) \multimap !(\mathbf{0}) : \ \cdot \vdash !(a)} \ !
            \qquad
            \cfrac{\ }{a, !(a) \multimap !(\mathbf{0}) : \ !(\mathbf{0}) \vdash b}
          }{a, !(a) \multimap !(\mathbf{0}) : \ !(a) \multimap !(\mathbf{0}) \vdash b} \ \star \multimap
        }{a, !(a) \multimap !(\mathbf{0}) : \ \cdot \vdash b} \ D_C
      }{!(a) \multimap !(\mathbf{0}) : \ \cdot \vdash !(a) \multimap b} \ \star
    }{!(a) \multimap !(\mathbf{0}) : \ \cdot \vdash !(!(a) \multimap b)} \ !
  }{\cdot : \ !(!(a) \multimap !(\mathbf{0})) \vdash !(!(a) \multimap b)} \ \star
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      \cfrac{\ }{a, b : \ \cdot \vdash b}
    }{b : \ \cdot \vdash !(a) \multimap b} \ \star
  }{b : \ \cdot \vdash !(!(a) \multimap b)} \ !
}{\cdot : \ !(b) \vdash !(!(a) \multimap b)} \ \star
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          \cfrac{\dfrac{a, b, !(a) \multimap !(!(b) \multimap !(\mathbf{0})) : \ \cdot \vdash a}{a, b, !(a) \multimap !(!(b) \multimap !(\mathbf{0})) : \ \cdot \vdash !(a)} \ !
          \qquad
          \dfrac{\cfrac{\cfrac{a, b, !(a) \multimap !(!(b) \multimap !(\mathbf{0})), !(b) \multimap !(\mathbf{0}) : \ \cdot \vdash b}{a, b, !(a) \multimap !(!(b) \multimap !(\mathbf{0})), !(b) \multimap !(\mathbf{0}) : \ \cdot \vdash !(b)} \ ! \quad a, b, !(a) \multimap !(!(b) \multimap !(\mathbf{0})), !(b) \multimap !(\mathbf{0}) : \ !(\mathbf{0}) \vdash \mathbf{0}}{a, b, !(a) \multimap !(!(b) \multimap !(\mathbf{0})), !(b) \multimap !(\mathbf{0}) : \ !(b) \multimap !(\mathbf{0}) \vdash \mathbf{0}} \ \star \multimap}{\cfrac{a, b, !(a) \multimap !(!(b) \multimap !(\mathbf{0})), !(b) \multimap !(\mathbf{0}) : \ \cdot \vdash \mathbf{0}}{a, b, !(a) \multimap !(!(b) \multimap !(\mathbf{0})) : \ !(!(b) \multimap !(\mathbf{0})) \vdash \mathbf{0}} \ \star} \ D_C}
        }{a, b, !(a) \multimap !(!(b) \multimap !(\mathbf{0})) : \ !(a) \multimap !(!(b) \multimap !(\mathbf{0})) \vdash \mathbf{0}} \ \multimap
      }{a, b, !(a) \multimap !(!(b) \multimap !(\mathbf{0})) : \ \cdot \vdash \mathbf{0}} \ D_C
    }{b, !(a) \multimap !(!(b) \multimap !(\mathbf{0})) : \ \cdot \vdash !(a) \multimap \mathbf{0}} \ \star
  }{b, !(a) \multimap !(!(b) \multimap !(\mathbf{0})) : \ \cdot \vdash !(!(a) \multimap \mathbf{0})} \ !
}{!(a) \multimap !(!(b) \multimap !(\mathbf{0})) : \ \cdot \vdash !(b) \multimap !(!(a) \multimap \mathbf{0})} \ \star
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\cfrac{!(a) \multimap !(!(b) \multimap !(\mathbf{0})) : \ \cdot \vdash !(!(b) \multimap !(!(a) \multimap \mathbf{0}))}{\cdot : \ !(!(a) \multimap !(!(b) \multimap !(\mathbf{0}))) \vdash !(!(b) \multimap !(!(a) \multimap \mathbf{0}))} \ \star
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        \cfrac{\dfrac{a, !(a) \multimap !(b), !(b) \multimap !(a) : \ \cdot \vdash a}{a, !(a) \multimap !(b), !(b) \multimap !(a) : \ \cdot \vdash !(a)} \ ! \quad \cfrac{\dfrac{a, b, !(a) \multimap !(b), !(b) \multimap !(a) : \ \cdot \vdash b}{a, !(a) \multimap !(b), !(b) \multimap !(a) : \ !(b) \vdash b} \ \star}{}}{a, !(a) \multimap !(b), !(b) \multimap !(a) : \ !(a) \multimap !(b) \vdash b} \ \multimap
      }{a, !(a) \multimap !(b), !(b) \multimap !(a) : \ \cdot \vdash b} \ D_C
    }{!(a) \multimap !(b), !(b) \multimap !(a) : \ \cdot \vdash !(a) \multimap b} \ \star
  }{!(a) \multimap !(b), !(b) \multimap !(a) : \ \cdot \vdash !(!(a) \multimap b)} \ !
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    \cfrac{\dfrac{b, !(a) \multimap !(b), !(b) \multimap !(a) : \ \cdot \vdash b}{b, !(a) \multimap !(b), !(b) \multimap !(a) : \ \cdot \vdash !(b)} \ ! \quad \dfrac{a, b, !(a) \multimap !(b), !(b) \multimap !(a) : \ \cdot \vdash a}{b, !(a) \multimap !(b), !(b) \multimap !(a) : \ !(a) \vdash a}}{\cfrac{b, !(a) \multimap !(b), !(b) \multimap !(a) : \ !(b) \multimap !(a) \vdash a}{\cfrac{b, !(a) \multimap !(b), !(b) \multimap !(a) : \ \cdot \vdash a}{!(a) \multimap !(b), !(b) \multimap !(a) : \ \cdot \vdash !(b) \multimap a} \ \star} \ D_C} \ \multimap}
  }{!(a) \multimap !(b), !(b) \multimap !(a) : \ \cdot \vdash !(!(b) \multimap a)} \ !
}{!(a) \multimap !(b), !(b) \multimap !(a) : \ \cdot \vdash !(!(a) \multimap b) \ \& \ !(!(b) \multimap a)} \ \star
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\cfrac{!(a) \multimap !(b), !(b) \multimap !(a) : \ \cdot \vdash !(!(!(a) \multimap b) \ \& \ !(!(b) \multimap a))}{\cdot : \ !(!(a) \multimap !(b)), !(!(b) \multimap !(a)) \vdash !(!(!(a) \multimap b) \ \& \ !(!(b) \multimap a))} \ \star
$$

$$\cfrac{\cfrac{\overline{a, !(a) \multimap !(b), !(b) \multimap !(a) : \; \cdot \vdash a}}{a, !(a) \multimap !(b), !(b) \multimap !(a) : \; \cdot \vdash !(a)} \; ! \quad \cfrac{\overline{a, b, !(a) \multimap !(b), !(b) \multimap !(a) : \; \cdot \vdash b}}{a, !(a) \multimap !(b), !(b) \multimap !(a) : \; !(b) \vdash b} \; \star}{\cfrac{\cfrac{a, !(a) \multimap !(b), !(b) \multimap !(a) : \; !(a) \multimap !(b) \vdash b}{a, !(a) \multimap !(b), !(b) \multimap !(a) : \; \cdot \vdash b} \; D_C}{\cfrac{\cfrac{!(a) \multimap !(b), !(b) \multimap !(a) : \; \cdot \vdash !(a) \multimap b}{!(a) \multimap !(b), !(b) \multimap !(a) : \; \cdot \vdash !(!(a) \multimap b)} \; !}{\cdot : \; !(!(!(a) \multimap !(b)) \,\&\, !(!(b) \multimap !(a))) \vdash !(!(a) \multimap b)} \; \star} \; \star}} \; \multimap$$

$$\cfrac{\cfrac{\overline{b, !(a) \multimap !(b), !(b) \multimap !(a) : \; \cdot \vdash b}}{b, !(a) \multimap !(b), !(b) \multimap !(a) : \; \cdot \vdash !(b)} \; ! \quad \cfrac{\overline{a, b, !(a) \multimap !(b), !(b) \multimap !(a) : \; \cdot \vdash a}}{b, !(a) \multimap !(b), !(b) \multimap !(a) : \; !(a) \vdash a} \; \star}{\cfrac{\cfrac{b, !(a) \multimap !(b), !(b) \multimap !(a) : \; !(b) \multimap !(a) \vdash a}{b, !(a) \multimap !(b), !(b) \multimap !(a) : \; \cdot \vdash a} \; D_C}{\cfrac{\cfrac{!(a) \multimap !(b), !(b) \multimap !(a) : \; \cdot \vdash !(b) \multimap a}{!(a) \multimap !(b), !(b) \multimap !(a) : \; \cdot \vdash !(!(b) \multimap a)} \; !}{\cdot : \; !(!(!(a) \multimap !(b)) \,\&\, !(!(b) \multimap !(a))) \vdash !(!(b) \multimap a)} \; \star} \; \star}} \; \multimap$$

$$\cfrac{\cfrac{\overline{a, !(a) \multimap !(b), !(b) \multimap !(a) : \; \cdot \vdash a}}{a, !(a) \multimap !(b), !(b) \multimap !(a) : \; \cdot \vdash !(a)} \; ! \quad \cfrac{\overline{a, b, !(a) \multimap !(b), !(b) \multimap !(a) : \; \cdot \vdash b}}{a, !(a) \multimap !(b), !(b) \multimap !(a) : \; !(b) \vdash b} \; \star}{\cfrac{\cfrac{a, !(a) \multimap !(b), !(b) \multimap !(a) : \; !(a) \multimap !(b) \vdash b}{a, !(a) \multimap !(b), !(b) \multimap !(a) : \; \cdot \vdash b} \; D_C}{\cdot : \; !(a), !(!(!(a) \multimap !(b)) \,\&\, !(!(b) \multimap !(a))) \vdash b} \; \star}} \; \multimap$$

$$\cfrac{\cfrac{\overline{b, !(a) \multimap !(b), !(b) \multimap !(a) : \; \cdot \vdash b}}{b, !(a) \multimap !(b), !(b) \multimap !(a) : \; \cdot \vdash !(b)} \; ! \quad \cfrac{\overline{a, b, !(a) \multimap !(b), !(b) \multimap !(a) : \; \cdot \vdash a}}{b, !(a) \multimap !(b), !(b) \multimap !(a) : \; !(a) \vdash a} \; \star}{\cfrac{\cfrac{b, !(a) \multimap !(b), !(b) \multimap !(a) : \; !(b) \multimap !(a) \vdash a}{b, !(a) \multimap !(b), !(b) \multimap !(a) : \; \cdot \vdash a} \; D_C}{\cdot : \; !(b), !(!(!(a) \multimap !(b)) \,\&\, !(!(b) \multimap !(a))) \vdash a} \; \star}} \; \multimap$$

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$$\cfrac{\cfrac{\cfrac{\cfrac{\overline{a: \ \cdot \vdash a}}{\cdot: \ \cdot \vdash !(a) \multimap a} \ \star}{\cdot: \ \cdot \vdash !(!(a) \multimap a)} \ ! \qquad \cfrac{\cfrac{\overline{a: \ \cdot \vdash a}}{\cdot: \ \cdot \vdash !(a) \multimap a} \ \star}{\cdot: \ \cdot \vdash !(!(a) \multimap a)} \ !}{\cdot: \ \cdot \vdash !(!(a) \multimap a) \ \& \ !(!(a) \multimap a)} \ \star}{\cdot: \ \cdot \vdash !(!(!(a) \multimap a) \ \& \ !(!(a) \multimap a))} \ !$$

file: KLE-01/KLE025+1.p (310 ms)

$$\cfrac{\cfrac{\cfrac{\cfrac{\cfrac{\overline{b, !(a) \multimap !(b), !(b) \multimap !(a): \ \cdot \vdash b}}{b, !(a) \multimap !(b), !(b) \multimap !(a): \ \cdot \vdash !(b)} \ ! \quad \cfrac{\overline{a, b, !(a) \multimap !(b), !(b) \multimap !(a): \ \cdot \vdash a}}{b, !(a) \multimap !(b), !(b) \multimap !(a): \ !(a) \vdash a} \ \star}{b, !(a) \multimap !(b), !(b) \multimap !(a): \ !(b) \multimap !(a) \vdash a} \ \multimap}{b, !(a) \multimap !(b), !(b) \multimap !(a): \ \cdot \vdash a} \ D_C}{\cfrac{!(a) \multimap !(b), !(b) \multimap !(a): \ \cdot \vdash !(b) \multimap a}{!(a) \multimap !(b), !(b) \multimap !(a): \ \cdot \vdash !(!(b) \multimap a)} \ !} \ \star \qquad \cfrac{\cfrac{\cfrac{\overline{a, !(a) \multimap !(b), !(b) \multimap !(a): \ \cdot \vdash a}}{a, !(a) \multimap !(b), !(b) \multimap !(a): \ \cdot \vdash !(a)} \ ! \quad \cfrac{\overline{a, b, !(a) \multimap !(b), !(b) \multimap !(a): \ \cdot \vdash b}}{a, !(a) \multimap !(b), !(b) \multimap !(a): \ !(b) \vdash b} \ \star}{a, !(a) \multimap !(b), !(b) \multimap !(a): \ !(a) \multimap !(b) \vdash b} \ \multimap}{a, !(a) \multimap !(b), !(b) \multimap !(a): \ \cdot \vdash b} \ D_C}{\cfrac{!(a) \multimap !(b), !(b) \multimap !(a): \ \cdot \vdash !(a) \multimap b}{!(a) \multimap !(b), !(b) \multimap !(a): \ \cdot \vdash !(!(a) \multimap b)} \ !} \ \star}{!(a) \multimap !(b), !(b) \multimap !(a): \ \cdot \vdash !(!(b) \multimap a) \ \& \ !(!(a) \multimap b)} \ \star}{!(a) \multimap !(b), !(b) \multimap !(a): \ \cdot \vdash !(!(!(b) \multimap a) \ \& \ !(!(a) \multimap b))} \ !}{\cdot: \ !(!(!(a) \multimap !(b)) \ \& \ !(!(b) \multimap !(a))) \vdash !(!(!(b) \multimap a) \ \& \ !(!(a) \multimap b))} \ \star$$

file: KLE-01/KLE026+1.p (612 ms)

file: KLE-01/KLE027+1.p (4199 ms)

file: KLE-01/KLE028+1.p (470 ms)

file: KLE-01/KLE029+1.p (687 ms)

file: KLE-01/KLE030+1.p (2903 ms)

file: KLE-01/KLE031+1.p (18722 ms)

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file: KLE-01/KLE032+1.p (416 ms)

file: KLE-01/KLE033+1.p (832 ms)

file: KLE-01/KLE034+1.p (382 ms)

file: KLE-01/KLE035+1.p (362 ms)

file: KLE-01/KLE036+1.p (3447 ms)

file: KLE-01/KLE037+1.p (674 ms)

file: KLE-01/KLE038+1.p (1781 ms)

$$\cfrac{\cfrac{\cfrac{a,b,c:\ \cdot\vdash a \quad \cfrac{\cfrac{\cfrac{a,b,c:\ \cdot\vdash b \quad a,b,c:\ \cdot\vdash c}{a,b,c:\ \cdot\vdash b\,\&\,c}\star}{a,b,c:\ \cdot\vdash !(b\,\&\,c)}!}{a,b,c:\ \cdot\vdash a\,\&\,!(b\,\&\,c)}}{a,b,c:\ \cdot\vdash !(a\,\&\,!(b\,\&\,c))}! \quad \cfrac{\cfrac{\cfrac{\cfrac{a,b,c:\ \cdot\vdash a \quad a,b,c:\ \cdot\vdash b}{a,b,c:\ \cdot\vdash a\,\&\,b}\star}{a,b,c:\ \cdot\vdash !(a\,\&\,b)}! \quad a,b,c:\ \cdot\vdash c}{a,b,c:\ \cdot\vdash !(a\,\&\,b)\,\&\,c}\star}{a,b,c:\ \cdot\vdash !(!(a\,\&\,b)\,\&\,c)}!}{}}$$

$$\cfrac{\cfrac{\cfrac{\cdot:\ \cdot\vdash !(!(!(!(a)\,\&\,!(b))\,\&\,!(c))\multimap !(a\,\&\,!(b\,\&\,c)))}{\cdot:\ \cdot\vdash !(!(!(!(!(a)\,\&\,!(b))\,\&\,!(c))\multimap !(a\,\&\,!(b\,\&\,c))))}! \quad \cfrac{\cdot:\ \cdot\vdash !(!(!(a)\,\&\,!(!(b)\,\&\,!(c)))\multimap !(!(a\,\&\,b)\,\&\,c))}{\cdot:\ \cdot\vdash !(!(!(!(a)\,\&\,!(!(b)\,\&\,!(c)))\multimap !(!(a\,\&\,b)\,\&\,c)))}!}{\cdot:\ \cdot\vdash !(!(!(!(!(a)\,\&\,!(b))\,\&\,!(c))\multimap !(a\,\&\,!(b\,\&\,c)))\,\&\,!(!(!(!(a)\,\&\,!(!(b)\,\&\,!(c)))\multimap !(!(a\,\&\,b)\,\&\,c))))}\star}{\cdot:\ \cdot\vdash !(!(!(!(!(!(a)\,\&\,!(b))\,\&\,!(c))\multimap !(a\,\&\,!(b\,\&\,c)))\,\&\,!(!(!(!(a)\,\&\,!(!(b)\,\&\,!(c)))\multimap !(!(a\,\&\,b)\,\&\,c))))}!}$$

$$\cfrac{\cfrac{\cfrac{\cfrac{a,b:\ \cdot\vdash b \quad a,b:\ \cdot\vdash a}{a,b:\ \cdot\vdash b\,\&\,a}\star}{a,b:\ \cdot\vdash !(b\,\&\,a)}!}{\cdot:\ \cdot\vdash !(!(a)\,\&\,!(b))\multimap !(b\,\&\,a)}\star \quad \cfrac{\cfrac{\cfrac{a,b:\ \cdot\vdash a \quad a,b:\ \cdot\vdash b}{a,b:\ \cdot\vdash a\,\&\,b}\star}{a,b:\ \cdot\vdash !(a\,\&\,b)}!}{\cdot:\ \cdot\vdash !(!(b)\,\&\,!(a))\multimap !(a\,\&\,b)}\star}{}$$

$$\cfrac{\cfrac{\cdot:\ \cdot\vdash !(!(!(a)\,\&\,!(b))\multimap !(b\,\&\,a))}{} \quad \cfrac{\cdot:\ \cdot\vdash !(!(!(b)\,\&\,!(a))\multimap !(a\,\&\,b))}{}}{\cfrac{\cdot:\ \cdot\vdash !(!(!(a)\,\&\,!(b))\multimap !(b\,\&\,a))\,\&\,!(!(!(b)\,\&\,!(a))\multimap !(a\,\&\,b))}{\cdot:\ \cdot\vdash !(!(!(!(a)\,\&\,!(b))\multimap !(b\,\&\,a))\,\&\,!(!(!(b)\,\&\,!(a))\multimap !(a\,\&\,b)))}!}\star$$

$$\cfrac{\cfrac{\cfrac{\cfrac{\cfrac{a,!(a)\oplus!(b):\ \cdot\vdash a}{a,!(a)\oplus!(b):\ \cdot\vdash !(a)}!}{a,!(a)\oplus!(b):\ \cdot\vdash !(b)\oplus!(a)}\oplus_1 \quad \cfrac{\cfrac{b,!(a)\oplus!(b):\ \cdot\vdash b}{b,!(a)\oplus!(b):\ \cdot\vdash !(b)}!}{b,!(a)\oplus!(b):\ \cdot\vdash !(b)\oplus!(a)}\oplus_1}{\cfrac{!(a)\oplus!(b):\ !(a)\oplus!(b)\vdash !(b)\oplus!(a)}{!(a)\oplus!(b):\ \cdot\vdash !(b)\oplus!(a)}D_C}}{\cfrac{\cdot:\ \cdot\vdash !(!(a)\oplus!(b))\multimap !(b)\oplus!(a)}{\cdot:\ \cdot\vdash !(!(!(a)\oplus!(b))\multimap !(b)\oplus!(a))}!}\star}{} \quad \cdots$$

$$\cfrac{\cfrac{\cfrac{\cfrac{\cfrac{b,!(b)\oplus!(a):\ \cdot\vdash b}{b,!(b)\oplus!(a):\ \cdot\vdash !(b)}!}{b,!(b)\oplus!(a):\ \cdot\vdash !(a)\oplus!(b)}\oplus_1 \quad \cfrac{\cfrac{a,!(b)\oplus!(a):\ \cdot\vdash a}{a,!(b)\oplus!(a):\ \cdot\vdash !(a)}!}{a,!(b)\oplus!(a):\ \cdot\vdash !(a)\oplus!(b)}\oplus_1}{\cfrac{!(b)\oplus!(a):\ !(b)\oplus!(a)\vdash !(a)\oplus!(b)}{!(b)\oplus!(a):\ \cdot\vdash !(a)\oplus!(b)}D_C}}{\cfrac{\cdot:\ \cdot\vdash !(!(b)\oplus!(a))\multimap !(a)\oplus!(b)}{\cdot:\ \cdot\vdash !(!(!(b)\oplus!(a))\multimap !(a)\oplus!(b))}!}\star}{}$$

$$\cfrac{\cdot:\ \cdot\vdash !(!(!(a)\oplus!(b))\multimap !(b)\oplus!(a))\,\&\,!(!(!(b)\oplus!(a))\multimap !(a)\oplus!(b))}{\cdot:\ \cdot\vdash !(!(!(!(a)\oplus!(b))\multimap !(b)\oplus!(a))\,\&\,!(!(!(b)\oplus!(a))\multimap !(a)\oplus!(b)))}!$$

$$
\cdots \vdash !(!(!(a) \oplus !(b) \& !(c))) \multimap !(!(a) \oplus !(b) \& !(a) \oplus !(c))) \& !(!(!(!(a) \oplus !(b)) \& !(!(a) \oplus !(c))) \multimap !(a) \oplus !(!(b \& c)))) \quad !
$$

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      \cfrac{\cdot: \ \cdot \vdash !(!(a) \,\&\, !(a)) \multimap a}{\cdot: \ \cdot \vdash !(!(!(a) \,\&\, !(a)) \multimap a)} \ !
    } \ \star
    \qquad
    \cfrac{
      \cfrac{
        \cfrac{
          \cfrac{\overline{a: \ \cdot \vdash a} \quad \overline{a: \ \cdot \vdash a}}{a: \ \cdot \vdash a \,\&\, a} \ \star
        }{a: \ \cdot \vdash !(a \,\&\, a)} \ !
      }{\cdot: \ \cdot \vdash !(a) \multimap !(a \,\&\, a)} \ \star
    }{\cdot: \ \cdot \vdash !(!(a) \multimap !(a \,\&\, a))} \ !
  }{\cdot: \ \cdot \vdash !(!(!(a) \,\&\, !(a)) \multimap a) \,\&\, !(!(a) \multimap !(a \,\&\, a))} \ \star
}{\cdot: \ \cdot \vdash !(!(!(!(a) \,\&\, !(a)) \multimap a) \,\&\, !(!(a) \multimap !(a \,\&\, a)))} \ !
$$

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        \cfrac{\overline{a, !(a) \oplus !(a): \ \cdot \vdash a} \quad \overline{a, !(a) \oplus !(a): \ \cdot \vdash a}}{!(a) \oplus !(a): \ !(a) \oplus !(a) \vdash a}
      }{!(a) \oplus !(a): \ \cdot \vdash a} \ D_C
    }{\cdot: \ \cdot \vdash !(!(a) \oplus !(a)) \multimap a} \ \star
  }{\cdot: \ \cdot \vdash !(!(!(a) \oplus !(a)) \multimap a)} \ !
  \qquad
  \cfrac{
    \cfrac{
      \cfrac{
        \cfrac{\overline{a: \ \cdot \vdash a}}{a: \ \cdot \vdash !(a)} \ !
      }{a: \ \cdot \vdash !(a) \oplus !(a)} \ \oplus_1
    }{\cdot: \ \cdot \vdash !(a) \multimap !(a) \oplus !(a)} \ \star
  }{\cdot: \ \cdot \vdash !(!(a) \multimap !(a) \oplus !(a))} \ !
}{
  \cfrac{\cdot: \ \cdot \vdash !(!(!(a) \oplus !(a)) \multimap a) \,\&\, !(!(a) \multimap !(a) \oplus !(a))}{\cdot: \ \cdot \vdash !(!(!(!(a) \oplus !(a)) \multimap a) \,\&\, !(!(a) \multimap !(a) \oplus !(a)))} \ !
} \ \star
$$

$$\cfrac{\cfrac{\cfrac{\cfrac{\cfrac{\overline{a:\ \cdot \vdash a}}{} \quad \cfrac{\cfrac{\cfrac{\overline{a:\ \cdot \vdash a}}{a:\ \cdot \vdash\ !(a)}\ !}{a:\ \cdot \vdash\ !(a)\oplus\ !(b)}\ \oplus_1}{}}{a:\ \cdot \vdash a\ \&\ !(a)\oplus\ !(b)}\ \star}{a:\ \cdot \vdash\ !(a\ \&\ !(a)\oplus\ !(b))}\ !}{\cdot:\ \cdot \vdash\ !(a)\multimap\ !(a\ \&\ !(a)\oplus\ !(b))}\ \star}{\cdot:\ \cdot \vdash\ !(!(a)\multimap\ !(a\ \&\ !(a)\oplus\ !(b)))}\ !$$

$$\cfrac{\cfrac{\cfrac{\cfrac{\overline{a,!(a)\oplus\ !(b):\ \cdot \vdash a}}{\cdot:\ \cdot \vdash\ !(!(a)\ \&\ !(!(a)\oplus\ !(b)))\multimap a}}{\cdot:\ \cdot \vdash\ !(!(!(a)\ \&\ !(!(a)\oplus\ !(b)))\multimap a)}\ !\quad \cfrac{\cdots}{\cdot:\ \cdot \vdash\ !(!(a)\multimap\ !(a\ \&\ !(a)\oplus\ !(b)))}\ !}{\cdot:\ \cdot \vdash\ !(!(!(a)\ \&\ !(!(a)\oplus\ !(b)))\multimap a)\ \&\ !(!(a)\multimap\ !(a\ \&\ !(a)\oplus\ !(b)))}\ \star}{\cdot:\ \cdot \vdash\ !(!(!(!(a)\ \&\ !(!(a)\oplus\ !(b)))\multimap a)\ \&\ !(!(a)\multimap\ !(a\ \&\ !(a)\oplus\ !(b))))}\ !$$

file: KLE-01/KLE048+1.p (104 ms)

$$\cfrac{\cfrac{\cfrac{\cfrac{\cfrac{\overline{a,!(a)\oplus\ !(!(a)\ \&\ !(b)):\ \cdot \vdash a}\quad \overline{a,b,!(a)\oplus\ !(!(a)\ \&\ !(b)):\ \cdot \vdash a}}{!(a)\oplus\ !(!(a)\ \&\ !(b)):\ !(a)\oplus\ !(!(a)\ \&\ !(b))\vdash a}}{!(a)\oplus\ !(!(a)\ \&\ !(b)):\ \cdot \vdash a}\ D_C}{\cdot:\ \cdot \vdash\ !(!(a)\oplus\ !(!(a)\ \&\ !(b)))\multimap a}\ \star}{\cdot:\ \cdot \vdash\ !(!(!(a)\oplus\ !(!(a)\ \&\ !(b)))\multimap a)}\ !\quad \cfrac{\cfrac{\cfrac{\cfrac{\overline{a:\ \cdot \vdash a}}{a:\ \cdot \vdash\ !(a)}\ !}{a:\ \cdot \vdash\ !(a)\oplus\ !(!(a\ \&\ b))}\ \oplus_1}{\cdot:\ \cdot \vdash\ !(a)\multimap\ !(a)\oplus\ !(!(a\ \&\ b))}\ \star}{\cdot:\ \cdot \vdash\ !(!(a)\multimap\ !(a)\oplus\ !(!(a\ \&\ b)))}\ !}{\cdot:\ \cdot \vdash\ !(!(!(a)\oplus\ !(!(a)\ \&\ !(b)))\multimap a)\ \&\ !(!(a)\multimap\ !(a)\oplus\ !(!(a\ \&\ b)))}\ \star$$

$$\cfrac{\cdot:\ \cdot \vdash\ !(!(!(a)\oplus\ !(!(a)\ \&\ !(b)))\multimap a)\ \&\ !(!(a)\multimap\ !(a)\oplus\ !(!(a\ \&\ b)))}{\cdot:\ \cdot \vdash\ !(!(!(!(a)\oplus\ !(!(a)\ \&\ !(b)))\multimap a)\ \&\ !(!(a)\multimap\ !(a)\oplus\ !(!(a\ \&\ b))))}\ !$$

file: KLE-01/KLE049+1.p (133 ms)

$$\cfrac{\cfrac{\cfrac{\cfrac{\cfrac{\cfrac{\overline{a,!(a)\multimap\ !(b):\ \cdot \vdash a}}{a,!(a)\multimap\ !(b):\ \cdot \vdash\ !(a)}\ !\quad \cfrac{\overline{a,b,!(a)\multimap\ !(b):\ \cdot \vdash b}}{a,!(a)\multimap\ !(b):\ !(b)\vdash b}}{a,!(a)\multimap\ !(b):\ !(a)\multimap\ !(b)\vdash b}\ \star}{a,!(a)\multimap\ !(b):\ \cdot \vdash b}\ D_C}{a:\ \cdot \vdash\ !(!(a)\multimap\ !(b))\multimap b}\ \star}{a:\ \cdot \vdash\ !(!(!(a)\multimap\ !(b))\multimap b)}\ !\quad \cfrac{\cfrac{\cfrac{\cfrac{\overline{a,b:\ \cdot \vdash b}}{a,b:\ \cdot \vdash\ !(a)\multimap b}\ \star}{a,b:\ \cdot \vdash\ !(!(a)\multimap b)}\ !}{a:\ \cdot \vdash\ !(b)\multimap\ !(!(a)\multimap b)}\ \star}{a:\ \cdot \vdash\ !(!(b)\multimap\ !(!(a)\multimap b))}\ !}{a:\ \cdot \vdash\ !(!(!(a)\multimap\ !(b))\multimap b)\ \&\ !(!(b)\multimap\ !(!(a)\multimap b))}\ \star$$

$$\cfrac{\cfrac{a:\ \cdot \vdash\ !(!(!(a)\multimap\ !(b))\multimap b)\ \&\ !(!(b)\multimap\ !(!(a)\multimap b))}{a:\ \cdot \vdash\ !(!(!(!(a)\multimap\ !(b))\multimap b)\ \&\ !(!(b)\multimap\ !(!(a)\multimap b)))}\ !}{\cdot:\ !(a)\vdash\ !(!(!(!(a)\multimap\ !(b))\multimap b)\ \&\ !(!(b)\multimap\ !(!(a)\multimap b)))}\ \star$$

file: KLE-01/KLE050+1.p (94 ms)

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$$\cfrac{\cfrac{\cfrac{\cfrac{\overline{\,b, !(a) \multimap !(b): \ \cdot \vdash b\,}}{b: \ \cdot \vdash !(!(a) \multimap !(b)) \multimap b} \ \star}{b: \ \cdot \vdash !(!(!(a) \multimap !(b)) \multimap b)} \ ! \qquad \cfrac{\cfrac{\cfrac{\cfrac{\overline{\,a, b: \ \cdot \vdash b\,}}{b: \ \cdot \vdash !(a) \multimap b} \ \star}{b: \ \cdot \vdash !(!(a) \multimap b)} \ !}{b: \ \cdot \vdash !(b) \multimap !(!(a) \multimap b)} \ \star}{b: \ \cdot \vdash !(!(b) \multimap !(!(a) \multimap b))} \ !}{b: \ \cdot \vdash !(!(!(a) \multimap !(b)) \multimap b) \ \& \ !(!(b) \multimap !(!(a) \multimap b))} \ \star}{b: \ \cdot \vdash !(!(!(!(a) \multimap !(b)) \multimap b) \ \& \ !(!(b) \multimap !(!(a) \multimap b)))} \ !}{\cdot: \ !(b) \vdash !(!(!(!(a) \multimap !(b)) \multimap b) \ \& \ !(!(b) \multimap !(!(a) \multimap b)))} \ \star$$

file: KLE-01/KLE051+1.p (312 ms)

$$\cfrac{\cfrac{\cfrac{\cfrac{\cfrac{\cfrac{\cfrac{\cfrac{\overline{\,a, !(a) \multimap !(b), !(a) \multimap !(\mathbf{0}): \ \cdot \vdash a\,}}{a, !(a) \multimap !(b), !(a) \multimap !(\mathbf{0}): \ \cdot \vdash !(a)} \ ! \quad \overline{a, !(a) \multimap !(b), !(a) \multimap !(\mathbf{0}): \ !(\mathbf{0}) \vdash \mathbf{0}} \ \star}{a, !(a) \multimap !(b), !(a) \multimap !(\mathbf{0}): \ !(a) \multimap !(\mathbf{0}) \vdash \mathbf{0}} \ \multimap}{a, !(a) \multimap !(b), !(a) \multimap !(\mathbf{0}): \ \cdot \vdash \mathbf{0}} \ D_C}{!(a) \multimap !(b), !(a) \multimap !(\mathbf{0}): \ \cdot \vdash !(a) \multimap \mathbf{0}} \ \star}{!(a) \multimap !(b), !(a) \multimap !(\mathbf{0}): \ \cdot \vdash !(!(a) \multimap \mathbf{0})} \ !}{!(a) \multimap !(\mathbf{0}): \ \cdot \vdash !(!(a) \multimap !(b)) \multimap !(!(a) \multimap \mathbf{0})} \ \star}{!(a) \multimap !(\mathbf{0}): \ \cdot \vdash !(!(!(a) \multimap !(b)) \multimap !(!(a) \multimap \mathbf{0}))} \ ! \qquad \cdots}{\ }$$

(right branch)

$$\cfrac{\cfrac{\cfrac{\cfrac{\cfrac{\cfrac{\overline{\,a, !(a) \multimap !(\mathbf{0}): \ \cdot \vdash a\,}}{a, !(a) \multimap !(\mathbf{0}): \ \cdot \vdash !(a)} \ ! \quad \overline{a, !(a) \multimap !(\mathbf{0}): \ !(\mathbf{0}) \vdash b} \ \star}{a, !(a) \multimap !(\mathbf{0}): \ !(a) \multimap !(\mathbf{0}) \vdash b} \ \multimap}{a, !(a) \multimap !(\mathbf{0}): \ \cdot \vdash b} \ D_C}{!(a) \multimap !(\mathbf{0}): \ \cdot \vdash !(a) \multimap b} \ \star}{!(a) \multimap !(\mathbf{0}): \ \cdot \vdash !(!(a) \multimap b)} \ !}{!(a) \multimap !(\mathbf{0}): \ \cdot \vdash !(!(a) \multimap !(\mathbf{0})) \multimap !(!(a) \multimap b)} \ \star$$

$$\cfrac{!(a) \multimap !(\mathbf{0}): \ \cdot \vdash !(!(!(a) \multimap !(b)) \multimap !(!(a) \multimap \mathbf{0})) \ \& \ !(!(!(a) \multimap !(\mathbf{0})) \multimap !(!(a) \multimap b))}{\cfrac{!(a) \multimap !(\mathbf{0}): \ \cdot \vdash !(!(!(!(a) \multimap !(b)) \multimap !(!(a) \multimap \mathbf{0})) \ \& \ !(!(!(a) \multimap !(\mathbf{0})) \multimap !(!(a) \multimap b)))}{\cdot: \ !(!(a) \multimap !(\mathbf{0})) \vdash !(!(!(!(a) \multimap !(b)) \multimap !(!(a) \multimap \mathbf{0})) \ \& \ !(!(!(a) \multimap !(\mathbf{0})) \multimap !(!(a) \multimap b)))} \ \star} \ !}$$

file: KLE-01/KLE052+1.p (414 ms)

file: KLE-01/KLE053+1.p (91 ms)

12

$$
\cfrac{
  \cfrac{
    \cfrac{
      \overline{a, b: \ \cdot \vdash a}
    }{b: \ \cdot \vdash !(!(a) \& !(b)) \multimap a} \star
  }{b: \ \cdot \vdash !(!(!(a) \& !(b)) \multimap a)} !
  \qquad
  \cfrac{
    \cfrac{
      \cfrac{
        \cfrac{
          \overline{a, b: \ \cdot \vdash a} \quad \overline{a, b: \ \cdot \vdash b}
        }{a, b: \ \cdot \vdash a \& b} \star
      }{a, b: \ \cdot \vdash !(a \& b)} !
    }{b: \ \cdot \vdash !(a) \multimap !(a \& b)} \star
  }{b: \ \cdot \vdash !(!(a) \multimap !(a \& b))} !
}{
  \cfrac{
    \cfrac{
      b: \ \cdot \vdash !(!(!(a) \& !(b)) \multimap a) \& !(!(a) \multimap !(a \& b))
    }{b: \ \cdot \vdash !(!(!(!(a) \& !(b)) \multimap a) \& !(!(a) \multimap !(a \& b)))} !
  }{\cdot: \ !(b) \vdash !(!(!(!(a) \& !(b)) \multimap a) \& !(!(a) \multimap !(a \& b)))} \star
} \star
$$

file: KLE-01/KLE054+1.p (89 ms)

$$
\cfrac{
  \cfrac{
    \cfrac{
      \overline{b, !(a) \oplus !(b): \ \cdot \vdash b}
    }{b: \ \cdot \vdash !(!(a) \oplus !(b)) \multimap b} \star
  }{b: \ \cdot \vdash !(!(!(a) \oplus !(b)) \multimap b)} !
  \qquad
  \cfrac{
    \cfrac{
      \cfrac{
        \cfrac{
          \overline{b: \ \cdot \vdash b}
        }{b: \ \cdot \vdash !(b)} !
      }{b: \ \cdot \vdash !(a) \oplus !(b)} \oplus_1
    }{b: \ \cdot \vdash !(b) \multimap !(a) \oplus !(b)} \star
  }{b: \ \cdot \vdash !(!(b) \multimap !(a) \oplus !(b))} !
}{
  \cfrac{
    \cfrac{
      b: \ \cdot \vdash !(!(!(a) \oplus !(b)) \multimap b) \& !(!(b) \multimap !(a) \oplus !(b))
    }{b: \ \cdot \vdash !(!(!(!(a) \oplus !(b)) \multimap b) \& !(!(b) \multimap !(a) \oplus !(b)))} !
  }{\cdot: \ !(b) \vdash !(!(!(!(a) \oplus !(b)) \multimap b) \& !(!(b) \multimap !(a) \oplus !(b)))} \star
} \star
$$

file: KLE-01/KLE055+1.p (258 ms)

$$
\cfrac{
  \cfrac{
    \cfrac{
      \overline{a, b, !(b) \multimap !(\mathbf{0}): \ \cdot \vdash b}
    }{!(b) \multimap !(\mathbf{0}): \ \cdot \vdash !(!(a) \& !(b)) \multimap b} \star
  }{!(b) \multimap !(\mathbf{0}): \ \cdot \vdash !(!(!(a) \& !(b)) \multimap b)} !
  \quad
  \cfrac{
    \cfrac{
      \cfrac{
        \cfrac{
          \cfrac{
            \overline{b, !(b) \multimap !(\mathbf{0}): \ \cdot \vdash b}
          }{b, !(b) \multimap !(\mathbf{0}): \ \cdot \vdash !(b)} ! \quad \overline{b, !(b) \multimap !(\mathbf{0}): \ !(\mathbf{0}) \vdash !(a \& b)} \star
        }{b, !(b) \multimap !(\mathbf{0}): \ !(b) \multimap !(\mathbf{0}) \vdash !(a \& b)} \multimap
      }{b, !(b) \multimap !(\mathbf{0}): \ \cdot \vdash !(a \& b)} D_C
    }{!(b) \multimap !(\mathbf{0}): \ \cdot \vdash !(b) \multimap !(a \& b)} \star
  }{!(b) \multimap !(\mathbf{0}): \ \cdot \vdash !(!(b) \multimap !(a \& b))} !
}{
  \cfrac{
    \cfrac{
      !(b) \multimap !(\mathbf{0}): \ \cdot \vdash !(!(!(a) \& !(b)) \multimap b) \& !(!(b) \multimap !(a \& b))
    }{!(b) \multimap !(\mathbf{0}): \ \cdot \vdash !(!(!(!(a) \& !(b)) \multimap b) \& !(!(b) \multimap !(a \& b)))} !
  }{\cdot: \ !(!(b) \multimap !(\mathbf{0})) \vdash !(!(!(!(a) \& !(b)) \multimap b) \& !(!(b) \multimap !(a \& b)))} \star
} \star
$$

file: KLE-01/KLE056+1.p (303 ms)

13

$$
\cfrac{
\cfrac{
\cfrac{
\cfrac{
\cfrac{b,!(a)\oplus!(b),!(b)\multimap!(\mathbf{0}):\ \cdot\vdash b}
{b,!(a)\oplus!(b),!(b)\multimap!(\mathbf{0}):\ \cdot\vdash !(b)}\,!
\quad b,!(a)\oplus!(b),!(b)\multimap!(\mathbf{0}):\ !(\mathbf{0})\vdash a}
{b,!(a)\oplus!(b),!(b)\multimap!(\mathbf{0}):\ !(b)\multimap!(\mathbf{0})\vdash a}\,\multimap}
{b,!(a)\oplus!(b),!(b)\multimap!(\mathbf{0}):\ \cdot\vdash a}\,D_C
}{\cdots}
}{\cdots}
$$

$$
\cfrac{
\cfrac{
\cfrac{
\cfrac{
\cfrac{
\cfrac{a,!(a)\oplus!(b),!(b)\multimap!(\mathbf{0}):\ \cdot\vdash a}
{!(a)\oplus!(b),!(b)\multimap!(\mathbf{0}):\ !(a)\oplus!(b)\vdash a}}
{!(a)\oplus!(b),!(b)\multimap!(\mathbf{0}):\ \cdot\vdash a}\,D_C}
{!(b)\multimap!(\mathbf{0}):\ \cdot\vdash !(!(a)\oplus!(b))\multimap a}\,\star}
{!(b)\multimap!(\mathbf{0}):\ \cdot\vdash !(!(!(a)\oplus!(b))\multimap a)}\,!
\qquad
\cfrac{
\cfrac{
\cfrac{
\cfrac{a,!(b)\multimap!(\mathbf{0}):\ \cdot\vdash a}
{a,!(b)\multimap!(\mathbf{0}):\ \cdot\vdash !(a)}\,!}
{a,!(b)\multimap!(\mathbf{0}):\ \cdot\vdash !(a)\oplus!(b)}\,\oplus_1}
{!(b)\multimap!(\mathbf{0}):\ \cdot\vdash !(a)\multimap!(a)\oplus!(b)}\,\star}
{!(b)\multimap!(\mathbf{0}):\ \cdot\vdash !(!(a)\multimap!(a)\oplus!(b))}\,!}
{!(b)\multimap!(\mathbf{0}):\ \cdot\vdash !(!(!(a)\oplus!(b))\multimap a)\,\&\,!(!(a)\multimap!(a)\oplus!(b))}}
{!(b)\multimap!(\mathbf{0}):\ \cdot\vdash !(!(!(!(a)\oplus!(b))\multimap a)\,\&\,!(!(a)\multimap!(a)\oplus!(b)))}\,!}
{\cdot:\ !(!(b)\multimap!(\mathbf{0}))\vdash !(!(!(!(a)\oplus!(b))\multimap a)\,\&\,!(!(a)\multimap!(a)\oplus!(b)))}\,\star
$$

file: KLE-01/KLE057+1.p (83 ms)

$$
\cfrac{
\cfrac{
\cfrac{
\cfrac{
\cfrac{
\cfrac{
\cfrac{a,!(a)\multimap!(\mathbf{0}):\ \cdot\vdash a}
{a,!(a)\multimap!(\mathbf{0}):\ \cdot\vdash !(a)}\,!
\quad a,!(a)\multimap!(\mathbf{0}):\ !(\mathbf{0})\vdash \mathbf{0}}
{a,!(a)\multimap!(\mathbf{0}):\ !(a)\multimap!(\mathbf{0})\vdash \mathbf{0}}\,\multimap}
{a,!(a)\multimap!(\mathbf{0}):\ \cdot\vdash \mathbf{0}}\,D_C}
{a:\ \cdot\vdash !(!(a)\multimap!(\mathbf{0}))\multimap \mathbf{0}}\,\star}
{a:\ \cdot\vdash !(!(!(a)\multimap!(\mathbf{0}))\multimap \mathbf{0})}\,!}
{\cdot:\ \cdot\vdash !(a)\multimap!(!(!(a)\multimap!(\mathbf{0}))\multimap \mathbf{0})}\,\star}
{\cdot:\ \cdot\vdash !(!(a)\multimap!(!(!(a)\multimap!(\mathbf{0}))\multimap \mathbf{0}))}\,!
$$

file: KLE-01/KLE058+1.p (480 ms)

file: KLE-01/KLE059+1.p (314 ms)

$$
\cfrac{
\cfrac{
\cfrac{
\cfrac{
\cfrac{
\cfrac{
\cfrac{
\cfrac{a,!(a)\oplus!(!(a)\multimap!(\mathbf{0})),!(!(!(a)\multimap a))\multimap!(\mathbf{0}):\ \cdot\vdash a}
{!(a)\oplus!(!(a)\multimap!(\mathbf{0})),!(!(!(a)\multimap a))\multimap!(\mathbf{0}):\ \cdot\vdash !(a)\multimap a}\,\star}
{!(a)\oplus!(!(a)\multimap!(\mathbf{0})),!(!(!(a)\multimap a))\multimap!(\mathbf{0}):\ \cdot\vdash !(!(a)\multimap a)}\,!}
{!(a)\oplus!(!(a)\multimap!(\mathbf{0})),!(!(!(a)\multimap a))\multimap!(\mathbf{0}):\ \cdot\vdash !(!(!(a)\multimap a))}\,!
\quad !(a)\oplus!(!(a)\multimap!(\mathbf{0})),!(!(!(a)\multimap a))\multimap!(\mathbf{0}):\ !(\mathbf{0})\vdash \mathbf{0}}
{!(a)\oplus!(!(a)\multimap!(\mathbf{0})),!(!(!(a)\multimap a))\multimap!(\mathbf{0}):\ !(!(!(a)\multimap a))\multimap!(\mathbf{0})\vdash \mathbf{0}}\,\multimap}
{!(a)\oplus!(!(a)\multimap!(\mathbf{0})),!(!(!(a)\multimap a))\multimap!(\mathbf{0}):\ \cdot\vdash \mathbf{0}}\,D_C}
{!(a)\oplus!(!(a)\multimap!(\mathbf{0})):\ \cdot\vdash !(!(!(!(a)\multimap a))\multimap!(\mathbf{0}))\multimap \mathbf{0}}\,\star}
{!(a)\oplus!(!(a)\multimap!(\mathbf{0})):\ \cdot\vdash !(!(!(!(!(a)\multimap a))\multimap!(\mathbf{0}))\multimap \mathbf{0})}\,!}
{\cdot:\ \cdot\vdash !(!(a)\oplus!(!(a)\multimap!(\mathbf{0})))\multimap !(!(!(!(!(a)\multimap a))\multimap!(\mathbf{0}))\multimap \mathbf{0})}\,\star}
{\cdot:\ \cdot\vdash !(!(!(a)\oplus!(!(a)\multimap!(\mathbf{0})))\multimap !(!(!(!(!(a)\multimap a))\multimap!(\mathbf{0}))\multimap \mathbf{0}))}\,!
$$

file: KLE-01/KLE060+1.p (443 ms)

file: KLE-01/KLE061+1.p (72 ms)

$$
\cfrac{
\cfrac{
\cfrac{
\cfrac{
\cfrac{
\cfrac{a,!(a)\multimap!(\mathbf{0}):\ \cdot\vdash a}
{a,!(a)\multimap!(\mathbf{0}):\ \cdot\vdash !(a)}\,!
\quad a,!(a)\multimap!(\mathbf{0}):\ !(\mathbf{0})\vdash \mathbf{0}}
{a,!(a)\multimap!(\mathbf{0}):\ !(a)\multimap!(\mathbf{0})\vdash \mathbf{0}}\,\multimap}
{a,!(a)\multimap!(\mathbf{0}):\ \cdot\vdash \mathbf{0}}\,D_C}
{\cdot:\ \cdot\vdash !(!(a)\,\&\,!(!(a)\multimap!(\mathbf{0})))\multimap \mathbf{0}}\,\star}
{\cdot:\ \cdot\vdash !(!(!(a)\,\&\,!(!(a)\multimap!(\mathbf{0})))\multimap \mathbf{0})}\,!
$$

14

file: KLE-01/KLE062+1.p (1285 ms)

file: KLE-01/KLE063+1.p (320 ms)

file: KLE-01/KLE064+1.p (329 ms)

file: KLE-01/KLE065+1.p (32 ms)

$$\cfrac{\cfrac{\cfrac{}{a, !(b) \oplus !(!(b) \multimap !(\mathbf{0})) : \cdot \vdash a}}{\cdot : \cdot \vdash !(!(a) \mathbin{\&} !(!(b) \oplus !(!(b) \multimap !(\mathbf{0})))) \multimap a} \star}{\cdot : \cdot \vdash !(!(!(a) \mathbin{\&} !(!(b) \oplus !(!(b) \multimap !(\mathbf{0})))) \multimap a)} \,!$$

file: KLE-01/KLE066+1.p (136 ms)

$$\cfrac{\cfrac{\cfrac{\cfrac{}{a, !(a) \oplus !(!(b) \mathbin{\&} !(!(b) \multimap !(\mathbf{0}))) : \cdot \vdash a} \quad \cfrac{\cfrac{\cfrac{\cfrac{}{b, !(a) \oplus !(!(b) \mathbin{\&} !(!(b) \multimap !(\mathbf{0}))), !(b) \multimap !(\mathbf{0}) : \cdot \vdash b}}{b, !(a) \oplus !(!(b) \mathbin{\&} !(!(b) \multimap !(\mathbf{0}))), !(b) \multimap !(\mathbf{0}) : \cdot \vdash !(b)} \, ! \quad \cfrac{}{b, !(a) \oplus !(!(b) \mathbin{\&} !(!(b) \multimap !(\mathbf{0}))), !(b) \multimap !(\mathbf{0}) : \ !(\mathbf{0}) \vdash a} \star}{b, !(a) \oplus !(!(b) \mathbin{\&} !(!(b) \multimap !(\mathbf{0}))), !(b) \multimap !(\mathbf{0}) : \ !(b) \multimap !(\mathbf{0}) \vdash a} \multimap}{b, !(a) \oplus !(!(b) \mathbin{\&} !(!(b) \multimap !(\mathbf{0}))), !(b) \multimap !(\mathbf{0}) : \cdot \vdash a} D_C}{!(a) \oplus !(!(b) \mathbin{\&} !(!(b) \multimap !(\mathbf{0}))) : \ !(a) \oplus !(!(b) \mathbin{\&} !(!(b) \multimap !(\mathbf{0}))) \vdash a} \star}{!(a) \oplus !(!(b) \mathbin{\&} !(!(b) \multimap !(\mathbf{0}))) : \cdot \vdash a} D_C}{\cdot : \cdot \vdash !(!(a) \oplus !(!(b) \mathbin{\&} !(!(b) \multimap !(\mathbf{0})))) \multimap a} \star}{\cdot : \cdot \vdash !(!(!(a) \oplus !(!(b) \mathbin{\&} !(!(b) \multimap !(\mathbf{0})))) \multimap a)} \,!$$

$$\cfrac{\cfrac{\cfrac{\cfrac{}{a : \cdot \vdash a}}{a : \cdot \vdash !(a)} \, !}{a : \cdot \vdash !(a) \oplus !(!(b \mathbin{\&} !(!(b) \multimap \mathbf{0})))} \oplus_1}{\cdot : \cdot \vdash !(a) \multimap !(a) \oplus !(!(b \mathbin{\&} !(!(b) \multimap \mathbf{0})))} \, !$$

$$\cdot : \cdot \vdash !(!(!(a) \oplus !(!(b) \mathbin{\&} !(!(b) \multimap !(\mathbf{0})))) \multimap a) \mathbin{\&} !(!(a) \multimap !(a) \oplus !(!(b \mathbin{\&} !(!(b) \multimap \mathbf{0}))))$$
$$\cdot : \cdot \vdash !(!(!(!(a) \oplus !(!(b) \mathbin{\&} !(!(b) \multimap !(\mathbf{0})))) \multimap a) \mathbin{\&} !(!(a) \multimap !(a) \oplus !(!(b \mathbin{\&} !(!(b) \multimap \mathbf{0}))))) \, !$$

file: KLE-01/KLE067+1.p (138 ms)

$$\cfrac{\cfrac{\cfrac{\cfrac{\cfrac{}{a, b, !(b) \multimap !(\mathbf{0}) : \cdot \vdash b}}{a, b, !(b) \multimap !(\mathbf{0}) : \cdot \vdash !(b)} \, ! \quad \cfrac{}{a, b, !(b) \multimap !(\mathbf{0}) : \ !(\mathbf{0}) \vdash !(b \mathbin{\&} !(!(b) \multimap \mathbf{0}))} \star}{a, b, !(b) \multimap !(\mathbf{0}) : \ !(b) \multimap !(\mathbf{0}) \vdash !(b \mathbin{\&} !(!(b) \multimap \mathbf{0}))} \multimap}{a, b, !(b) \multimap !(\mathbf{0}) : \cdot \vdash !(b \mathbin{\&} !(!(b) \multimap \mathbf{0}))} D_C}{\cdot : \cdot \vdash !(!(a) \mathbin{\&} !(!(b) \mathbin{\&} !(!(b) \multimap !(\mathbf{0})))) \multimap !(b \mathbin{\&} !(!(b) \multimap \mathbf{0}))} \star}{\cdot : \cdot \vdash !(!(!(a) \mathbin{\&} !(!(b) \mathbin{\&} !(!(b) \multimap !(\mathbf{0})))) \multimap !(b \mathbin{\&} !(!(b) \multimap \mathbf{0})))} \, !$$

$$\cfrac{\cfrac{\cfrac{\cfrac{\cfrac{}{b, !(b) \multimap !(\mathbf{0}) : \cdot \vdash b}}{b, !(b) \multimap !(\mathbf{0}) : \cdot \vdash !(b)} \, ! \quad \cfrac{}{b, !(b) \multimap !(\mathbf{0}) : \ !(\mathbf{0}) \vdash !(a \mathbin{\&} !(b \mathbin{\&} !(!(b) \multimap \mathbf{0})))} \star}{b, !(b) \multimap !(\mathbf{0}) : \ !(b) \multimap !(\mathbf{0}) \vdash !(a \mathbin{\&} !(b \mathbin{\&} !(!(b) \multimap \mathbf{0})))} \multimap}{b, !(b) \multimap !(\mathbf{0}) : \cdot \vdash !(a \mathbin{\&} !(b \mathbin{\&} !(!(b) \multimap \mathbf{0})))} D_C}{\cdot : \cdot \vdash !(!(!(b) \mathbin{\&} !(!(b) \multimap !(\mathbf{0}))) \multimap !(a \mathbin{\&} !(b \mathbin{\&} !(!(b) \multimap \mathbf{0}))))} \star}{\cdot : \cdot \vdash !(!(!(b) \mathbin{\&} !(!(b) \multimap !(\mathbf{0}))) \multimap !(a \mathbin{\&} !(b \mathbin{\&} !(!(b) \multimap \mathbf{0}))))} \, !$$

$$\cdot : \cdot \vdash !(!(!(a) \mathbin{\&} !(!(b) \mathbin{\&} !(!(b) \multimap !(\mathbf{0})))) \multimap !(b \mathbin{\&} !(!(b) \multimap \mathbf{0}))) \mathbin{\&} !(!(!(b) \mathbin{\&} !(!(b) \multimap !(\mathbf{0}))) \multimap !(a \mathbin{\&} !(b \mathbin{\&} !(!(b) \multimap \mathbf{0}))))$$
$$\cdot : \cdot \vdash !(!(!(!(a) \mathbin{\&} !(!(b) \mathbin{\&} !(!(b) \multimap !(\mathbf{0})))) \multimap !(b \mathbin{\&} !(!(b) \multimap \mathbf{0}))) \mathbin{\&} !(!(!(b) \mathbin{\&} !(!(b) \multimap !(\mathbf{0}))) \multimap !(a \mathbin{\&} !(b \mathbin{\&} !(!(b) \multimap \mathbf{0}))))) \, !$$

file: KLE-01/KLE068+1.p (timeout!)

file: KLE-01/KLE069+1.p (timeout!)

file: KLE-01/KLE070+1.p (318 ms)

15

file: KLE-01/KLE071+1.p (288 ms)

file: KLE-01/KLE072+1.p (319 ms)

file: KLE-01/KLE073+1.p (297 ms)

file: KLE-01/KLE074+1.p (timeout!)

file: KLE-01/KLE075+1.p (timeout!)

file: KLE-01/KLE076+1.p (395 ms)

file: KLE-01/KLE077+1.p (284 ms)

file: KLE-01/KLE078+1.p (timeout!)

file: KLE-01/KLE079+1.p (360 ms)

file: KLE-01/KLE080+1.p (109 ms)

$$
\cfrac{
\cfrac{
\cfrac{
\cfrac{a,b,!(a) \multimap !(!(b) \multimap !(\mathbf{0})), !(b) \multimap !(\mathbf{0}) : \cdot \vdash b}
{a,b,!(a) \multimap !(!(b) \multimap !(\mathbf{0})), !(b) \multimap !(\mathbf{0}) : \cdot \vdash !(b)} \; !
\quad
a,b,!(a) \multimap !(!(b) \multimap !(\mathbf{0})), !(b) \multimap !(\mathbf{0}) : \; !(\mathbf{0}) \vdash \mathbf{0}}
{\cfrac{a,b,!(a) \multimap !(!(b) \multimap !(\mathbf{0})), !(b) \multimap !(\mathbf{0}) : \; !(b) \multimap !(\mathbf{0}) \vdash \mathbf{0}}
{\cfrac{a,b,!(a) \multimap !(!(b) \multimap !(\mathbf{0})), !(b) \multimap !(\mathbf{0}) : \cdot \vdash \mathbf{0}}
{a,b,!(a) \multimap !(!(b) \multimap !(\mathbf{0})) : \; !(!(b) \multimap !(\mathbf{0})) \vdash \mathbf{0}} \; \star} \; D_C} \; \multimap}
{
\cfrac{
\cfrac{a,b,!(a) \multimap !(!(b) \multimap !(\mathbf{0})) : \cdot \vdash a}
{a,b,!(a) \multimap !(!(b) \multimap !(\mathbf{0})) : \cdot \vdash !(a)} \; !
\quad
a,b,!(a) \multimap !(!(b) \multimap !(\mathbf{0})) : \; !(a) \multimap !(!(b) \multimap !(\mathbf{0})) \vdash \mathbf{0}}
{\cfrac{a,b,!(a) \multimap !(!(b) \multimap !(\mathbf{0})) : \cdot \vdash \mathbf{0}}
{\cfrac{a,b : \cdot \vdash !(!(a) \multimap !(!(b) \multimap !(\mathbf{0}))) \multimap \mathbf{0}}
{\cfrac{a,b : \cdot \vdash !(!(!(a) \multimap !(!(b) \multimap !(\mathbf{0}))) \multimap \mathbf{0})}
{\cfrac{\cdot : \cdot \vdash !(!(a) \& !(b)) \multimap !(!(!(a) \multimap !(!(b) \multimap !(\mathbf{0}))) \multimap \mathbf{0})}
{\cdot : \cdot \vdash !(!(!(a) \& !(b)) \multimap !(!(!(a) \multimap !(!(b) \multimap !(\mathbf{0}))) \multimap \mathbf{0}))} \; !} \; \star} \; !} \; \star} \; D_C}
}
$$

file: KLE-01/KLE081+1.p (294 ms)

file: KLE-01/KLE082+1.p (382 ms)

file: KLE-01/KLE083+1.p (timeout!)

file: KLE-01/KLE084+1.p (timeout!)

file: KLE-01/KLE085+1.p (timeout!)

file: KLE-01/KLE086+1.p (timeout!)

file: KLE-01/KLE087+1.p (326 ms)

file: KLE-01/KLE088+1.p (timeout!)

2.2 LCL Problems

file: ILLTP-01/LCL/LCL181+1.p (timeout!)

file: ILLTP-01/LCL/LCL230+1.p (timeout!)

2.3 SYJ Problems

file: ILLTP-01/SYJ/SYJ101+1.p (24 ms)

$$\dfrac{\dfrac{}{a:\ \cdot \vdash a}}{\cdot:\ !(a) \vdash a}\ \star$$

file: ILLTP-01/SYJ/SYJ102+1.p (78 ms)

$$\cfrac{\cfrac{\cfrac{\cfrac{\cfrac{\cfrac{\cfrac{\overline{a,!(a) \multimap\, !(\mathbf{0}): \ \cdot \vdash a}}{a,!(a) \multimap\, !(\mathbf{0}): \ \cdot \vdash !(a)}\ ! \quad \overline{a,!(a) \multimap\, !(\mathbf{0}): \ !(\mathbf{0}) \vdash \mathbf{0}}\ \star}{a,!(a) \multimap\, !(\mathbf{0}): \ !(a) \multimap\, !(\mathbf{0}) \vdash \mathbf{0}}\ \multimap}{a,!(a) \multimap\, !(\mathbf{0}): \ \cdot \vdash \mathbf{0}}\ D_C}{a: \ \cdot \vdash !(!(a) \multimap\, !(\mathbf{0})) \multimap\, \mathbf{0}}\ \star}{a: \ \cdot \vdash !(!(!(a) \multimap\, !(\mathbf{0})) \multimap\, \mathbf{0})}\ !}{\cdot: \ !(a) \vdash !(!(!(a) \multimap\, !(\mathbf{0})) \multimap\, \mathbf{0})}\ \star$$

file: ILLTP-01/SYJ/SYJ103+1.p (timeout!)

file: ILLTP-01/SYJ/SYJ104+1.p (210 ms)

$$\cfrac{\cfrac{\cfrac{\cfrac{\cfrac{\cfrac{\overline{a,!(a) \multimap\, !(b): \ \cdot \vdash a}}{a,!(a) \multimap\, !(b): \ \cdot \vdash !(a)}\ ! \quad \cfrac{\overline{a,b,!(a) \multimap\, !(b): \ \cdot \vdash b}}{a,!(a) \multimap\, !(b): \ !(b) \vdash b}\ \star}{a,!(a) \multimap\, !(b): \ !(a) \multimap\, !(b) \vdash b}\ \multimap}{a,!(a) \multimap\, !(b): \ \cdot \vdash b}\ D_C}{!(a) \multimap\, !(b): \ \cdot \vdash !(a) \multimap\, b}\ \star}{!(a) \multimap\, !(b): \ \cdot \vdash !(!(a) \multimap\, b)}\ !}{\cdot: \ !(!(a) \multimap\, !(b)) \vdash !(!(a) \multimap\, b)}\ \star$$

file: ILLTP-01/SYJ/SYJ105+1.002.p (331 ms)

file: ILLTP-01/SYJ/SYJ105+1.003.p (timeout!)

file: ILLTP-01/SYJ/SYJ105+1.004.p (timeout!)

file: ILLTP-01/SYJ/SYJ106+1.p (1776 ms)

file: ILLTP-01/SYJ/SYJ107+1.001.p (777 ms)

file: ILLTP-01/SYJ/SYJ107+1.002.p (113788 ms)

file: ILLTP-01/SYJ/SYJ107+1.003.p (timeout!)

file: ILLTP-01/SYJ/SYJ107+1.004.p (timeout!)

file: ILLTP-01/SYJ/SYJ201+1.001.p (59069 ms)
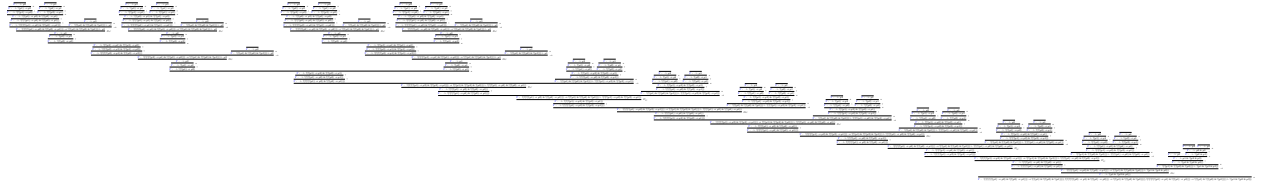
file: ILLTP-01/SYJ/SYJ201+1.002.p (timeout!)

file: ILLTP-01/SYJ/SYJ201+1.003.p (timeout!)

file: ILLTP-01/SYJ/SYJ201+1.004.p (timeout!)

file: ILLTP-01/SYJ/SYJ201+1.005.p (timeout!)

file: ILLTP-01/SYJ/SYJ201+1.006.p (timeout!)

file: ILLTP-01/SYJ/SYJ201+1.007.p (timeout!)

file: ILLTP-01/SYJ/SYJ201+1.008.p (timeout!)

file: ILLTP-01/SYJ/SYJ201+1.009.p (timeout!)

file: ILLTP-01/SYJ/SYJ201+1.010.p (timeout!)

file: ILLTP-01/SYJ/SYJ201+1.011.p (timeout!)

file: ILLTP-01/SYJ/SYJ201+1.012.p (timeout!)

file: ILLTP-01/SYJ/SYJ201+1.013.p (timeout!)

file: ILLTP-01/SYJ/SYJ201+1.014.p (timeout!)

file: ILLTP-01/SYJ/SYJ201+1.015.p (timeout!)

file: ILLTP-01/SYJ/SYJ201+1.016.p (timeout!)

file: ILLTP-01/SYJ/SYJ201+1.017.p (timeout!)

file: ILLTP-01/SYJ/SYJ201+1.018.p (timeout!)

file: ILLTP-01/SYJ/SYJ201+1.019.p (timeout!)

file: ILLTP-01/SYJ/SYJ201+1.020.p (timeout!)

file: ILLTP-01/SYJ/SYJ202+1.001.p (38 ms)

$$\cfrac{\cfrac{\cfrac{\cfrac{}{o11, o21 : \; \cdot \vdash o11}}{o11, o21 : \; \cdot \vdash !(o11)} \; ! }{o11, o21 : \; \cdot \vdash !(o11) \oplus !(o21)} \; \oplus_1}{\cdot : \; !(o11), !(o21) \vdash !(o11) \oplus !(o21)} \; \star$$

file: ILLTP-01/SYJ/SYJ202+1.002.p (timeout!)

file: ILLTP-01/SYJ/SYJ202+1.003.p (timeout!)

file: ILLTP-01/SYJ/SYJ202+1.004.p (timeout!)

file: ILLTP-01/SYJ/SYJ202+1.005.p (timeout!)

file: ILLTP-01/SYJ/SYJ202+1.006.p (timeout!)

file: ILLTP-01/SYJ/SYJ202+1.007.p (timeout!)

file: ILLTP-01/SYJ/SYJ202+1.008.p (timeout!)

file: ILLTP-01/SYJ/SYJ202+1.009.p (timeout!)

file: ILLTP-01/SYJ/SYJ202+1.010.p (timeout!)

```
file: ILLTP-01/SYJ/SYJ202+1.011.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ202+1.012.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ202+1.013.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ202+1.014.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ202+1.015.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ202+1.016.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ202+1.017.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ202+1.018.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ202+1.019.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ202+1.020.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ203+1.001.p (708 ms)
```
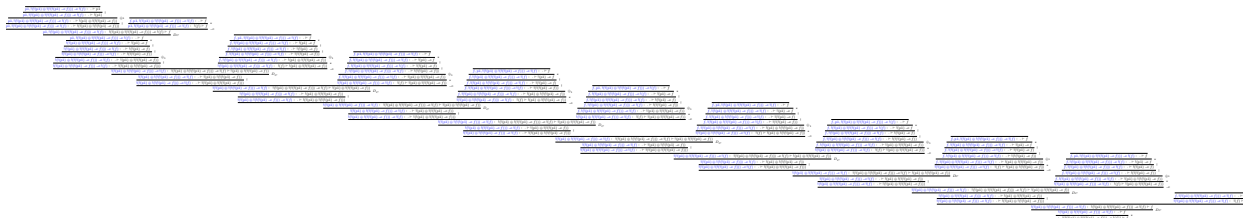


```
file: ILLTP-01/SYJ/SYJ203+1.002.p (4141 ms)
```



```
file: ILLTP-01/SYJ/SYJ203+1.003.p (4196 ms)
```
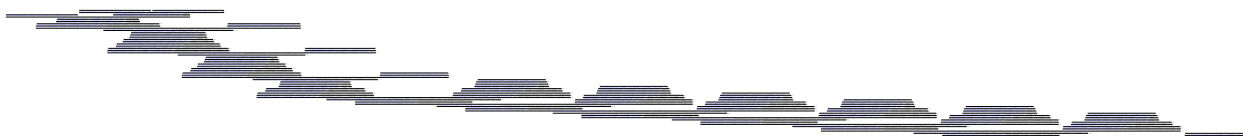


```
file: ILLTP-01/SYJ/SYJ203+1.004.p (5121 ms)
```



```
file: ILLTP-01/SYJ/SYJ203+1.005.p (7110 ms)
```
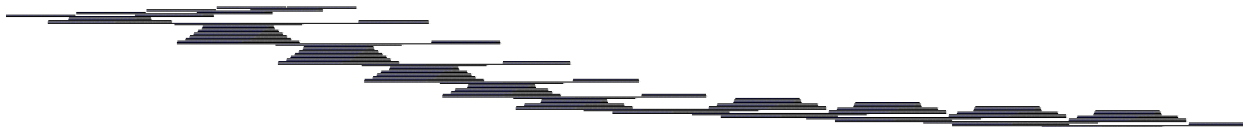


```
file: ILLTP-01/SYJ/SYJ203+1.006.p (11445 ms)
```

Not shown due to LATEX restrictions.

file: ILLTP-01/SYJ/SYJ203+1.007.p (21914 ms)

Not shown due to LATEX restrictions.

file: ILLTP-01/SYJ/SYJ203+1.008.p (46238 ms)

Not shown due to LATEX restrictions.

file: ILLTP-01/SYJ/SYJ203+1.009.p (97294 ms)

Not shown due to LATEX restrictions.

file: ILLTP-01/SYJ/SYJ203+1.010.p (timeout!)

file: ILLTP-01/SYJ/SYJ203+1.011.p (timeout!)

file: ILLTP-01/SYJ/SYJ203+1.012.p (timeout!)

file: ILLTP-01/SYJ/SYJ203+1.013.p (timeout!)

file: ILLTP-01/SYJ/SYJ203+1.014.p (timeout!)

file: ILLTP-01/SYJ/SYJ203+1.015.p (timeout!)

file: ILLTP-01/SYJ/SYJ203+1.016.p (timeout!)

file: ILLTP-01/SYJ/SYJ203+1.017.p (timeout!)

file: ILLTP-01/SYJ/SYJ203+1.018.p (timeout!)

file: ILLTP-01/SYJ/SYJ203+1.019.p (timeout!)

file: ILLTP-01/SYJ/SYJ203+1.020.p (timeout!)

file: ILLTP-01/SYJ/SYJ204+1.001.p (96 ms)

$$
\cfrac{
\cfrac{
\cfrac{p1, !(p1) \multimap !(p0), !(p1) \multimap !(!(p1) \multimap !(p0)) : \ \cdot \vdash p1}{p1, !(p1) \multimap !(p0), !(p1) \multimap !(!(p1) \multimap !(p0)) : \ \cdot \vdash !(p1)} \ ! \quad
\cfrac{p0, p1, !(p1) \multimap !(p0), !(p1) \multimap !(!(p1) \multimap !(p0)) : \ \cdot \vdash p0}{p1, !(p1) \multimap !(p0), !(p1) \multimap !(!(p1) \multimap !(p0)) : \ !(p0) \vdash p0} \ \star}{p1, !(p1) \multimap !(p0), !(p1) \multimap !(!(p1) \multimap !(p0)) : \ !(p1) \multimap !(p0) \vdash p0} \ \multimap
}{
\cfrac{
\cfrac{p1, !(p1) \multimap !(!(p1) \multimap !(p0)) : \ \cdot \vdash p1}{p1, !(p1) \multimap !(!(p1) \multimap !(p0)) : \ \cdot \vdash !(p1)} \ ! \quad
\cfrac{p1, !(p1) \multimap !(p0), !(p1) \multimap !(!(p1) \multimap !(p0)) : \ \cdot \vdash p0}{p1, !(p1) \multimap !(!(p1) \multimap !(p0)) : \ !(!(p1) \multimap !(p0)) \vdash p0} \ \star}{p1, !(p1) \multimap !(!(p1) \multimap !(p0)) : \ !(p1) \multimap !(!(p1) \multimap !(p0)) \vdash p0} \ D_C
}{
\cfrac{p1, !(p1) \multimap !(!(p1) \multimap !(p0)) : \ \cdot \vdash p0}{\cdot : \ !(p1), !(!(p1) \multimap !(!(p1) \multimap !(p0))) \vdash p0} \ \star} \ D_C
$$

file: ILLTP-01/SYJ/SYJ204+1.002.p (512 ms)

file: ILLTP-01/SYJ/SYJ204+1.003.p (1919 ms)

file: ILLTP-01/SYJ/SYJ204+1.004.p (9018 ms)

file: ILLTP-01/SYJ/SYJ204+1.005.p (34407 ms)

```
file: ILLTP-01/SYJ/SYJ204+1.006.p (145814 ms)
```

```
file: ILLTP-01/SYJ/SYJ204+1.007.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ204+1.008.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ204+1.009.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ204+1.010.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ204+1.011.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ204+1.012.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ204+1.013.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ204+1.014.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ204+1.015.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ204+1.016.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ204+1.017.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ204+1.018.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ204+1.019.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ204+1.020.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ205+1.001.p (31385 ms)
```

```
file: ILLTP-01/SYJ/SYJ205+1.002.p (93005 ms)
```

```
file: ILLTP-01/SYJ/SYJ205+1.003.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ205+1.004.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ205+1.005.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ205+1.006.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ205+1.007.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ205+1.008.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ205+1.009.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ205+1.010.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ205+1.011.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ205+1.012.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ205+1.013.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ205+1.014.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ205+1.015.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ205+1.016.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ205+1.017.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ205+1.018.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ205+1.019.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ205+1.020.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ206+1.001.p (46 ms)
```

$$
\cfrac{
  \cfrac{
    \cfrac{\overline{a1:\ \cdot \vdash a1}}{\cdot:\ \cdot \vdash\ !(a1)\multimap a1}\ \star
  }{\cdot:\ \cdot \vdash\ !(!(a1)\multimap a1)}\ !
  \quad
  \cfrac{
    \cfrac{\overline{a1:\ \cdot \vdash a1}}{\cdot:\ \cdot \vdash\ !(a1)\multimap a1}\ \star
  }{\cdot:\ \cdot \vdash\ !(!(a1)\multimap a1)}\ !
}{
  \cfrac{\cdot:\ \cdot \vdash\ !(!(a1)\multimap a1)\ \&\ !(!(a1)\multimap a1)}{\cdot:\ \cdot \vdash\ !(!(!(a1)\multimap a1)\ \&\ !(!(a1)\multimap a1))}\ !
}\ \star
$$

```
file: ILLTP-01/SYJ/SYJ206+1.002.p (494 ms)
```



```
file: ILLTP-01/SYJ/SYJ206+1.003.p (58237 ms)
```



```
file: ILLTP-01/SYJ/SYJ206+1.004.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ206+1.005.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ206+1.006.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ206+1.007.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ206+1.008.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ206+1.009.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ206+1.010.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ206+1.011.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ206+1.012.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ206+1.013.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ206+1.014.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ206+1.015.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ206+1.016.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ206+1.017.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ206+1.018.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ206+1.019.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ206+1.020.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ207+1.001.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ207+1.002.p (timeout!)

file: ILLTP-01/SYJ/SYJ207+1.003.p (timeout!)

file: ILLTP-01/SYJ/SYJ207+1.004.p (timeout!)

file: ILLTP-01/SYJ/SYJ207+1.005.p (timeout!)

file: ILLTP-01/SYJ/SYJ207+1.006.p (timeout!)

file: ILLTP-01/SYJ/SYJ207+1.007.p (timeout!)

file: ILLTP-01/SYJ/SYJ207+1.008.p (timeout!)

file: ILLTP-01/SYJ/SYJ207+1.009.p (timeout!)

file: ILLTP-01/SYJ/SYJ207+1.010.p (timeout!)

file: ILLTP-01/SYJ/SYJ207+1.011.p (timeout!)

file: ILLTP-01/SYJ/SYJ207+1.012.p (timeout!)

file: ILLTP-01/SYJ/SYJ207+1.013.p (timeout!)

file: ILLTP-01/SYJ/SYJ207+1.014.p (timeout!)

file: ILLTP-01/SYJ/SYJ207+1.015.p (timeout!)

file: ILLTP-01/SYJ/SYJ207+1.016.p (timeout!)

file: ILLTP-01/SYJ/SYJ207+1.017.p (timeout!)

file: ILLTP-01/SYJ/SYJ207+1.018.p (timeout!)

file: ILLTP-01/SYJ/SYJ207+1.019.p (timeout!)

file: ILLTP-01/SYJ/SYJ207+1.020.p (timeout!)

file: ILLTP-01/SYJ/SYJ208+1.001.p (timeout!)

file: ILLTP-01/SYJ/SYJ208+1.002.p (timeout!)

file: ILLTP-01/SYJ/SYJ208+1.003.p (timeout!)

file: ILLTP-01/SYJ/SYJ208+1.004.p (timeout!)

file: ILLTP-01/SYJ/SYJ208+1.005.p (timeout!)

file: ILLTP-01/SYJ/SYJ208+1.006.p (timeout!)

file: ILLTP-01/SYJ/SYJ208+1.007.p (timeout!)

file: ILLTP-01/SYJ/SYJ208+1.008.p (timeout!)

file: ILLTP-01/SYJ/SYJ208+1.009.p (timeout!)

file: ILLTP-01/SYJ/SYJ208+1.010.p (timeout!)

file: ILLTP-01/SYJ/SYJ208+1.011.p (timeout!)

file: ILLTP-01/SYJ/SYJ208+1.012.p (timeout!)

file: ILLTP-01/SYJ/SYJ208+1.013.p (timeout!)

file: ILLTP-01/SYJ/SYJ208+1.014.p (timeout!)

file: ILLTP-01/SYJ/SYJ208+1.015.p (timeout!)

file: ILLTP-01/SYJ/SYJ208+1.016.p (timeout!)

file: ILLTP-01/SYJ/SYJ208+1.017.p (timeout!)
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file: ILLTP-01/SYJ/SYJ208+1.018.p (timeout!)
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file: ILLTP-01/SYJ/SYJ208+1.019.p (timeout!)
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```
file: ILLTP-01/SYJ/SYJ208+1.020.p (timeout!)
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```
file: ILLTP-01/SYJ/SYJ209+1.001.p (timeout!)
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```
file: ILLTP-01/SYJ/SYJ209+1.002.p (timeout!)
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file: ILLTP-01/SYJ/SYJ209+1.003.p (timeout!)
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file: ILLTP-01/SYJ/SYJ209+1.004.p (timeout!)
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file: ILLTP-01/SYJ/SYJ209+1.005.p (timeout!)
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file: ILLTP-01/SYJ/SYJ209+1.006.p (timeout!)
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```
file: ILLTP-01/SYJ/SYJ209+1.007.p (timeout!)
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file: ILLTP-01/SYJ/SYJ209+1.008.p (timeout!)
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file: ILLTP-01/SYJ/SYJ209+1.009.p (timeout!)
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file: ILLTP-01/SYJ/SYJ209+1.010.p (timeout!)
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file: ILLTP-01/SYJ/SYJ209+1.011.p (timeout!)
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file: ILLTP-01/SYJ/SYJ209+1.012.p (timeout!)
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file: ILLTP-01/SYJ/SYJ209+1.013.p (timeout!)
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file: ILLTP-01/SYJ/SYJ209+1.014.p (timeout!)
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file: ILLTP-01/SYJ/SYJ209+1.015.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ209+1.016.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ209+1.017.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ209+1.018.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ209+1.019.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ209+1.020.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ210+1.001.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ210+1.002.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ210+1.003.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ210+1.004.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ210+1.005.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ210+1.006.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ210+1.007.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ210+1.008.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ210+1.009.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ210+1.010.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ210+1.011.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ210+1.012.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ210+1.013.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ210+1.014.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ210+1.015.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ210+1.016.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ210+1.017.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ210+1.018.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ210+1.019.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ210+1.020.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ211+1.001.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ211+1.002.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ211+1.003.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ211+1.004.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ211+1.005.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ211+1.006.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ211+1.007.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ211+1.008.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ211+1.009.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ211+1.010.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ211+1.011.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ211+1.012.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ211+1.013.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ211+1.014.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ211+1.015.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ211+1.016.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ211+1.017.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ211+1.018.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ211+1.019.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ211+1.020.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ212+1.001.p (1303 ms)
```



```
file: ILLTP-01/SYJ/SYJ212+1.002.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ212+1.003.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ212+1.004.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ212+1.005.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ212+1.006.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ212+1.007.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ212+1.008.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ212+1.009.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ212+1.010.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ212+1.011.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ212+1.012.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ212+1.013.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ212+1.014.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ212+1.015.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ212+1.016.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ212+1.017.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ212+1.018.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ212+1.019.p (timeout!)
```

```
file: ILLTP-01/SYJ/SYJ212+1.020.p (timeout!)
```

2.4 SYN Problems

```
file: ILLTP-01/SYN/SYN001+1.p (316 ms)
```
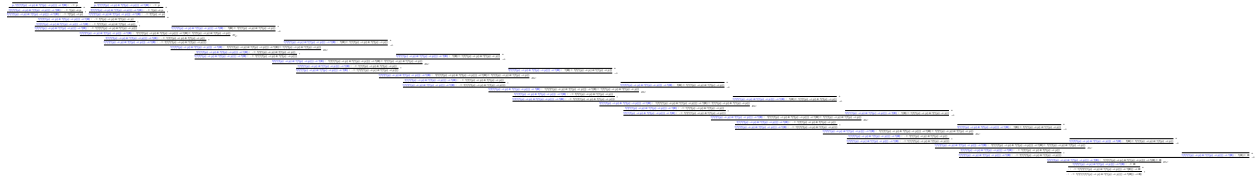


```
file: ILLTP-01/SYN/SYN007+1.014.p (timeout!)
```

```
file: ILLTP-01/SYN/SYN040+1.p (timeout!)
```

```
file: ILLTP-01/SYN/SYN041+1.p (timeout!)
```

```
file: ILLTP-01/SYN/SYN044+1.p (633 ms)
```



```
file: ILLTP-01/SYN/SYN045+1.p (812 ms)
```
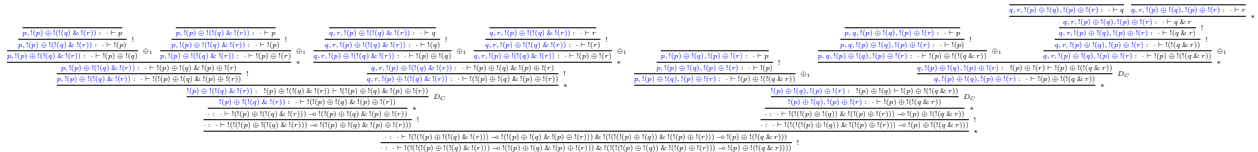


```
file: ILLTP-01/SYN/SYN046+1.p (timeout!)
```

```
file: ILLTP-01/SYN/SYN047+1.p (timeout!)
```

$$
\cfrac{
  \cfrac{
    \cfrac{\overline{p:\ \cdot \vdash p}}{\cdot:\ \cdot \vdash \,!(p) \multimap p}\ \star
  }{\cdot:\ \cdot \vdash \,!(!(p) \multimap p)}\ !
  \qquad
  \cfrac{
    \cfrac{\overline{p:\ \cdot \vdash p}}{\cdot:\ \cdot \vdash \,!(p) \multimap p}\ \star
  }{\cdot:\ \cdot \vdash \,!(!(p) \multimap p)}\ !
}{
  \cfrac{\cdot:\ \cdot \vdash \,!(!(p) \multimap p)\ \&\ !(!(p) \multimap p)}{\cdot:\ \cdot \vdash \,!(!(!(p) \multimap p)\ \&\ !(!(p) \multimap p))}\ !
}\ \star
$$

$$
\overline{\cdot:\ \cdot \vdash \mathbf{1}}
$$

$$
\cfrac{
  \cfrac{
    \cfrac{
      \cfrac{
        \cfrac{\overline{a,b:\ \cdot \vdash b}}{a,b:\ \cdot \vdash \,!(a) \multimap b}\ \star
      }{a,b:\ \cdot \vdash \,!(!(a) \multimap b)}\ !
      \qquad
      \cfrac{
        \cfrac{\overline{a,b:\ \cdot \vdash a}}{a,b:\ \cdot \vdash \,!(b) \multimap a}\ \star
      }{a,b:\ \cdot \vdash \,!(!(b) \multimap a)}\ !
    }{
      \cfrac{a,b:\ \cdot \vdash \,!(!(a) \multimap b)\ \&\ !(!(b) \multimap a)}{a,b:\ \cdot \vdash \,!(!(!(a) \multimap b)\ \&\ !(!(b) \multimap a))}\ !
    }\ \star
  }{\cdot:\ \cdot \vdash \,!(!(a)\ \&\ !(b)) \multimap \,!(!(!(a) \multimap b)\ \&\ !(!(b) \multimap a))}\ \star
}{\cdot:\ \cdot \vdash \,!(!(!(a)\ \&\ !(b)) \multimap \,!(!(!(a) \multimap b)\ \&\ !(!(b) \multimap a)))}\ !
$$

3 Translation Call-by-Name

3.1 KLE Problems

$$
\cfrac{\overline{a:\ \cdot \vdash a}}{\cdot:\ \cdot \vdash \,!(a) \multimap a}\ \star
$$

$$\dfrac{\dfrac{\dfrac{\overline{a, !(a) \multimap b, !(b) \multimap c : \ \cdot \vdash a}}{a, !(a) \multimap b, !(b) \multimap c : \ \cdot \vdash !(a)} \ ! \quad \overline{a, !(a) \multimap b, !(b) \multimap c : \ b \vdash b}}{\dfrac{\dfrac{a, !(a) \multimap b, !(b) \multimap c : \ !(a) \multimap b \vdash b}{a, !(a) \multimap b, !(b) \multimap c : \ \cdot \vdash b}}{a, !(a) \multimap b, !(b) \multimap c : \ \cdot \vdash !(b)} \ ! \quad D_C} \multimap \quad \overline{a, !(a) \multimap b, !(b) \multimap c : \ c \vdash c}}{\dfrac{\dfrac{a, !(a) \multimap b, !(b) \multimap c : \ !(b) \multimap c \vdash c}{a, !(a) \multimap b, !(b) \multimap c : \ \cdot \vdash c}}{\cdot : \ !(!(a) \multimap b), !(!(b) \multimap c) \vdash !(a) \multimap c} \ \star} D_C \multimap$$

file: KLE-cbn/KLE003+1.p (71 ms)

$$\dfrac{\dfrac{\dfrac{\overline{a, b, !(a) \multimap !(b) \multimap c : \ \cdot \vdash a}}{a, b, !(a) \multimap !(b) \multimap c : \ \cdot \vdash !(a)} \ ! \quad \dfrac{\dfrac{\overline{a, b, !(a) \multimap !(b) \multimap c : \ \cdot \vdash b}}{a, b, !(a) \multimap !(b) \multimap c : \ \cdot \vdash !(b)} \ ! \quad \overline{a, b, !(a) \multimap !(b) \multimap c : \ c \vdash c}}{a, b, !(a) \multimap !(b) \multimap c : \ !(b) \multimap c \vdash c} \multimap}{a, b, !(a) \multimap !(b) \multimap c : \ !(a) \multimap !(b) \multimap c \vdash c} \multimap}{\dfrac{a, b, !(a) \multimap !(b) \multimap c : \ \cdot \vdash c}{\cdot : \ !(!(a) \multimap !(b) \multimap c) \vdash !(b) \multimap !(a) \multimap c} \ \star} D_C$$

file: KLE-cbn/KLE004+1.p (71 ms)

$$\dfrac{\dfrac{\dfrac{\overline{a, b, !(a) \multimap !(b) \multimap c : \ \cdot \vdash a}}{a, b, !(a) \multimap !(b) \multimap c : \ \cdot \vdash !(a)} \ ! \quad \dfrac{\dfrac{\overline{a, b, !(a) \multimap !(b) \multimap c : \ \cdot \vdash b}}{a, b, !(a) \multimap !(b) \multimap c : \ \cdot \vdash !(b)} \ ! \quad \overline{a, b, !(a) \multimap !(b) \multimap c : \ c \vdash c}}{a, b, !(a) \multimap !(b) \multimap c : \ !(b) \multimap c \vdash c} \multimap}{a, b, !(a) \multimap !(b) \multimap c : \ !(a) \multimap !(b) \multimap c \vdash c} \multimap}{\dfrac{a, b, !(a) \multimap !(b) \multimap c : \ \cdot \vdash c}{\cdot : \ !(!(a) \multimap !(b) \multimap c) \vdash !(a \,\&\, b) \multimap c} \ \star} D_C$$

file: KLE-cbn/KLE005+1.p (79 ms)

$$\dfrac{\dfrac{\dfrac{\dfrac{\overline{a, b, !(a \,\&\, b) \multimap c : \ \cdot \vdash a} \quad \overline{a, b, !(a \,\&\, b) \multimap c : \ \cdot \vdash b}}{a, b, !(a \,\&\, b) \multimap c : \ \cdot \vdash a \,\&\, b} \ \star}{a, b, !(a \,\&\, b) \multimap c : \ \cdot \vdash !(a \,\&\, b)} \ ! \quad \overline{a, b, !(a \,\&\, b) \multimap c : \ c \vdash c}}{\dfrac{a, b, !(a \,\&\, b) \multimap c : \ !(a \,\&\, b) \multimap c \vdash c}{a, b, !(a \,\&\, b) \multimap c : \ \cdot \vdash c}} \multimap}{\cdot : \ !(!(a \,\&\, b) \multimap c) \vdash !(a) \multimap !(b) \multimap c} \ \star} D_C$$

file: KLE-cbn/KLE006+1.p (221 ms)

$$\cfrac{\cfrac{\cfrac{\cfrac{\cfrac{\overline{a, !(a) \multimap b, !(b) \multimap c : \ \cdot \vdash a}}{a, !(a) \multimap b, !(b) \multimap c : \ \cdot \vdash !(a)} \ ! \quad \overline{a, !(a) \multimap b, !(b) \multimap c : \ b \vdash b}}{a, !(a) \multimap b, !(b) \multimap c : \ !(a) \multimap b \vdash b} \multimap}{a, !(a) \multimap b, !(b) \multimap c : \ \cdot \vdash b} \ D_C}{a, !(a) \multimap b, !(b) \multimap c : \ \cdot \vdash !(b)} \ ! \quad \overline{a, !(a) \multimap b, !(b) \multimap c : \ c \vdash c}}{\cfrac{a, !(a) \multimap b, !(b) \multimap c : \ !(b) \multimap c \vdash c}{a, !(a) \multimap b, !(b) \multimap c : \ \cdot \vdash c} \ D_C} \multimap}{\cdot : \ !(!(a) \multimap b) \vdash !(!(b) \multimap c) \multimap !(a) \multimap c} \ \star$$

file: KLE-cbn/KLE007+1.p (222 ms)

$$\cfrac{\cfrac{\cfrac{\cfrac{\cfrac{\overline{c, !(a) \multimap b, !(c) \multimap a : \ \cdot \vdash c}}{c, !(a) \multimap b, !(c) \multimap a : \ \cdot \vdash !(c)} \ ! \quad \overline{c, !(a) \multimap b, !(c) \multimap a : \ a \vdash a}}{c, !(a) \multimap b, !(c) \multimap a : \ !(c) \multimap a \vdash a} \multimap}{c, !(a) \multimap b, !(c) \multimap a : \ \cdot \vdash a} \ D_C}{c, !(a) \multimap b, !(c) \multimap a : \ \cdot \vdash !(a)} \ ! \quad \overline{c, !(a) \multimap b, !(c) \multimap a : \ b \vdash b}}{\cfrac{c, !(a) \multimap b, !(c) \multimap a : \ !(a) \multimap b \vdash b}{c, !(a) \multimap b, !(c) \multimap a : \ \cdot \vdash b} \ D_C} \multimap}{\cdot : \ !(!(a) \multimap b) \vdash !(!(c) \multimap a) \multimap !(c) \multimap b} \ \star$$

file: KLE-cbn/KLE008+1.p (73 ms)

$$\cfrac{\cfrac{\cfrac{\cfrac{\overline{a, c, !(a) \multimap b : \ \cdot \vdash a}}{a, c, !(a) \multimap b : \ \cdot \vdash !(a)} \ ! \quad \overline{a, c, !(a) \multimap b : \ b \vdash b}}{a, c, !(a) \multimap b : \ !(a) \multimap b \vdash b} \multimap}{a, c, !(a) \multimap b : \ \cdot \vdash b} \ D_C \quad \overline{a, c, !(a) \multimap b : \ \cdot \vdash c}}{\cdot : \ !(!(a) \multimap b) \vdash !(a \& c) \multimap b \& c} \ \star$$

file: KLE-cbn/KLE009+1.p (62 ms)

$$\cfrac{\overline{a, c, !(a) \multimap b : \ \cdot \vdash c} \quad \cfrac{\cfrac{\cfrac{\overline{a, c, !(a) \multimap b : \ \cdot \vdash a}}{a, c, !(a) \multimap b : \ \cdot \vdash !(a)} \ ! \quad \overline{a, c, !(a) \multimap b : \ b \vdash b}}{a, c, !(a) \multimap b : \ !(a) \multimap b \vdash b} \multimap}{a, c, !(a) \multimap b : \ \cdot \vdash b} \ D_C}{\cdot : \ !(!(a) \multimap b) \vdash !(c \& a) \multimap c \& b} \ \star$$

file: KLE-cbn/KLE010+1.p (463 ms)

31

$$\cdots$$

$$
\cfrac{
  \cfrac{
    \cfrac{
      \cfrac{a,!(c)\oplus!(a),!(a)\multimap b:\ \cdot\vdash a}{a,!(c)\oplus!(a),!(a)\multimap b:\ \cdot\vdash!(a)}\ !
      \quad \overline{a,!(c)\oplus!(a),!(a)\multimap b:\ b\vdash b}
    }{
      \cfrac{a,!(c)\oplus!(a),!(a)\multimap b:\ !(a)\multimap b\vdash b}{
        \cfrac{a,!(c)\oplus!(a),!(a)\multimap b:\ \cdot\vdash b}{a,!(c)\oplus!(a),!(a)\multimap b:\ \cdot\vdash!(b)}\ !
      }\ D_C
    }{a,!(c)\oplus!(a),!(a)\multimap b:\ \cdot\vdash!(c)\oplus!(b)}\ \oplus_1
  }{\ \star}
}{\ }
$$

$$
\cfrac{
  \cfrac{\cfrac{\overline{c,!(c)\oplus!(a),!(a)\multimap b:\ \cdot\vdash c}}{c,!(c)\oplus!(a),!(a)\multimap b:\ \cdot\vdash!(c)}\ !}{c,!(c)\oplus!(a),!(a)\multimap b:\ \cdot\vdash!(c)\oplus!(b)}\ \oplus_1
  \qquad
  (\text{right branch})
}{
  \cfrac{!(c)\oplus!(a),!(a)\multimap b:\ !(c)\oplus!(a)\vdash!(c)\oplus!(b)}{
    \cfrac{!(c)\oplus!(a),!(a)\multimap b:\ \cdot\vdash!(c)\oplus!(b)}{\cdot:\ !(!(a)\multimap b)\vdash!(!(c)\oplus!(a))\multimap!(c)\oplus!(b)}\ \star
  }\ D_C
}
$$

$$
\cfrac{
  \cfrac{
    \cfrac{\overline{a,!(a)\multimap\mathbf{0}:\ \cdot\vdash a}}{a,!(a)\multimap\mathbf{0}:\ \cdot\vdash!(a)}\ !
    \qquad
    \overline{a,!(a)\multimap\mathbf{0}:\ \mathbf{0}\vdash b}\ \star
  }{
    \cfrac{a,!(a)\multimap\mathbf{0}:\ !(a)\multimap\mathbf{0}\vdash b}{a,!(a)\multimap\mathbf{0}:\ \cdot\vdash b}\ D_C
  }\ \multimap
}{\cdot:\ !(!(a)\multimap\mathbf{0})\vdash!(a)\multimap b}\ \star
$$

$$
\cfrac{\overline{a,b:\ \cdot\vdash b}}{\cdot:\ !(b)\vdash!(a)\multimap b}\ \star
$$

$$
\cfrac{
  \cfrac{
    \cfrac{\overline{a,b,!(a)\multimap!(b)\multimap\mathbf{0}:\ \cdot\vdash a}}{a,b,!(a)\multimap!(b)\multimap\mathbf{0}:\ \cdot\vdash!(a)}\ !
    \qquad
    \cfrac{
      \cfrac{\overline{a,b,!(a)\multimap!(b)\multimap\mathbf{0}:\ \cdot\vdash b}}{a,b,!(a)\multimap!(b)\multimap\mathbf{0}:\ \cdot\vdash!(b)}\ !
      \quad \overline{a,b,!(a)\multimap!(b)\multimap\mathbf{0}:\ \mathbf{0}\vdash\mathbf{0}}\ \star
    }{a,b,!(a)\multimap!(b)\multimap\mathbf{0}:\ !(b)\multimap\mathbf{0}\vdash\mathbf{0}}\ \multimap
  }{
    \cfrac{a,b,!(a)\multimap!(b)\multimap\mathbf{0}:\ !(a)\multimap!(b)\multimap\mathbf{0}\vdash\mathbf{0}}{
      \cfrac{a,b,!(a)\multimap!(b)\multimap\mathbf{0}:\ \cdot\vdash\mathbf{0}}{\cdot:\ !(!(a)\multimap!(b)\multimap\mathbf{0})\vdash!(b)\multimap!(a)\multimap\mathbf{0}}\ \star
    }\ D_C
  }\ \multimap
}{\ }
$$

$$
\cfrac{
\cfrac{
\cfrac{\overline{a,!(a)\multimap b,!(b)\multimap a:\ \cdot\vdash a}}{a,!(a)\multimap b,!(b)\multimap a:\ \cdot\vdash !(a)}\ ^{!}\quad \overline{a,!(a)\multimap b,!(b)\multimap a:\ b\vdash b}
}{
\cfrac{a,!(a)\multimap b,!(b)\multimap a:\ !(a)\multimap b\vdash b}{a,!(a)\multimap b,!(b)\multimap a:\ \cdot\vdash b}\ ^{D_C}
}\ ^{\multimap}
\qquad
\cfrac{
\cfrac{\overline{b,!(a)\multimap b,!(b)\multimap a:\ \cdot\vdash b}}{b,!(a)\multimap b,!(b)\multimap a:\ \cdot\vdash !(b)}\ ^{!}\quad \overline{b,!(a)\multimap b,!(b)\multimap a:\ a\vdash a}
}{
\cfrac{b,!(a)\multimap b,!(b)\multimap a:\ !(b)\multimap a\vdash a}{b,!(a)\multimap b,!(b)\multimap a:\ \cdot\vdash a}\ ^{D_C}
}\ ^{\multimap}
}{
\cdot:\ !(!(a)\multimap b),!(!(b)\multimap a)\vdash !(a)\multimap b\ \&\ !(b)\multimap a
}\ ^{\star}
$$

$$
\cfrac{
\cfrac{\overline{a,!(a)\multimap b,!(b)\multimap a:\ \cdot\vdash a}}{a,!(a)\multimap b,!(b)\multimap a:\ \cdot\vdash !(a)}\ ^{!}\quad \overline{a,!(a)\multimap b,!(b)\multimap a:\ b\vdash b}
}{
\cfrac{\cfrac{a,!(a)\multimap b,!(b)\multimap a:\ !(a)\multimap b\vdash b}{a,!(a)\multimap b,!(b)\multimap a:\ \cdot\vdash b}\ ^{D_C}}{\cdot:\ !(!(a)\multimap b\ \&\ !(b)\multimap a)\vdash !(a)\multimap b}\ ^{\star}
}\ ^{\multimap}
$$

$$
\cfrac{
\cfrac{\overline{b,!(a)\multimap b,!(b)\multimap a:\ \cdot\vdash b}}{b,!(a)\multimap b,!(b)\multimap a:\ \cdot\vdash !(b)}\ ^{!}\quad \overline{b,!(a)\multimap b,!(b)\multimap a:\ a\vdash a}
}{
\cfrac{\cfrac{b,!(a)\multimap b,!(b)\multimap a:\ !(b)\multimap a\vdash a}{b,!(a)\multimap b,!(b)\multimap a:\ \cdot\vdash a}\ ^{D_C}}{\cdot:\ !(!(a)\multimap b\ \&\ !(b)\multimap a)\vdash !(b)\multimap a}\ ^{\star}
}\ ^{\multimap}
$$

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$$\cfrac{\cfrac{\cfrac{\overline{a, !(a) \multimap b, !(b) \multimap a : \ \cdot \vdash a}}{a, !(a) \multimap b, !(b) \multimap a : \ \cdot \vdash !(a)} \ ! \quad \cfrac{\overline{a, !(a) \multimap b, !(b) \multimap a : \ b \vdash b}}{}}{\cfrac{a, !(a) \multimap b, !(b) \multimap a : \ !(a) \multimap b \vdash b}{a, !(a) \multimap b, !(b) \multimap a : \ \cdot \vdash b} \ D_C} \ \multimap}{\cdot : \ !(a), !(!(a) \multimap b \ \& \ !(b) \multimap a) \vdash b} \ \star$$

$$\cfrac{\cfrac{\cfrac{\overline{b, !(a) \multimap b, !(b) \multimap a : \ \cdot \vdash b}}{b, !(a) \multimap b, !(b) \multimap a : \ \cdot \vdash !(b)} \ ! \quad \cfrac{\overline{b, !(a) \multimap b, !(b) \multimap a : \ a \vdash a}}{}}{\cfrac{b, !(a) \multimap b, !(b) \multimap a : \ !(b) \multimap a \vdash a}{b, !(a) \multimap b, !(b) \multimap a : \ \cdot \vdash a} \ D_C} \ \multimap}{\cdot : \ !(b), !(!(a) \multimap b \ \& \ !(b) \multimap a) \vdash a} \ \star$$

$$\cfrac{\overline{a : \ \cdot \vdash a} \quad \overline{a : \ \cdot \vdash a}}{\cdot : \ \cdot \vdash !(a) \multimap a \ \& \ !(a) \multimap a} \ \star$$

$$\cfrac{\cfrac{\cfrac{\overline{b, !(a) \multimap b, !(b) \multimap a : \ \cdot \vdash b}}{b, !(a) \multimap b, !(b) \multimap a : \ \cdot \vdash !(b)} \ ! \ \overline{b, !(a) \multimap b, !(b) \multimap a : \ a \vdash a}}{\cfrac{b, !(a) \multimap b, !(b) \multimap a : \ !(b) \multimap a \vdash a}{b, !(a) \multimap b, !(b) \multimap a : \ \cdot \vdash a} \ D_C} \ \multimap \quad \cfrac{\cfrac{\overline{a, !(a) \multimap b, !(b) \multimap a : \ \cdot \vdash a}}{a, !(a) \multimap b, !(b) \multimap a : \ \cdot \vdash !(a)} \ ! \ \overline{a, !(a) \multimap b, !(b) \multimap a : \ b \vdash b}}{\cfrac{a, !(a) \multimap b, !(b) \multimap a : \ !(a) \multimap b \vdash b}{a, !(a) \multimap b, !(b) \multimap a : \ \cdot \vdash b} \ D_C} \ \multimap}{\cdot : \ !(!(a) \multimap b \ \& \ !(b) \multimap a) \vdash !(b) \multimap a \ \& \ !(a) \multimap b} \ \star$$

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file: KLE-cbn/KLE029+1.p (921 ms)

file: KLE-cbn/KLE030+1.p (27712 ms)

file: KLE-cbn/KLE031+1.p (237319 ms)

file: KLE-cbn/KLE032+1.p (303 ms)

$$\cdot:\ !(!(a) \multimap b\ \&\ !(b) \multimap a) \vdash !(!(a) \multimap c) \multimap !(b) \multimap c\ \&\ !(!(b) \multimap c) \multimap !(a) \multimap c \quad \star$$

file: KLE-cbn/KLE033+1.p (643 ms)

file: KLE-cbn/KLE034+1.p (258 ms)

$$\cdot:\ !(!(a) \multimap b\ \&\ !(b) \multimap a) \vdash !(a\ \&\ c) \multimap b\ \&\ c\ \&\ !(b\ \&\ c) \multimap a\ \&\ c \quad \star$$

file: KLE-cbn/KLE035+1.p (257 ms)

$$\cdot:\ !(!(a) \multimap b\ \&\ !(b) \multimap a) \vdash !(c\ \&\ a) \multimap c\ \&\ b\ \&\ !(c\ \&\ b) \multimap c\ \&\ a \quad \star$$

file: KLE-cbn/KLE036+1.p (7420 ms)

file: KLE-cbn/KLE037+1.p (5515 ms)

35

file: KLE-cbn/KLE038+1.p (844 ms)

file: KLE-cbn/KLE039+1.p (31 ms)

$$
\cfrac{\overline{a,b,c:\ \cdot\vdash a}\quad \overline{a,b,c:\ \cdot\vdash b}\quad \overline{a,b,c:\ \cdot\vdash c}\quad \overline{a,b,c:\ \cdot\vdash a}\quad \overline{a,b,c:\ \cdot\vdash b}\quad \overline{a,b,c:\ \cdot\vdash c}}{\cdot:\ \cdot\vdash\ !(a\ \&\ b\ \&\ c)\multimap a\ \&\ b\ \&\ c\ \&\ !(a\ \&\ b\ \&\ c)\multimap a\ \&\ b\ \&\ c}\ \star
$$

file: KLE-cbn/KLE040+1.p (1297 ms)

file: KLE-cbn/KLE041+1.p (31 ms)

$$
\cfrac{\overline{a,b:\ \cdot\vdash b}\quad \overline{a,b:\ \cdot\vdash a}\quad \overline{a,b:\ \cdot\vdash a}\quad \overline{a,b:\ \cdot\vdash b}}{\cdot:\ \cdot\vdash\ !(a\ \&\ b)\multimap b\ \&\ a\ \&\ !(b\ \&\ a)\multimap a\ \&\ b}\ \star
$$

file: KLE-cbn/KLE042+1.p (325 ms)

file: KLE-cbn/KLE043+1.p (328 ms)

file: KLE-cbn/KLE044+1.p (498 ms)

file: KLE-cbn/KLE045+1.p (23 ms)

$$
\cfrac{\overline{a:\ \cdot\vdash a}\quad \overline{a:\ \cdot\vdash a}\quad \overline{a:\ \cdot\vdash a}}{\cdot:\ \cdot\vdash\ !(a\ \&\ a)\multimap a\ \&\ !(a)\multimap a\ \&\ a}\ \star
$$

file: KLE-cbn/KLE046+1.p (66 ms)

$$\cfrac{\cfrac{\cfrac{\overline{a,!(a) \oplus !(a): \ \cdot \vdash a} \quad \overline{a,!(a) \oplus !(a): \ \cdot \vdash a}}{!(a) \oplus !(a): \ !(a) \oplus !(a) \vdash a}}{!(a) \oplus !(a): \ \cdot \vdash a} D_C \quad \star \quad \cfrac{\cfrac{\cfrac{\overline{a: \ \cdot \vdash a}}{a: \ \cdot \vdash !(a)} \ !}{a: \ \cdot \vdash !(a) \oplus !(a)} \oplus_1}{}}{\cdot: \ \cdot \vdash !(!(a) \oplus !(a)) \multimap a \ \& \ !(a) \multimap !(a) \oplus !(a)} \star$$

file: KLE-cbn/KLE047+1.p (44 ms)

$$\cfrac{\overline{a,!(a) \oplus !(b): \ \cdot \vdash a} \quad \overline{a: \ \cdot \vdash a} \quad \cfrac{\cfrac{\overline{a: \ \cdot \vdash a}}{a: \ \cdot \vdash !(a)} \ !}{a: \ \cdot \vdash !(a) \oplus !(b)} \oplus_1}{\cdot: \ \cdot \vdash !(a \ \& \ !(a) \oplus !(b)) \multimap a \ \& \ !(a) \multimap a \ \& \ !(a) \oplus !(b)} \star$$

file: KLE-cbn/KLE048+1.p (73 ms)

$$\cfrac{\cfrac{\cfrac{\overline{a,!(a) \oplus !(a \& b): \ \cdot \vdash a} \quad \overline{a,b,!(a) \oplus !(a \& b): \ \cdot \vdash a}}{!(a) \oplus !(a \& b): \ !(a) \oplus !(a \& b) \vdash a}}{!(a) \oplus !(a \& b): \ \cdot \vdash a} D_C \quad \star \quad \cfrac{\cfrac{\cfrac{\overline{a: \ \cdot \vdash a}}{a: \ \cdot \vdash !(a)} \ !}{a: \ \cdot \vdash !(a) \oplus !(a \& b)} \oplus_1}{}}{\cdot: \ \cdot \vdash !(!(a) \oplus !(a \& b)) \multimap a \ \& \ !(a) \multimap !(a) \oplus !(a \& b)} \star$$

file: KLE-cbn/KLE049+1.p (72 ms)

$$\cfrac{\cfrac{\cfrac{\cfrac{\overline{a,!(a) \multimap b: \ \cdot \vdash a}}{a,!(a) \multimap b: \ \cdot \vdash !(a)} \ ! \quad \overline{a,!(a) \multimap b: \ b \vdash b}}{a,!(a) \multimap b: \ !(a) \multimap b \vdash b} \multimap}{a,!(a) \multimap b: \ \cdot \vdash b} D_C \quad \overline{a,b: \ \cdot \vdash b}}{\cdot: \ !(a) \vdash !(!(a) \multimap b) \multimap b \ \& \ !(b) \multimap !(a) \multimap b} \star$$

file: KLE-cbn/KLE050+1.p (31 ms)

$$\cfrac{\overline{b,!(a) \multimap b: \ \cdot \vdash b} \quad \overline{a,b: \ \cdot \vdash b}}{\cdot: \ !(b) \vdash !(!(a) \multimap b) \multimap b \ \& \ !(b) \multimap !(a) \multimap b} \star$$

file: KLE-cbn/KLE051+1.p (104 ms)

$$\cfrac{\cfrac{\cfrac{\cfrac{\overline{a,!(a) \multimap b,!(a) \multimap \mathbf{0}: \ \cdot \vdash a}}{a,!(a) \multimap b,!(a) \multimap \mathbf{0}: \ \cdot \vdash !(a)} \ ! \quad \overline{a,!(a) \multimap b,!(a) \multimap \mathbf{0}: \ \mathbf{0} \vdash \mathbf{0}}}{a,!(a) \multimap b,!(a) \multimap \mathbf{0}: \ !(a) \multimap \mathbf{0} \vdash \mathbf{0}} \star}{a,!(a) \multimap b,!(a) \multimap \mathbf{0}: \ \cdot \vdash \mathbf{0}} \multimap} \quad \cfrac{\cfrac{\cfrac{\overline{a,!(a) \multimap \mathbf{0}: \ \cdot \vdash a}}{a,!(a) \multimap \mathbf{0}: \ \cdot \vdash !(a)} \ ! \quad \overline{a,!(a) \multimap \mathbf{0}: \ \mathbf{0} \vdash b}}{a,!(a) \multimap \mathbf{0}: \ !(a) \multimap \mathbf{0} \vdash b} \star}{a,!(a) \multimap \mathbf{0}: \ \cdot \vdash b} D_C} \multimap}{\cdot: \ !(!(a) \multimap \mathbf{0}) \vdash !(!(a) \multimap b) \multimap !(a) \multimap \mathbf{0} \ \& \ !(!(a) \multimap \mathbf{0}) \multimap !(a) \multimap b} \star$$

file: KLE-cbn/KLE052+1.p (318 ms)

37

file: KLE-cbn/KLE053+1.p (30 ms)

$$\frac{\overline{a,b:\ \cdot\vdash a}\quad\overline{a,b:\ \cdot\vdash a}\quad\overline{a,b:\ \cdot\vdash b}}{\cdot:\ !(b)\vdash !(a\ \&\ b)\multimap a\ \&\ !(a)\multimap a\ \&\ b}\ \star$$

file: KLE-cbn/KLE054+1.p (44 ms)

$$\frac{\overline{b,!(a)\oplus !(b):\ \cdot\vdash b}\quad\dfrac{\dfrac{\overline{b:\ \cdot\vdash b}}{b:\ \cdot\vdash !(b)}\ !}{b:\ \cdot\vdash !(a)\oplus !(b)}\ \oplus_1}{\cdot:\ !(b)\vdash !(!(a)\oplus !(b))\multimap b\ \&\ !(b)\multimap !(a)\oplus !(b)}\ \star$$

file: KLE-cbn/KLE055+1.p (79 ms)

$$\frac{\overline{a,b,!(b)\multimap\mathbf{0}:\ \cdot\vdash b}\quad \dfrac{\dfrac{\dfrac{\overline{b,!(b)\multimap\mathbf{0}:\ \cdot\vdash b}}{b,!(b)\multimap\mathbf{0}:\ \cdot\vdash !(b)}\ !\quad \overline{b,!(b)\multimap\mathbf{0}:\ \mathbf{0}\vdash a}\ \star}{b,!(b)\multimap\mathbf{0}:\ !(b)\multimap\mathbf{0}\vdash a}\ \multimap}{b,!(b)\multimap\mathbf{0}:\ \cdot\vdash a}\ D_C\quad \overline{b,!(b)\multimap\mathbf{0}:\ \cdot\vdash b}}{\cdot:\ !(!(b)\multimap\mathbf{0})\vdash !(a\ \&\ b)\multimap b\ \&\ !(b)\multimap a\ \&\ b}\ \star$$

file: KLE-cbn/KLE056+1.p (253 ms)

$$\frac{\overline{a,!(a)\oplus !(b),!(b)\multimap\mathbf{0}:\ \cdot\vdash a}\quad\dfrac{\dfrac{\dfrac{\dfrac{\overline{b,!(a)\oplus !(b),!(b)\multimap\mathbf{0}:\ \cdot\vdash b}}{b,!(a)\oplus !(b),!(b)\multimap\mathbf{0}:\ \cdot\vdash !(b)}\ !\quad\overline{b,!(a)\oplus !(b),!(b)\multimap\mathbf{0}:\ \mathbf{0}\vdash a}\ \star}{b,!(a)\oplus !(b),!(b)\multimap\mathbf{0}:\ !(b)\multimap\mathbf{0}\vdash a}\ \multimap}{b,!(a)\oplus !(b),!(b)\multimap\mathbf{0}:\ \cdot\vdash a}\ D_C}{!(a)\oplus !(b),!(b)\multimap\mathbf{0}:\ !(a)\oplus !(b)\vdash a}\ \star}{!(a)\oplus !(b),!(b)\multimap\mathbf{0}:\ \cdot\vdash a}\ D_C\quad\dfrac{\dfrac{\overline{a,!(b)\multimap\mathbf{0}:\ \cdot\vdash a}}{a,!(b)\multimap\mathbf{0}:\ \cdot\vdash !(a)}\ !}{a,!(b)\multimap\mathbf{0}:\ \cdot\vdash !(a)\oplus !(b)}\ \oplus_1}{\cdot:\ !(!(b)\multimap\mathbf{0})\vdash !(!(a)\oplus !(b))\multimap a\ \&\ !(a)\multimap !(a)\oplus !(b)}\ \star$$

file: KLE-cbn/KLE057+1.p (65 ms)

$$\cfrac{\cfrac{\cfrac{\overline{a, !(a) \multimap \mathbf{0} : \ \cdot \vdash a}}{a, !(a) \multimap \mathbf{0} : \ \cdot \vdash !(a)} \ ! \quad \overline{a, !(a) \multimap \mathbf{0} : \ \mathbf{0} \vdash \mathbf{0}}}{\cfrac{a, !(a) \multimap \mathbf{0} : \ !(a) \multimap \mathbf{0} \vdash \mathbf{0}}{a, !(a) \multimap \mathbf{0} : \ \cdot \vdash \mathbf{0}} \ D_C} \ \star}{\cdot : \ \cdot \vdash !(a) \multimap !(!(a) \multimap \mathbf{0}) \multimap \mathbf{0}} \ \star$$

file: KLE-cbn/KLE058+1.p (570 ms)

file: KLE-cbn/KLE059+1.p (219 ms)

$$\cfrac{\cfrac{\cfrac{\overline{a, !(a) \oplus !(!(a) \multimap \mathbf{0}), !(!(a) \multimap a) \multimap \mathbf{0} : \ \cdot \vdash a}}{!(a) \oplus !(!(a) \multimap \mathbf{0}), !(!(a) \multimap a) \multimap \mathbf{0} : \ \cdot \vdash !(a) \multimap a} \ \star}{!(a) \oplus !(!(a) \multimap \mathbf{0}), !(!(a) \multimap a) \multimap \mathbf{0} : \ \cdot \vdash !(!(a) \multimap a)} \ ! \quad \overline{!(a) \oplus !(!(a) \multimap \mathbf{0}), !(!(a) \multimap a) \multimap \mathbf{0} : \ \mathbf{0} \vdash \mathbf{0}}}{\cfrac{!(a) \oplus !(!(a) \multimap \mathbf{0}), !(!(a) \multimap a) \multimap \mathbf{0} : \ !(!(a) \multimap a) \multimap \mathbf{0} \vdash \mathbf{0}}{!(a) \oplus !(!(a) \multimap \mathbf{0}), !(!(a) \multimap a) \multimap \mathbf{0} : \ \cdot \vdash \mathbf{0}} \ D_C} \ \star}{\cdot : \ \cdot \vdash !(!(a) \oplus !(!(a) \multimap \mathbf{0})) \multimap !(!(!(a) \multimap a) \multimap \mathbf{0}) \multimap \mathbf{0}} \ \star$$

file: KLE-cbn/KLE060+1.p (213 ms)

file: KLE-cbn/KLE061+1.p (64 ms)

$$\cfrac{\cfrac{\cfrac{\overline{a, !(a) \multimap \mathbf{0} : \ \cdot \vdash a}}{a, !(a) \multimap \mathbf{0} : \ \cdot \vdash !(a)} \ ! \quad \overline{a, !(a) \multimap \mathbf{0} : \ \mathbf{0} \vdash \mathbf{0}}}{\cfrac{a, !(a) \multimap \mathbf{0} : \ !(a) \multimap \mathbf{0} \vdash \mathbf{0}}{a, !(a) \multimap \mathbf{0} : \ \cdot \vdash \mathbf{0}} \ D_C} \ \star}{\cdot : \ \cdot \vdash !(a \ \& \ !(a) \multimap \mathbf{0}) \multimap \mathbf{0}} \ \star$$

file: KLE-cbn/KLE062+1.p (356 ms)

file: KLE-cbn/KLE063+1.p (302 ms)

file: KLE-cbn/KLE064+1.p (244 ms)

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$$\cfrac{\cfrac{\cfrac{\cfrac{\cfrac{\cfrac{\cfrac{\cfrac{\overline{a, !(!(a) \multimap a) \multimap \mathbf{0}, !(!(!(!(a) \multimap a) \multimap \mathbf{0}) \multimap \mathbf{0}) \multimap \mathbf{0} : \ \cdot \vdash a}}{!(!(a) \multimap a) \multimap \mathbf{0}, !(!(!(!(a) \multimap a) \multimap \mathbf{0}) \multimap \mathbf{0}) \multimap \mathbf{0} : \ \cdot \vdash !(a) \multimap a}}{!(!(a) \multimap a) \multimap \mathbf{0}, !(!(!(!(a) \multimap a) \multimap \mathbf{0}) \multimap \mathbf{0}) \multimap \mathbf{0} : \ \cdot \vdash !(!(a) \multimap a)} \ ! \quad \overline{!(!(a) \multimap a) \multimap \mathbf{0}, !(!(!(!(a) \multimap a) \multimap \mathbf{0}) \multimap \mathbf{0}) \multimap \mathbf{0} : \ \mathbf{0} \vdash \mathbf{0}} \ \star}{!(!(a) \multimap a) \multimap \mathbf{0}, !(!(!(!(a) \multimap a) \multimap \mathbf{0}) \multimap \mathbf{0}) \multimap \mathbf{0} : \ !(!(a) \multimap a) \multimap \mathbf{0} \vdash \mathbf{0}} \ {\multimap}}{!(!(a) \multimap a) \multimap \mathbf{0}, !(!(!(!(a) \multimap a) \multimap \mathbf{0}) \multimap \mathbf{0}) \multimap \mathbf{0} : \ \cdot \vdash \mathbf{0}} \ D_C}{!(!(!(!(a) \multimap a) \multimap \mathbf{0}) \multimap \mathbf{0}) \multimap \mathbf{0} : \ \cdot \vdash !(!(!(a) \multimap a) \multimap \mathbf{0}) \multimap \mathbf{0}}}{!(!(!(!(a) \multimap a) \multimap \mathbf{0}) \multimap \mathbf{0}) \multimap \mathbf{0} : \ \cdot \vdash !(!(!(!(a) \multimap a) \multimap \mathbf{0}) \multimap \mathbf{0})} \ ! \quad \overline{!(!(!(!(a) \multimap a) \multimap \mathbf{0}) \multimap \mathbf{0}) \multimap \mathbf{0} : \ \mathbf{0} \vdash \mathbf{0}} \ \star}{!(!(!(!(a) \multimap a) \multimap \mathbf{0}) \multimap \mathbf{0}) \multimap \mathbf{0} : \ !(!(!(!(a) \multimap a) \multimap \mathbf{0}) \multimap \mathbf{0}) \multimap \mathbf{0} \vdash \mathbf{0}} \ {\multimap}}{!(!(!(!(a) \multimap a) \multimap \mathbf{0}) \multimap \mathbf{0}) \multimap \mathbf{0} : \ \cdot \vdash \mathbf{0}} \ D_C}{\cdot : \ \cdot \vdash !(!(!(!(!(a) \multimap a) \multimap \mathbf{0}) \multimap \mathbf{0}) \multimap \mathbf{0}) \multimap \mathbf{0}} \ \star$$

file: KLE-cbn/KLE065+1.p (27 ms)

$$\cfrac{\overline{a, !(b) \oplus !(!(b) \multimap \mathbf{0}) : \ \cdot \vdash a}}{\cdot : \ \cdot \vdash !(a \ \& \ !(b) \oplus !(!(b) \multimap \mathbf{0})) \multimap a} \ \star$$

file: KLE-cbn/KLE066+1.p (105 ms)

$$\cfrac{\cfrac{\cfrac{\cfrac{\cfrac{\overline{a, !(a) \oplus !(b \ \& \ !(b) \multimap \mathbf{0}) : \ \cdot \vdash a}}{\vdots}}{!(a) \oplus !(b \ \& \ !(b) \multimap \mathbf{0}) : \ !(a) \oplus !(b \ \& \ !(b) \multimap \mathbf{0}) \vdash a} \ D_C}{!(a) \oplus !(b \ \& \ !(b) \multimap \mathbf{0}) : \ \cdot \vdash a}}{\cdot : \ \cdot \vdash !(!(a) \oplus !(b \ \& \ !(b) \multimap \mathbf{0})) \multimap a \ \& \ !(a) \multimap !(a) \oplus !(b \ \& \ !(b) \multimap \mathbf{0})}}$$

$$\cfrac{\cfrac{\cfrac{\cfrac{\overline{b, !(a) \oplus !(b \ \& \ !(b) \multimap \mathbf{0}), !(b) \multimap \mathbf{0} : \ \cdot \vdash b}}{b, !(a) \oplus !(b \ \& \ !(b) \multimap \mathbf{0}), !(b) \multimap \mathbf{0} : \ \cdot \vdash !(b)} \ ! \quad \overline{b, !(a) \oplus !(b \ \& \ !(b) \multimap \mathbf{0}), !(b) \multimap \mathbf{0} : \ \mathbf{0} \vdash a}}{b, !(a) \oplus !(b \ \& \ !(b) \multimap \mathbf{0}), !(b) \multimap \mathbf{0} : \ !(b) \multimap \mathbf{0} \vdash a} \ {\multimap}}{b, !(a) \oplus !(b \ \& \ !(b) \multimap \mathbf{0}), !(b) \multimap \mathbf{0} : \ \cdot \vdash a} \ D_C}{}$$

$$\cfrac{\cfrac{\overline{a : \ \cdot \vdash a}}{a : \ \cdot \vdash !(a)} \ !}{a : \ \cdot \vdash !(a) \oplus !(b \ \& \ !(b) \multimap \mathbf{0})} \ {\oplus_1}$$

file: KLE-cbn/KLE067+1.p (123 ms)

$$\cfrac{\cfrac{\overline{a, b, !(b) \multimap \mathbf{0} : \ \cdot \vdash b}}{a, b, !(b) \multimap \mathbf{0} : \ \cdot \vdash !(b)} \ ! \quad \overline{a, b, !(b) \multimap \mathbf{0} : \ \mathbf{0} \vdash \mathbf{0}} \ \star}{\cfrac{a, b, !(b) \multimap \mathbf{0} : \ !(b) \multimap \mathbf{0} \vdash \mathbf{0}}{a, b, !(b) \multimap \mathbf{0} : \ \cdot \vdash \mathbf{0}} \ D_C} \quad \cdots$$

$$\cdot : \ \cdot \vdash !(a \ \& \ b \ \& \ !(b) \multimap \mathbf{0}) \multimap b \ \& \ !(b) \multimap \mathbf{0} \ \& \ !(b \ \& \ !(b) \multimap \mathbf{0}) \multimap a \ \& \ b \ \& \ !(b) \multimap \mathbf{0} \ \ \star$$

file: KLE-cbn/KLE068+1.p (timeout!)
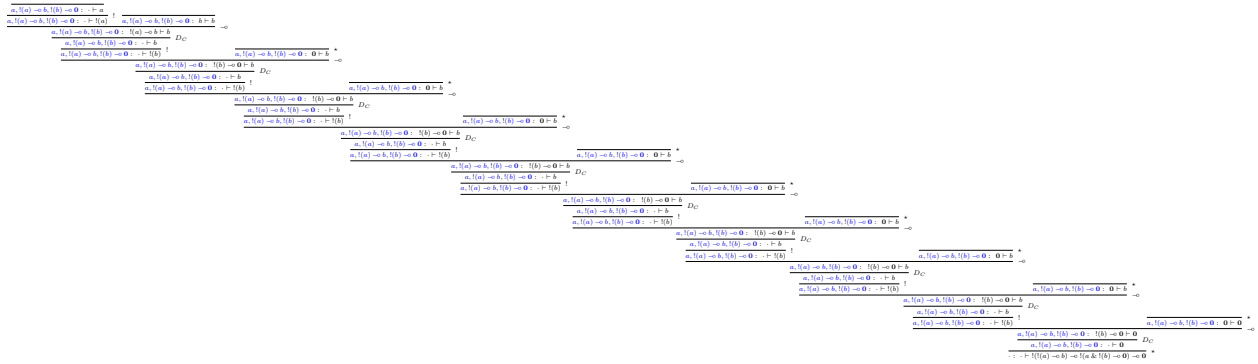
file: KLE-cbn/KLE069+1.p (timeout!)

file: KLE-cbn/KLE070+1.p (290 ms)

file: KLE-cbn/KLE071+1.p (261 ms)

file: KLE-cbn/KLE072+1.p (295 ms)

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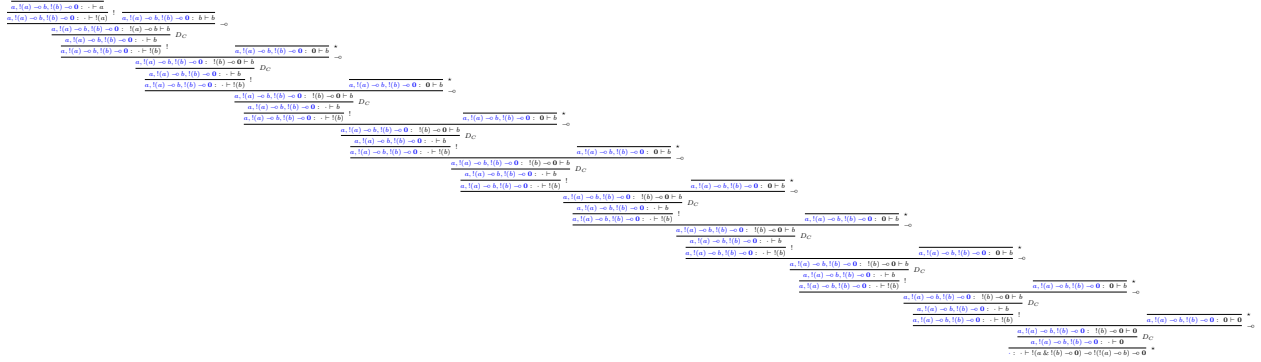file: KLE-cbn/KLE073+1.p (275 ms)

file: KLE-cbn/KLE074+1.p (timeout!)

file: KLE-cbn/KLE075+1.p (timeout!)

file: KLE-cbn/KLE076+1.p (380 ms)

file: KLE-cbn/KLE077+1.p (255 ms)

file: KLE-cbn/KLE078+1.p (timeout!)

file: KLE-cbn/KLE079+1.p (349 ms)

$$
\cfrac{
  \cfrac{
    \cfrac{a, b, !(a) \multimap !(b) \multimap \mathbf{0} : \ \cdot \vdash a}
    {a, b, !(a) \multimap !(b) \multimap \mathbf{0} : \ \cdot \vdash !(a)} \ !
    \quad
    \cfrac{
      \cfrac{a, b, !(a) \multimap !(b) \multimap \mathbf{0} : \ \cdot \vdash b}
      {a, b, !(a) \multimap !(b) \multimap \mathbf{0} : \ \cdot \vdash !(b)} \ !
      \quad
      \cfrac{}{a, b, !(a) \multimap !(b) \multimap \mathbf{0} : \ \mathbf{0} \vdash \mathbf{0}} \ \star
    }{a, b, !(a) \multimap !(b) \multimap \mathbf{0} : \ !(b) \multimap \mathbf{0} \vdash \mathbf{0}} \ \multimap
  }{a, b, !(a) \multimap !(b) \multimap \mathbf{0} : \ !(a) \multimap !(b) \multimap \mathbf{0} \vdash \mathbf{0}} \ \multimap
  }{
  \cfrac{
  a, b, !(a) \multimap !(b) \multimap \mathbf{0} : \ \cdot \vdash \mathbf{0}
  }{\cdot : \ \cdot \vdash !(a \ \& \ b) \multimap !(!(a) \multimap !(b) \multimap \mathbf{0}) \multimap \mathbf{0}} \ \star
} \ D_C
$$

```
file: KLE-cbn/KLE085+1.p (timeout!)
```

```
file: KLE-cbn/KLE086+1.p (timeout!)
```

```
file: KLE-cbn/KLE087+1.p (277 ms)
```



```
file: KLE-cbn/KLE088+1.p (timeout!)
```

3.2 LCL Problems

```
file: ILLTP-cbn/LCL/LCL181+1.p (timeout!)
```

```
file: ILLTP-cbn/LCL/LCL230+1.p (timeout!)
```

3.3 SYJ Problems

```
file: ILLTP-cbn/SYJ/SYJ101+1.p (24 ms)
```

$$\dfrac{\dfrac{}{a : \ \cdot \vdash a}}{\cdot : \ !(a) \vdash a} \ \star$$

```
file: ILLTP-cbn/SYJ/SYJ102+1.p (70 ms)
```

$$\dfrac{\dfrac{\dfrac{}{a, !(a) \multimap \mathbf{0} : \ \cdot \vdash a}}{a, !(a) \multimap \mathbf{0} : \ \cdot \vdash !(a)} \ ! \quad \dfrac{}{a, !(a) \multimap \mathbf{0} : \ \mathbf{0} \vdash \mathbf{0}}}{\dfrac{\dfrac{a, !(a) \multimap \mathbf{0} : \ !(a) \multimap \mathbf{0} \vdash \mathbf{0}}{a, !(a) \multimap \mathbf{0} : \ \cdot \vdash \mathbf{0}} \ D_C}{\cdot : \ !(a) \vdash !(!(a) \multimap \mathbf{0}) \multimap \mathbf{0}} \ \star} \ \multimap$$

```
file: ILLTP-cbn/SYJ/SYJ103+1.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ104+1.p (58 ms)
```

$$\dfrac{\dfrac{\dfrac{}{a, !(a) \multimap b : \ \cdot \vdash a}}{a, !(a) \multimap b : \ \cdot \vdash !(a)} \ ! \quad \dfrac{}{a, !(a) \multimap b : \ b \vdash b}}{\dfrac{\dfrac{a, !(a) \multimap b : \ !(a) \multimap b \vdash b}{a, !(a) \multimap b : \ \cdot \vdash b} \ D_C}{\cdot : \ !(!(a) \multimap b) \vdash !(a) \multimap b} \ \star} \ \multimap$$

```
file: ILLTP-cbn/SYJ/SYJ105+1.002.p (314 ms)
```


43

```
file: ILLTP-cbn/SYJ/SYJ105+1.003.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ105+1.004.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ106+1.p (1504 ms)
```

```
file: ILLTP-cbn/SYJ/SYJ107+1.001.p (479 ms)
```

$$\cfrac{\cfrac{\cfrac{\cfrac{\cfrac{\overline{b,c,!(b)\oplus!(a),!(!(b)\oplus!(a))\oplus!(b):\ \cdot\vdash b}\quad\overline{b,c,!(b)\oplus!(a),!(!(b)\oplus!(a))\oplus!(b):\ \cdot\vdash c}}{b,c,!(b)\oplus!(a),!(!(b)\oplus!(a))\oplus!(b):\ \cdot\vdash b\&c}\ \star}{b,c,!(b)\oplus!(a),!(!(b)\oplus!(a))\oplus!(b):\ \cdot\vdash !(b\&c)}\ !}{b,c,!(b)\oplus!(a),!(!(b)\oplus!(a))\oplus!(b):\ \cdot\vdash !(a)\oplus!(b\&c)}\ \oplus_1}{c,!(b)\oplus!(a),!(!(b)\oplus!(a))\oplus!(b):\ !(b)\oplus!(a)\vdash !(a)\oplus!(b\&c)}}{c,!(b)\oplus!(a),!(!(b)\oplus!(a))\oplus!(b):\ \cdot\vdash !(a)\oplus!(b\&c)}\ D_C \quad\cdots}{c,!(!(b)\oplus!(a))\oplus!(b):\ !(!(b)\oplus!(a))\oplus!(b)\vdash !(a)\oplus!(b\&c)}\ D_C$$
$$\cfrac{}{c,!(!(b)\oplus!(a))\oplus!(b):\ \cdot\vdash !(a)\oplus!(b\&c)}$$
$$\cfrac{}{\cdot:\ !(c),!(!(!(b)\oplus!(a))\oplus!(b))\vdash !(a)\oplus!(b\&c)}\ \star$$

```
file: ILLTP-cbn/SYJ/SYJ107+1.002.p (13117 ms)
```

```
file: ILLTP-cbn/SYJ/SYJ107+1.003.p (186392 ms)
```

```
file: ILLTP-cbn/SYJ/SYJ107+1.004.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ201+1.001.p (10921 ms)
```

```
file: ILLTP-cbn/SYJ/SYJ201+1.002.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ201+1.003.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ201+1.004.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ201+1.005.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ201+1.006.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ201+1.007.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ201+1.008.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ201+1.009.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ201+1.010.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ201+1.011.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ201+1.012.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ201+1.013.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ201+1.014.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ201+1.015.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ201+1.016.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ201+1.017.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ201+1.018.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ201+1.019.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ201+1.020.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ202+1.001.p (39 ms)
```

$$
\cfrac{\cfrac{\cfrac{\cfrac{}{o11, o21 : \ \cdot \vdash o11}}{o11, o21 : \ \cdot \vdash !(o11)} \ !}{o11, o21 : \ \cdot \vdash !(o11) \oplus !(o21)} \ \oplus_1}{\cdot : \ !(o11), !(o21) \vdash !(o11) \oplus !(o21)} \ \star
$$

```
file: ILLTP-cbn/SYJ/SYJ202+1.002.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ202+1.003.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ202+1.004.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ202+1.005.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ202+1.006.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ202+1.007.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ202+1.008.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ202+1.009.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ202+1.010.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ202+1.011.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ202+1.012.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ202+1.013.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ202+1.014.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ202+1.015.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ202+1.016.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ202+1.017.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ202+1.018.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ202+1.019.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ202+1.020.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ203+1.001.p (322 ms)
```

$$
\cfrac{\cfrac{\cfrac{\cfrac{\cfrac{\cfrac{\cfrac{}{p1, !(!(p1) \oplus !(!(p1) \multimap f)) \multimap f : \ \cdot \vdash p1}}{p1, !(!(p1) \oplus !(!(p1) \multimap f)) \multimap f : \ \cdot \vdash !(p1)} \ !}{p1, !(!(p1) \oplus !(!(p1) \multimap f)) \multimap f : \ \cdot \vdash !(p1) \oplus !(!(p1) \multimap f)} \ \oplus_1}{p1, !(!(p1) \oplus !(!(p1) \multimap f)) \multimap f : \ \cdot \vdash !(!(p1) \oplus !(!(p1) \multimap f))} \ ! \quad \cfrac{}{p1, !(!(p1) \oplus !(!(p1) \multimap f)) \multimap f : \ f \vdash f}}{p1, !(!(p1) \oplus !(!(p1) \multimap f)) \multimap f : \ !(!(p1) \oplus !(!(p1) \multimap f)) \multimap f \vdash f} \ D_C}{\cfrac{\cfrac{\cfrac{\cfrac{\cfrac{\cfrac{p1, !(!(p1) \oplus !(!(p1) \multimap f)) \multimap f : \ \cdot \vdash f}{!(!(p1) \oplus !(!(p1) \multimap f)) \multimap f : \ \cdot \vdash !(p1) \multimap f} \ \star}{!(!(p1) \oplus !(!(p1) \multimap f)) \multimap f : \ \cdot \vdash !(!(p1) \multimap f)} \ !}{!(!(p1) \oplus !(!(p1) \multimap f)) \multimap f : \ \cdot \vdash !(p1) \oplus !(!(p1) \multimap f)} \ \oplus_1}{!(!(p1) \oplus !(!(p1) \multimap f)) \multimap f : \ \cdot \vdash !(!(p1) \oplus !(!(p1) \multimap f))} \ !}{!(!(p1) \oplus !(!(p1) \multimap f)) \multimap f : \ !(!(p1) \oplus !(!(p1) \multimap f)) \multimap f \vdash f} \ \multimap \quad \cfrac{}{!(!(p1) \oplus !(!(p1) \multimap f)) \multimap f : \ f \vdash f}}{\cfrac{!(!(p1) \oplus !(!(p1) \multimap f)) \multimap f : \ \cdot \vdash f}{\cdot : \ !(!(!(p1) \oplus !(!(p1) \multimap f)) \multimap f) \vdash f} \ \star} \ D_C}
$$

file: ILLTP-cbn/SYJ/SYJ203+1.002.p (2117 ms)

file: ILLTP-cbn/SYJ/SYJ203+1.003.p (2233 ms)

file: ILLTP-cbn/SYJ/SYJ203+1.004.p (2900 ms)
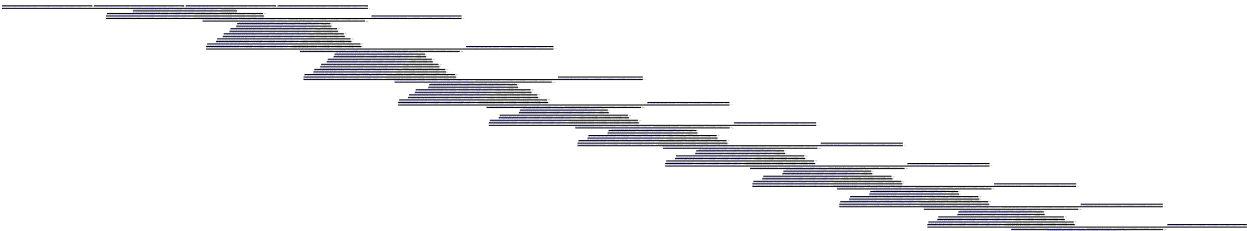
file: ILLTP-cbn/SYJ/SYJ203+1.005.p (4348 ms)
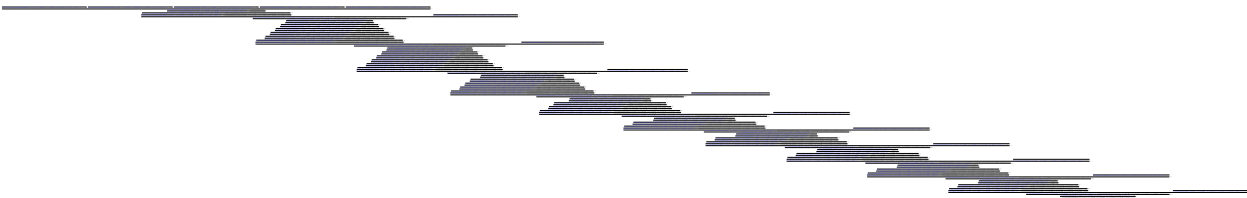
file: ILLTP-cbn/SYJ/SYJ203+1.006.p (7610 ms)

Not shown due to LaTeX restrictions.

file: ILLTP-cbn/SYJ/SYJ203+1.007.p (16481 ms)

Not shown due to LaTeX restrictions.

file: ILLTP-cbn/SYJ/SYJ203+1.008.p (32963 ms)

Not shown due to LATEX restrictions.

```
file: ILLTP-cbn/SYJ/SYJ203+1.009.p (59870 ms)
```

Not shown due to LATEX restrictions.

```
file: ILLTP-cbn/SYJ/SYJ203+1.010.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ203+1.011.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ203+1.012.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ203+1.013.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ203+1.014.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ203+1.015.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ203+1.016.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ203+1.017.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ203+1.018.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ203+1.019.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ203+1.020.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ204+1.001.p (67 ms)
```

$$\cfrac{\cfrac{\cfrac{p1, !(p1) \multimap !(p1) \multimap p0 : \ \cdot \vdash p1}{p1, !(p1) \multimap !(p1) \multimap p0 : \ \cdot \vdash !(p1)} \ ! \quad \cfrac{\cfrac{p1, !(p1) \multimap !(p1) \multimap p0 : \ \cdot \vdash p1}{p1, !(p1) \multimap !(p1) \multimap p0 : \ \cdot \vdash !(p1)} \ ! \quad \cfrac{p1, !(p1) \multimap !(p1) \multimap p0 : \ p0 \vdash p0}{p1, !(p1) \multimap !(p1) \multimap p0 : \ !(p1) \multimap p0 \vdash p0} \multimap}{p1, !(p1) \multimap !(p1) \multimap p0 : \ !(p1) \multimap !(p1) \multimap p0 \vdash p0} \multimap}{\cfrac{p1, !(p1) \multimap !(p1) \multimap p0 : \ \cdot \vdash p0}{\cdot : \ !(p1), !(!(p1) \multimap !(p1) \multimap p0) \vdash p0} \ \star} \ D_C}$$

```
file: ILLTP-cbn/SYJ/SYJ204+1.002.p (279 ms)
```

```
file: ILLTP-cbn/SYJ/SYJ204+1.003.p (421 ms)
```

```
file: ILLTP-cbn/SYJ/SYJ204+1.004.p (790 ms)
```

```
file: ILLTP-cbn/SYJ/SYJ204+1.005.p (1831 ms)
```

```
file: ILLTP-cbn/SYJ/SYJ204+1.006.p (5235 ms)
```

```
file: ILLTP-cbn/SYJ/SYJ204+1.007.p (18285 ms)
```

```
file: ILLTP-cbn/SYJ/SYJ204+1.008.p (233894 ms)
```

Not shown due to LaTeX restrictions.

```
file: ILLTP-cbn/SYJ/SYJ204+1.009.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ204+1.010.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ204+1.011.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ204+1.012.p (timeout!)
```
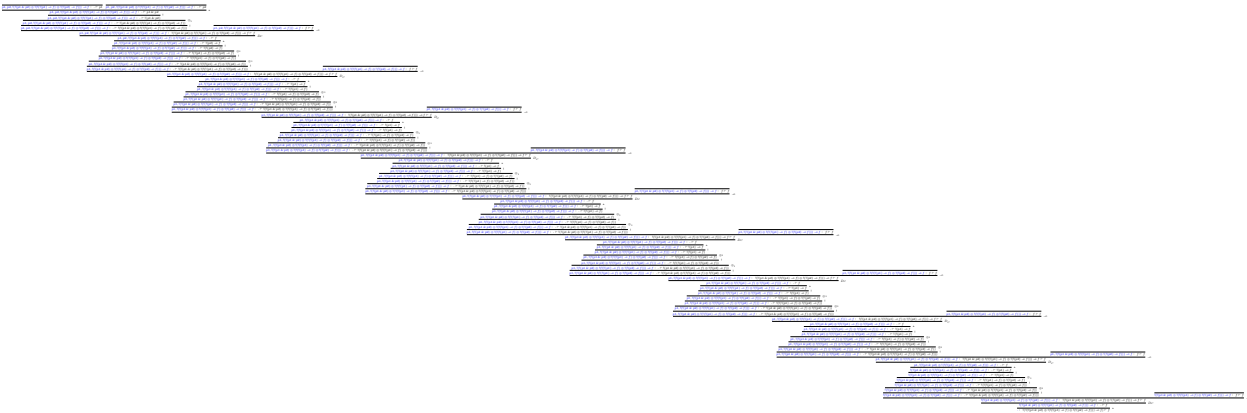
```
file: ILLTP-cbn/SYJ/SYJ204+1.013.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ204+1.014.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ204+1.015.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ204+1.016.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ204+1.017.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ204+1.018.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ204+1.019.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ204+1.020.p (timeout!)
```
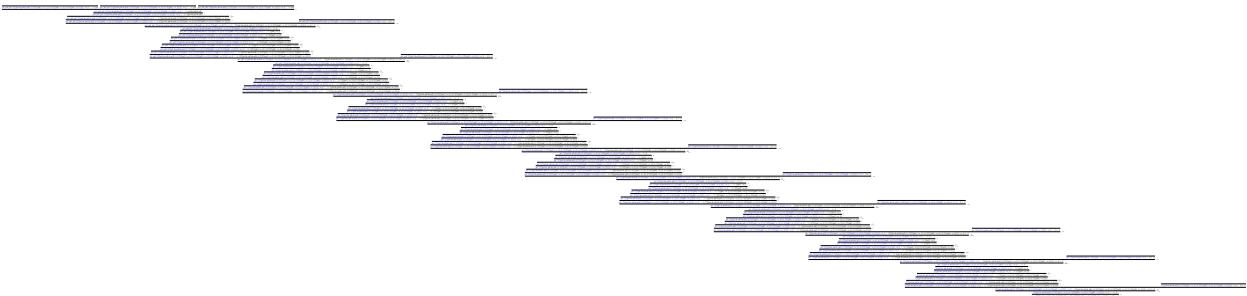
```
file: ILLTP-cbn/SYJ/SYJ205+1.001.p (2858 ms)
```
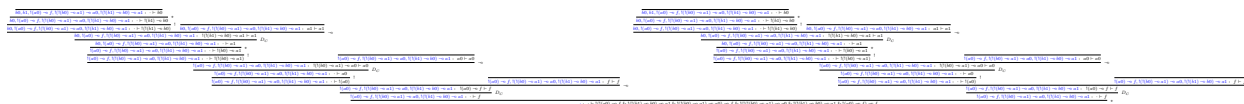
```
file: ILLTP-cbn/SYJ/SYJ205+1.002.p (5722 ms)
```

```
file: ILLTP-cbn/SYJ/SYJ205+1.003.p (8821 ms)
```

```
file: ILLTP-cbn/SYJ/SYJ205+1.004.p (17740 ms)
```

```
file: ILLTP-cbn/SYJ/SYJ205+1.005.p (81907 ms)
```

```
file: ILLTP-cbn/SYJ/SYJ205+1.006.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ205+1.007.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ205+1.008.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ205+1.009.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ205+1.010.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ205+1.011.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ205+1.012.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ205+1.013.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ205+1.014.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ205+1.015.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ205+1.016.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ205+1.017.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ205+1.018.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ205+1.019.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ205+1.020.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ206+1.001.p (24 ms)
```

$$\frac{\overline{a1:\ \cdot \vdash a1} \quad \overline{a1:\ \cdot \vdash a1}}{\cdot :\ \cdot \vdash\ !(a1) \multimap a1\ \&\ !(a1) \multimap a1}\ \star$$

```
file: ILLTP-cbn/SYJ/SYJ206+1.002.p (250 ms)
```



```
file: ILLTP-cbn/SYJ/SYJ206+1.003.p (3249 ms)
```



```
file: ILLTP-cbn/SYJ/SYJ206+1.004.p (245359 ms)
```



```
file: ILLTP-cbn/SYJ/SYJ206+1.005.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ206+1.006.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ206+1.007.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ206+1.008.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ206+1.009.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ206+1.010.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ206+1.011.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ206+1.012.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ206+1.013.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ206+1.014.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ206+1.015.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ206+1.016.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ206+1.017.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ206+1.018.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ206+1.019.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ206+1.020.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ207+1.001.p (timeout!)
```
```
file: ILLTP-cbn/SYJ/SYJ207+1.002.p (timeout!)
```
```
file: ILLTP-cbn/SYJ/SYJ207+1.003.p (timeout!)
```
```
file: ILLTP-cbn/SYJ/SYJ207+1.004.p (timeout!)
```
```
file: ILLTP-cbn/SYJ/SYJ207+1.005.p (timeout!)
```
```
file: ILLTP-cbn/SYJ/SYJ207+1.006.p (timeout!)
```
```
file: ILLTP-cbn/SYJ/SYJ207+1.007.p (timeout!)
```
```
file: ILLTP-cbn/SYJ/SYJ207+1.008.p (timeout!)
```
```
file: ILLTP-cbn/SYJ/SYJ207+1.009.p (timeout!)
```
```
file: ILLTP-cbn/SYJ/SYJ207+1.010.p (timeout!)
```
```
file: ILLTP-cbn/SYJ/SYJ207+1.011.p (timeout!)
```
```
file: ILLTP-cbn/SYJ/SYJ207+1.012.p (timeout!)
```
```
file: ILLTP-cbn/SYJ/SYJ207+1.013.p (timeout!)
```
```
file: ILLTP-cbn/SYJ/SYJ207+1.014.p (timeout!)
```
```
file: ILLTP-cbn/SYJ/SYJ207+1.015.p (timeout!)
```
```
file: ILLTP-cbn/SYJ/SYJ207+1.016.p (timeout!)
```
```
file: ILLTP-cbn/SYJ/SYJ207+1.017.p (timeout!)
```
```
file: ILLTP-cbn/SYJ/SYJ207+1.018.p (timeout!)
```
```
file: ILLTP-cbn/SYJ/SYJ207+1.019.p (timeout!)
```
```
file: ILLTP-cbn/SYJ/SYJ207+1.020.p (timeout!)
```
```
file: ILLTP-cbn/SYJ/SYJ208+1.001.p (timeout!)
```
```
file: ILLTP-cbn/SYJ/SYJ208+1.002.p (timeout!)
```
```
file: ILLTP-cbn/SYJ/SYJ208+1.003.p (timeout!)
```
```
file: ILLTP-cbn/SYJ/SYJ208+1.004.p (timeout!)
```
```
file: ILLTP-cbn/SYJ/SYJ208+1.005.p (timeout!)
```
```
file: ILLTP-cbn/SYJ/SYJ208+1.006.p (timeout!)
```
```
file: ILLTP-cbn/SYJ/SYJ208+1.007.p (timeout!)
```
```
file: ILLTP-cbn/SYJ/SYJ208+1.008.p (timeout!)
```
```
file: ILLTP-cbn/SYJ/SYJ208+1.009.p (timeout!)
```
```
file: ILLTP-cbn/SYJ/SYJ208+1.010.p (timeout!)
```
```
file: ILLTP-cbn/SYJ/SYJ208+1.011.p (timeout!)
```
```
file: ILLTP-cbn/SYJ/SYJ208+1.012.p (timeout!)
```
```
file: ILLTP-cbn/SYJ/SYJ208+1.013.p (timeout!)
```
```
file: ILLTP-cbn/SYJ/SYJ208+1.014.p (timeout!)
```
```
file: ILLTP-cbn/SYJ/SYJ208+1.015.p (timeout!)
```
```
file: ILLTP-cbn/SYJ/SYJ208+1.016.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ208+1.017.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ208+1.018.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ208+1.019.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ208+1.020.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ209+1.001.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ209+1.002.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ209+1.003.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ209+1.004.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ209+1.005.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ209+1.006.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ209+1.007.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ209+1.008.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ209+1.009.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ209+1.010.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ209+1.011.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ209+1.012.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ209+1.013.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ209+1.014.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ209+1.015.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ209+1.016.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ209+1.017.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ209+1.018.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ209+1.019.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ209+1.020.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ210+1.001.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ210+1.002.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ210+1.003.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ210+1.004.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ210+1.005.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ210+1.006.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ210+1.007.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ210+1.008.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ210+1.009.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ210+1.010.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ210+1.011.p (timeout!)
```

file: ILLTP-cbn/SYJ/SYJ210+1.012.p (timeout!)

file: ILLTP-cbn/SYJ/SYJ210+1.013.p (timeout!)

file: ILLTP-cbn/SYJ/SYJ210+1.014.p (timeout!)

file: ILLTP-cbn/SYJ/SYJ210+1.015.p (timeout!)

file: ILLTP-cbn/SYJ/SYJ210+1.016.p (timeout!)

file: ILLTP-cbn/SYJ/SYJ210+1.017.p (timeout!)

file: ILLTP-cbn/SYJ/SYJ210+1.018.p (timeout!)

file: ILLTP-cbn/SYJ/SYJ210+1.019.p (timeout!)

file: ILLTP-cbn/SYJ/SYJ210+1.020.p (timeout!)

file: ILLTP-cbn/SYJ/SYJ211+1.001.p (timeout!)

file: ILLTP-cbn/SYJ/SYJ211+1.002.p (timeout!)

file: ILLTP-cbn/SYJ/SYJ211+1.003.p (timeout!)

file: ILLTP-cbn/SYJ/SYJ211+1.004.p (timeout!)

file: ILLTP-cbn/SYJ/SYJ211+1.005.p (timeout!)

file: ILLTP-cbn/SYJ/SYJ211+1.006.p (timeout!)

file: ILLTP-cbn/SYJ/SYJ211+1.007.p (timeout!)

file: ILLTP-cbn/SYJ/SYJ211+1.008.p (timeout!)

file: ILLTP-cbn/SYJ/SYJ211+1.009.p (timeout!)

file: ILLTP-cbn/SYJ/SYJ211+1.010.p (timeout!)

file: ILLTP-cbn/SYJ/SYJ211+1.011.p (timeout!)

file: ILLTP-cbn/SYJ/SYJ211+1.012.p (timeout!)

file: ILLTP-cbn/SYJ/SYJ211+1.013.p (timeout!)

file: ILLTP-cbn/SYJ/SYJ211+1.014.p (timeout!)

file: ILLTP-cbn/SYJ/SYJ211+1.015.p (timeout!)

file: ILLTP-cbn/SYJ/SYJ211+1.016.p (timeout!)

file: ILLTP-cbn/SYJ/SYJ211+1.017.p (timeout!)

file: ILLTP-cbn/SYJ/SYJ211+1.018.p (timeout!)

file: ILLTP-cbn/SYJ/SYJ211+1.019.p (timeout!)

file: ILLTP-cbn/SYJ/SYJ211+1.020.p (timeout!)

file: ILLTP-cbn/SYJ/SYJ212+1.001.p (357 ms)

file: ILLTP-cbn/SYJ/SYJ212+1.002.p (timeout!)

file: ILLTP-cbn/SYJ/SYJ212+1.003.p (timeout!)

file: ILLTP-cbn/SYJ/SYJ212+1.004.p (timeout!)

```
file: ILLTP-cbn/SYJ/SYJ212+1.005.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ212+1.006.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ212+1.007.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ212+1.008.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ212+1.009.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ212+1.010.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ212+1.011.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ212+1.012.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ212+1.013.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ212+1.014.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ212+1.015.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ212+1.016.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ212+1.017.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ212+1.018.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ212+1.019.p (timeout!)
```

```
file: ILLTP-cbn/SYJ/SYJ212+1.020.p (timeout!)
```

3.4   SYN Problems

```
file: ILLTP-cbn/SYN/SYN001+1.p (72 ms)
```

$$\cfrac{\cfrac{\cfrac{\cfrac{\cfrac{p,!(!(p)\multimap p\,\&\,!(p)\multimap p)\multimap\mathbf{0}:\ \cdot\vdash p \quad p,!(!(p)\multimap p\,\&\,!(p)\multimap p)\multimap\mathbf{0}:\ \cdot\vdash p}{!(!(p)\multimap p\,\&\,!(p)\multimap p)\multimap\mathbf{0}:\ \cdot\vdash !(p)\multimap p\,\&\,!(p)\multimap p}\star}{!(!(p)\multimap p\,\&\,!(p)\multimap p)\multimap\mathbf{0}:\ \cdot\vdash !(!(p)\multimap p\,\&\,!(p)\multimap p)}!\quad \cfrac{}{!(!(p)\multimap p\,\&\,!(p)\multimap p)\multimap\mathbf{0}:\ \mathbf{0}\vdash\mathbf{0}}\star}{!(!(p)\multimap p\,\&\,!(p)\multimap p)\multimap\mathbf{0}:\ !(!(p)\multimap p\,\&\,!(p)\multimap p)\multimap\mathbf{0}\vdash\mathbf{0}}\multimap}{!(!(p)\multimap p\,\&\,!(p)\multimap p)\multimap\mathbf{0}:\ \cdot\vdash\mathbf{0}}D_C}{\cdot:\ \cdot\vdash !(!(!(p)\multimap p\,\&\,!(p)\multimap p)\multimap\mathbf{0})\multimap\mathbf{0}}\star$$

```
file: ILLTP-cbn/SYN/SYN007+1.014.p (timeout!)
```

```
file: ILLTP-cbn/SYN/SYN040+1.p (timeout!)
```

```
file: ILLTP-cbn/SYN/SYN041+1.p (timeout!)
```

```
file: ILLTP-cbn/SYN/SYN044+1.p (840 ms)
```

```
file: ILLTP-cbn/SYN/SYN045+1.p (516 ms)
```

```
file: ILLTP-cbn/SYN/SYN046+1.p (timeout!)
```

```
file: ILLTP-cbn/SYN/SYN047+1.p (timeout!)
```

```
file: ILLTP-cbn/SYN/SYN387+1.p fail (19 ms)
```

```
file: ILLTP-cbn/SYN/SYN388+1.p (timeout!)
```

```
file: ILLTP-cbn/SYN/SYN389+1.p (timeout!)
```

```
file: ILLTP-cbn/SYN/SYN390+1.p (25 ms)
```

$$\dfrac{\overline{p: \ \cdot \vdash p} \quad \overline{p: \ \cdot \vdash p}}{\cdot : \ \cdot \vdash \ !(p) \multimap p \ \& \ !(p) \multimap p} \ \star$$

```
file: ILLTP-cbn/SYN/SYN391+1.p (541 ms)
```



```
file: ILLTP-cbn/SYN/SYN392+1.p (timeout!)
```

```
file: ILLTP-cbn/SYN/SYN393+1.p (timeout!)
```

```
file: ILLTP-cbn/SYN/SYN416+1.p fail (20 ms)
```

```
file: ILLTP-cbn/SYN/SYN915+1.p fail (18 ms)
```

```
file: ILLTP-cbn/SYN/SYN916+1.p fail (21 ms)
```

```
file: ILLTP-cbn/SYN/SYN977+1.p fail (25 ms)
```

```
file: ILLTP-cbn/SYN/SYN978+1.p (32 ms)
```

$$\dfrac{\overline{a,b: \ \cdot \vdash b} \quad \overline{a,b: \ \cdot \vdash a}}{\cdot : \ \cdot \vdash \ !(a \ \& \ b) \multimap !(a) \multimap b \ \& \ !(b) \multimap a} \ \star$$

4 Translation Call-by-Value

4.1 KLE Problems

```
file: KLE-cbv/KLE001+1.p (38 ms)
```

$$\dfrac{\dfrac{\dfrac{\overline{a: \ \cdot \vdash a}}{a: \ \cdot \vdash \ !(a)} \ !}{\cdot : \ \cdot \vdash \ !(a) \multimap !(a)} \ \star}{\cdot : \ \cdot \vdash \ !(!(a) \multimap !(a))} \ !$$

```
file: KLE-cbv/KLE002+1.p (294 ms)
```

$$\frac{a, !(a) \multimap !(b), !(b) \multimap !(c) : \ \cdot \vdash a}{a, !(a) \multimap !(b), !(b) \multimap !(c) : \ \cdot \vdash !(a)} \ ! \qquad \frac{a, b, !(a) \multimap !(b), !(b) \multimap !(c) : \ \cdot \vdash b}{a, !(a) \multimap !(b), !(b) \multimap !(c) : \ !(b) \vdash b} \ \star$$

$$\frac{a, !(a) \multimap !(b), !(b) \multimap !(c) : \ !(a) \multimap !(b) \vdash b}{\dfrac{a, !(a) \multimap !(b), !(b) \multimap !(c) : \ \cdot \vdash b}{a, !(a) \multimap !(b), !(b) \multimap !(c) : \ \cdot \vdash !(b)} \ !} \ \multimap \quad D_C$$

$$\frac{a, c, !(a) \multimap !(b), !(b) \multimap !(c) : \ \cdot \vdash c}{a, c, !(a) \multimap !(b), !(b) \multimap !(c) : \ \cdot \vdash !(c)} \ ! \qquad \frac{}{a, !(a) \multimap !(b), !(b) \multimap !(c) : \ !(c) \vdash !(c)} \ \star$$

$$\frac{a, !(a) \multimap !(b), !(b) \multimap !(c) : \ !(b) \multimap !(c) \vdash !(c)}{a, !(a) \multimap !(b), !(b) \multimap !(c) : \ \cdot \vdash !(c)} \ D_C$$

$$\frac{!(a) \multimap !(b), !(b) \multimap !(c) : \ \cdot \vdash !(a) \multimap !(c)}{!(a) \multimap !(b), !(b) \multimap !(c) : \ \cdot \vdash !(!(a) \multimap !(c))} \ !$$

$$\frac{}{\cdot : \ !(!(a) \multimap !(b)), !(!(b) \multimap !(c)) \vdash !(!(a) \multimap !(c))} \ \star$$

```
file: KLE-cbv/KLE003+1.p (268 ms)
```

$$\frac{a, b, !(a) \multimap !(!(b) \multimap !(c)), !(b) \multimap !(c) : \ \cdot \vdash b}{a, b, !(a) \multimap !(!(b) \multimap !(c)), !(b) \multimap !(c) : \ \cdot \vdash !(b)} \ ! \qquad \frac{\dfrac{a, b, c, !(a) \multimap !(!(b) \multimap !(c)), !(b) \multimap !(c) : \ \cdot \vdash c}{a, b, c, !(a) \multimap !(!(b) \multimap !(c)), !(b) \multimap !(c) : \ \cdot \vdash !(c)} \ !}{a, b, !(a) \multimap !(!(b) \multimap !(c)), !(b) \multimap !(c) : \ !(c) \vdash !(c)} \ \star$$

$$\frac{a, b, !(a) \multimap !(!(b) \multimap !(c)), !(b) \multimap !(c) : \ !(b) \multimap !(c) \vdash !(c)}{a, b, !(a) \multimap !(!(b) \multimap !(c)), !(b) \multimap !(c) : \ \cdot \vdash !(c)} \ \multimap \ D_C$$

$$\frac{a, b, !(a) \multimap !(!(b) \multimap !(c)) : \ \cdot \vdash a}{a, b, !(a) \multimap !(!(b) \multimap !(c)) : \ \cdot \vdash !(a)} \ ! \qquad \frac{a, b, !(a) \multimap !(!(b) \multimap !(c)) : \ !(!(b) \multimap !(c)) \vdash !(c)}{} \ \star$$

$$\frac{a, b, !(a) \multimap !(!(b) \multimap !(c)) : \ !(a) \multimap !(!(b) \multimap !(c)) \vdash !(c)}{a, b, !(a) \multimap !(!(b) \multimap !(c)) : \ \cdot \vdash !(c)} \ D_C$$

$$\frac{b, !(a) \multimap !(!(b) \multimap !(c)) : \ \cdot \vdash !(a) \multimap !(c)}{b, !(a) \multimap !(!(b) \multimap !(c)) : \ \cdot \vdash !(!(a) \multimap !(c))} \ !$$

$$\frac{!(a) \multimap !(!(b) \multimap !(c)) : \ \cdot \vdash !(b) \multimap !(!(a) \multimap !(c))}{!(a) \multimap !(!(b) \multimap !(c)) : \ \cdot \vdash !(!(b) \multimap !(!(a) \multimap !(c)))} \ !$$

$$\frac{}{\cdot : \ !(!(a) \multimap !(!(b) \multimap !(c))) \vdash !(!(b) \multimap !(!(a) \multimap !(c)))} \ \star$$

```
file: KLE-cbv/KLE004+1.p (250 ms)
```

$$\frac{a, b, !(a) \multimap !(!(b) \multimap !(c)), !(b) \multimap !(c) : \ \cdot \vdash b}{a, b, !(a) \multimap !(!(b) \multimap !(c)), !(b) \multimap !(c) : \ \cdot \vdash !(b)} \ ! \qquad \frac{\dfrac{a, b, c, !(a) \multimap !(!(b) \multimap !(c)), !(b) \multimap !(c) : \ \cdot \vdash c}{a, b, c, !(a) \multimap !(!(b) \multimap !(c)), !(b) \multimap !(c) : \ \cdot \vdash !(c)} \ !}{a, b, !(a) \multimap !(!(b) \multimap !(c)), !(b) \multimap !(c) : \ !(c) \vdash !(c)} \ \star$$

$$\frac{a, b, !(a) \multimap !(!(b) \multimap !(c)), !(b) \multimap !(c) : \ !(b) \multimap !(c) \vdash !(c)}{a, b, !(a) \multimap !(!(b) \multimap !(c)), !(b) \multimap !(c) : \ \cdot \vdash !(c)} \ \multimap \ D_C$$

$$\frac{a, b, !(a) \multimap !(!(b) \multimap !(c)) : \ \cdot \vdash a}{a, b, !(a) \multimap !(!(b) \multimap !(c)) : \ \cdot \vdash !(a)} \ ! \qquad \frac{a, b, !(a) \multimap !(!(b) \multimap !(c)) : \ !(!(b) \multimap !(c)) \vdash !(c)}{} \ \star$$

$$\frac{a, b, !(a) \multimap !(!(b) \multimap !(c)) : \ !(a) \multimap !(!(b) \multimap !(c)) \vdash !(c)}{a, b, !(a) \multimap !(!(b) \multimap !(c)) : \ \cdot \vdash !(c)} \ D_C$$

$$\frac{!(a) \multimap !(!(b) \multimap !(c)) : \ \cdot \vdash !(a) \otimes !(b) \multimap !(c)}{!(a) \multimap !(!(b) \multimap !(c)) : \ \cdot \vdash !(!(a) \otimes !(b) \multimap !(c))} \ !$$

$$\frac{}{\cdot : \ !(!(a) \multimap !(!(b) \multimap !(c))) \vdash !(!(a) \otimes !(b) \multimap !(c))} \ \star$$

```
file: KLE-cbv/KLE005+1.p (407 ms)
```

$$\frac{a, b, !(a) \otimes !(b) \multimap !(c) : \ \cdot \vdash a}{a, b, !(a) \otimes !(b) \multimap !(c) : \ \cdot \vdash !(a)} \ ! \qquad \frac{a, b, !(a) \otimes !(b) \multimap !(c) : \ \cdot \vdash b}{a, b, !(a) \otimes !(b) \multimap !(c) : \ \cdot \vdash !(b)} \ ! \qquad \frac{a, b, c, !(a) \otimes !(b) \multimap !(c) : \ \cdot \vdash c}{a, b, c, !(a) \otimes !(b) \multimap !(c) : \ \cdot \vdash !(c)} \ !$$

$$\frac{a, b, !(a) \otimes !(b) \multimap !(c) : \ \cdot \vdash !(a) \otimes !(b)}{} \ \otimes \qquad \frac{a, b, !(a) \otimes !(b) \multimap !(c) : \ !(c) \vdash !(c)}{} \ \star$$

$$\frac{a, b, !(a) \otimes !(b) \multimap !(c) : \ !(a) \otimes !(b) \multimap !(c) \vdash !(c)}{a, b, !(a) \otimes !(b) \multimap !(c) : \ \cdot \vdash !(c)} \ \multimap \ D_C$$

$$\frac{a, !(a) \otimes !(b) \multimap !(c) : \ \cdot \vdash !(b) \multimap !(c)}{a, !(a) \otimes !(b) \multimap !(c) : \ \cdot \vdash !(!(b) \multimap !(c))} \ !$$

$$\frac{!(a) \otimes !(b) \multimap !(c) : \ \cdot \vdash !(a) \multimap !(!(b) \multimap !(c))}{!(a) \otimes !(b) \multimap !(c) : \ \cdot \vdash !(!(a) \multimap !(!(b) \multimap !(c)))} \ !$$

$$\frac{}{\cdot : \ !(!(a) \otimes !(b) \multimap !(c)) \vdash !(!(a) \multimap !(!(b) \multimap !(c)))} \ \star$$

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$$\cfrac{\cfrac{\cfrac{\cfrac{\overline{a,!(a)\multimap !(b),!(b)\multimap !(c): \ \cdot \vdash a}}{a,!(a)\multimap !(b),!(b)\multimap !(c): \ \cdot \vdash !(a)}\ ! \quad \cfrac{\overline{a,b,!(a)\multimap !(b),!(b)\multimap !(c): \ \cdot \vdash b}}{a,!(a)\multimap !(b),!(b)\multimap !(c): \ !(b)\vdash b}\ \star}{a,!(a)\multimap !(b),!(b)\multimap !(c): \ !(a)\multimap !(b)\vdash b}\ \multimap}{a,!(a)\multimap !(b),!(b)\multimap !(c): \ \cdot \vdash b}\ D_C}{a,!(a)\multimap !(b),!(b)\multimap !(c): \ \cdot \vdash !(b)}\ !\quad \cfrac{\cfrac{\cfrac{\overline{a,c,!(a)\multimap !(b),!(b)\multimap !(c): \ \cdot \vdash c}}{a,c,!(a)\multimap !(b),!(b)\multimap !(c): \ \cdot \vdash !(c)}\ !}{a,!(a)\multimap !(b),!(b)\multimap !(c): \ !(c)\vdash !(c)}\ \star}{}}{}$$

$$\cfrac{\cfrac{\cfrac{\cfrac{\cfrac{\cfrac{\cfrac{a,!(a)\multimap !(b),!(b)\multimap !(c): \ !(b)\multimap !(c)\vdash !(c)}{a,!(a)\multimap !(b),!(b)\multimap !(c): \ \cdot \vdash !(c)}\ D_C}{!(a)\multimap !(b),!(b)\multimap !(c): \ \cdot \vdash !(a)\multimap !(c)}\ \star}{!(a)\multimap !(b),!(b)\multimap !(c): \ \cdot \vdash !(!(a)\multimap !(c))}\ !}{!(a)\multimap !(b): \ \cdot \vdash !(!(b)\multimap !(c))\multimap !(!(a)\multimap !(c))}\ \star}{!(a)\multimap !(b): \ \cdot \vdash !(!(!(b)\multimap !(c))\multimap !(!(a)\multimap !(c)))}\ !}{\cdot: \ !(!(a)\multimap !(b))\vdash !(!(!(b)\multimap !(c))\multimap !(!(a)\multimap !(c)))}\ \star}$$

$$\cfrac{\cfrac{\cfrac{\overline{c,!(a)\multimap !(b),!(c)\multimap !(a): \ \cdot \vdash c}}{c,!(a)\multimap !(b),!(c)\multimap !(a): \ \cdot \vdash !(c)}\ ! \quad \cfrac{\overline{a,c,!(a)\multimap !(b),!(c)\multimap !(a): \ \cdot \vdash a}}{c,!(a)\multimap !(b),!(c)\multimap !(a): \ !(a)\vdash a}\ \star}{c,!(a)\multimap !(b),!(c)\multimap !(a): \ !(c)\multimap !(a)\vdash a}\ \multimap}{\cfrac{c,!(a)\multimap !(b),!(c)\multimap !(a): \ \cdot \vdash a}{c,!(a)\multimap !(b),!(c)\multimap !(a): \ \cdot \vdash !(a)}\ !}\ D_C\quad \cfrac{\cfrac{\overline{b,c,!(a)\multimap !(b),!(c)\multimap !(a): \ \cdot \vdash b}}{b,c,!(a)\multimap !(b),!(c)\multimap !(a): \ \cdot \vdash !(b)}\ !}{c,!(a)\multimap !(b),!(c)\multimap !(a): \ !(b)\vdash !(b)}\ \star}{}$$

$$\cfrac{\cfrac{\cfrac{\cfrac{\cfrac{\cfrac{\cfrac{c,!(a)\multimap !(b),!(c)\multimap !(a): \ !(a)\multimap !(b)\vdash !(b)}{c,!(a)\multimap !(b),!(c)\multimap !(a): \ \cdot \vdash !(b)}\ D_C}{!(a)\multimap !(b),!(c)\multimap !(a): \ \cdot \vdash !(c)\multimap !(b)}\ \star}{!(a)\multimap !(b),!(c)\multimap !(a): \ \cdot \vdash !(!(c)\multimap !(b))}\ !}{!(a)\multimap !(b): \ \cdot \vdash !(!(c)\multimap !(a))\multimap !(!(c)\multimap !(b))}\ \star}{!(a)\multimap !(b): \ \cdot \vdash !(!(!(c)\multimap !(a))\multimap !(!(c)\multimap !(b)))}\ !}{\cdot: \ !(!(a)\multimap !(b))\vdash !(!(!(c)\multimap !(a))\multimap !(!(c)\multimap !(b)))}\ \star}$$

$$\cfrac{\cfrac{\cfrac{\cfrac{\overline{a,c,!(a)\multimap !(b): \ \cdot \vdash a}}{a,c,!(a)\multimap !(b): \ \cdot \vdash !(a)}\ ! \quad \cfrac{\overline{a,b,c,!(a)\multimap !(b): \ \cdot \vdash b}}{a,c,!(a)\multimap !(b): \ !(b)\vdash b}\ \star}{a,c,!(a)\multimap !(b): \ !(a)\multimap !(b)\vdash b}\ \multimap}{\cfrac{a,c,!(a)\multimap !(b): \ \cdot \vdash b}{a,c,!(a)\multimap !(b): \ \cdot \vdash !(b)}\ !}\ D_C\quad \cfrac{\overline{a,c,!(a)\multimap !(b): \ \cdot \vdash c}}{a,c,!(a)\multimap !(b): \ \cdot \vdash !(c)}\ !}{a,c,!(a)\multimap !(b): \ \cdot \vdash !(b)\otimes !(c)}\ \otimes$$

$$\cfrac{\cfrac{\cfrac{a,c,!(a)\multimap !(b): \ \cdot \vdash !(b)\otimes !(c)}{!(a)\multimap !(b): \ \cdot \vdash !(a)\otimes !(c)\multimap !(b)\otimes !(c)}\ \star}{!(a)\multimap !(b): \ \cdot \vdash !(!(a)\otimes !(c)\multimap !(b)\otimes !(c))}\ !}{\cdot: \ !(!(a)\multimap !(b))\vdash !(!(a)\otimes !(c)\multimap !(b)\otimes !(c))}\ \star}$$

56

$$\cfrac{\cfrac{\cfrac{\overline{a,c,!(a) \multimap !(b): \ \cdot \vdash a}}{a,c,!(a) \multimap !(b): \ \cdot \vdash !(a)} \ ! \qquad \cfrac{\cfrac{\cfrac{\overline{a,b,c,!(a) \multimap !(b): \ \cdot \vdash c}}{a,b,c,!(a) \multimap !(b): \ \cdot \vdash !(c)} \ ! \qquad \cfrac{\overline{a,b,c,!(a) \multimap !(b): \ \cdot \vdash b}}{a,b,c,!(a) \multimap !(b): \ \cdot \vdash !(b)} \ !}{a,b,c,!(a) \multimap !(b): \ \cdot \vdash !(c) \otimes !(b)} \ \otimes}{a,c,!(a) \multimap !(b): \ !(b) \vdash !(c) \otimes !(b)} \ \star}{a,c,!(a) \multimap !(b): \ !(a) \multimap !(b) \vdash !(c) \otimes !(b)} \ \multimap}{a,c,!(a) \multimap !(b): \ \cdot \vdash !(c) \otimes !(b)} \ D_C}{\cfrac{\cfrac{\cfrac{!(a) \multimap !(b): \ \cdot \vdash !(c) \otimes !(a) \multimap !(c) \otimes !(b)}{!(a) \multimap !(b): \ \cdot \vdash !(!(c) \otimes !(a) \multimap !(c) \otimes !(b))} \ !}{\cdot: \ !(!(a) \multimap !(b)) \vdash !(!(c) \otimes !(a) \multimap !(c) \otimes !(b))} \ \star}{}}\ \star$$

file: KLE-cbv/KLE010+1.p (252 ms)

$$\cfrac{\cfrac{\cfrac{\overline{a,!(a) \multimap !(b): \ \cdot \vdash a}}{a,!(a) \multimap !(b): \ \cdot \vdash !(a)} \ ! \qquad \cfrac{\cfrac{\cfrac{\overline{a,b,!(a) \multimap !(b): \ \cdot \vdash b}}{a,b,!(a) \multimap !(b): \ \cdot \vdash !(b)} \ !}{a,b,!(a) \multimap !(b): \ \cdot \vdash !(b) \oplus !(c)} \ \oplus_1}{a,!(a) \multimap !(b): \ !(b) \vdash !(b) \oplus !(c)} \ \star}{a,!(a) \multimap !(b): \ !(a) \multimap !(b) \vdash !(b) \oplus !(c)} \ \multimap}{a,!(a) \multimap !(b): \ \cdot \vdash !(b) \oplus !(c)} \ D_C \qquad \cfrac{\cfrac{\overline{c,!(a) \multimap !(b): \ \cdot \vdash c}}{c,!(a) \multimap !(b): \ \cdot \vdash !(c)} \ !}{c,!(a) \multimap !(b): \ \cdot \vdash !(b) \oplus !(c)} \ \oplus_1}{\cfrac{\cfrac{!(a) \multimap !(b): \ \cdot \vdash !(a) \oplus !(c) \multimap !(b) \oplus !(c)}{!(a) \multimap !(b): \ \cdot \vdash !(!(a) \oplus !(c) \multimap !(b) \oplus !(c))} \ !}{\cdot: \ !(!(a) \multimap !(b)) \vdash !(!(a) \oplus !(c) \multimap !(b) \oplus !(c))} \ \star} \ \star$$

file: KLE-cbv/KLE011+1.p (258 ms)

$$\cfrac{\cfrac{\cfrac{\overline{c,!(a) \multimap !(b): \ \cdot \vdash c}}{c,!(a) \multimap !(b): \ \cdot \vdash !(c)} \ !}{c,!(a) \multimap !(b): \ \cdot \vdash !(c) \oplus !(b)} \ \oplus_1 \qquad \cfrac{\cfrac{\overline{a,!(a) \multimap !(b): \ \cdot \vdash a}}{a,!(a) \multimap !(b): \ \cdot \vdash !(a)} \ ! \qquad \cfrac{\cfrac{\cfrac{\overline{a,b,!(a) \multimap !(b): \ \cdot \vdash b}}{a,b,!(a) \multimap !(b): \ \cdot \vdash !(b)} \ !}{a,b,!(a) \multimap !(b): \ \cdot \vdash !(c) \oplus !(b)} \ \oplus_1}{a,!(a) \multimap !(b): \ !(b) \vdash !(c) \oplus !(b)} \ \star}{a,!(a) \multimap !(b): \ !(a) \multimap !(b) \vdash !(c) \oplus !(b)} \ \multimap}{a,!(a) \multimap !(b): \ \cdot \vdash !(c) \oplus !(b)} \ D_C}{\cfrac{\cfrac{\cfrac{!(a) \multimap !(b): \ \cdot \vdash !(c) \oplus !(a) \multimap !(c) \oplus !(b)}{!(a) \multimap !(b): \ \cdot \vdash !(!(c) \oplus !(a) \multimap !(c) \oplus !(b))} \ !}{\cdot: \ !(!(a) \multimap !(b)) \vdash !(!(c) \oplus !(a) \multimap !(c) \oplus !(b))} \ \star}{}} \ \star$$

file: KLE-cbv/KLE012+1.p (214 ms)

$$\cfrac{\cfrac{\cfrac{\cfrac{\overline{a,!(a) \multimap \mathbf{0}: \ \cdot \vdash a}}{a,!(a) \multimap \mathbf{0}: \ \cdot \vdash !(a)} \ ! \qquad \overline{a,!(a) \multimap \mathbf{0}: \ \mathbf{0} \vdash !(b)} \ \star}{a,!(a) \multimap \mathbf{0}: \ !(a) \multimap \mathbf{0} \vdash !(b)} \ \multimap}{a,!(a) \multimap \mathbf{0}: \ \cdot \vdash !(b)} \ D_C}{\cfrac{\cfrac{!(a) \multimap \mathbf{0}: \ \cdot \vdash !(a) \multimap !(b)}{!(a) \multimap \mathbf{0}: \ \cdot \vdash !(!(a) \multimap !(b))} \ !}{\cdot: \ !(!(a) \multimap \mathbf{0}) \vdash !(!(a) \multimap !(b))} \ \star} \ \star$$

file: KLE-cbv/KLE013+1.p (timeout!)

file: KLE-cbv/KLE014+1.p (46 ms)

$$
\cfrac{
  \cfrac{
    \cfrac{
      \overline{a, b : \ \cdot \vdash b}
    }{
      a, b : \ \cdot \vdash !(b)
    } \ !
  }{
    b : \ \cdot \vdash !(a) \multimap !(b)
  } \ \star
  \quad
}{
  \cfrac{
    b : \ \cdot \vdash !(!(a) \multimap !(b))
  }{
    \cdot : \ !(b) \vdash !(!(a) \multimap !(b))
  } \ \star
} \ !
$$

file: KLE-cbv/KLE015+1.p (timeout!)

file: KLE-cbv/KLE016+1.p (253 ms)

$$
\cfrac{
\cfrac{
\cfrac{
\cfrac{
\cfrac{
\cfrac{
\cfrac{
\overline{a, b, !(a) \multimap !(!(b) \multimap \mathbf{0}) : \ \cdot \vdash a}
}{
a, b, !(a) \multimap !(!(b) \multimap \mathbf{0}) : \ \cdot \vdash !(a)
} \ !
\quad
\cfrac{
\cfrac{
\cfrac{
\overline{a, b, !(a) \multimap !(!(b) \multimap \mathbf{0}), !(b) \multimap \mathbf{0} : \ \cdot \vdash b}
}{
a, b, !(a) \multimap !(!(b) \multimap \mathbf{0}), !(b) \multimap \mathbf{0} : \ \cdot \vdash !(b)
} \ ! \quad \overline{a, b, !(a) \multimap !(!(b) \multimap \mathbf{0}), !(b) \multimap \mathbf{0} : \ \mathbf{0} \vdash \mathbf{0}}
}{
a, b, !(a) \multimap !(!(b) \multimap \mathbf{0}), !(b) \multimap \mathbf{0} : \ !(b) \multimap \mathbf{0} \vdash \mathbf{0}
} \ \multimap
}{
a, b, !(a) \multimap !(!(b) \multimap \mathbf{0}), !(b) \multimap \mathbf{0} : \ \cdot \vdash \mathbf{0}
} \ D_C
}{
a, b, !(a) \multimap !(!(b) \multimap \mathbf{0}) : \ !(!(b) \multimap \mathbf{0}) \vdash \mathbf{0}
} \ \star
}{
a, b, !(a) \multimap !(!(b) \multimap \mathbf{0}) : \ !(a) \multimap !(!(b) \multimap \mathbf{0}) \vdash \mathbf{0}
} \ \multimap
}{
a, b, !(a) \multimap !(!(b) \multimap \mathbf{0}) : \ \cdot \vdash \mathbf{0}
} \ D_C
}{
b, !(a) \multimap !(!(b) \multimap \mathbf{0}) : \ \cdot \vdash !(a) \multimap \mathbf{0}
} \ \star
}{
b, !(a) \multimap !(!(b) \multimap \mathbf{0}) : \ \cdot \vdash !(!(a) \multimap \mathbf{0})
} \ !
}{
!(a) \multimap !(!(b) \multimap \mathbf{0}) : \ \cdot \vdash !(b) \multimap !(!(a) \multimap \mathbf{0})
} \ \star
$$
$$
\cfrac{
!(a) \multimap !(!(b) \multimap \mathbf{0}) : \ \cdot \vdash !(!(b) \multimap !(!(a) \multimap \mathbf{0}))
}{
\cdot : \ !(!(a) \multimap !(!(b) \multimap \mathbf{0})) \vdash !(!(b) \multimap !(!(a) \multimap \mathbf{0}))
} \ \star \ !
$$

file: KLE-cbv/KLE017+1.p (timeout!)

file: KLE-cbv/KLE018+1.p (462 ms)

file: KLE-cbv/KLE019+1.p (334 ms)

$$
\cfrac{
\cfrac{
\cfrac{
\cfrac{
\cfrac{
\cfrac{
\overline{a, !(a) \multimap !(b), !(b) \multimap !(a) : \ \cdot \vdash a}
}{
a, !(a) \multimap !(b), !(b) \multimap !(a) : \ \cdot \vdash !(a)
} \ !
\quad
\cfrac{
\cfrac{
\overline{a, b, !(a) \multimap !(b), !(b) \multimap !(a) : \ \cdot \vdash b}
}{
a, b, !(a) \multimap !(b), !(b) \multimap !(a) : \ \cdot \vdash !(b)
} \ !
}{
a, !(a) \multimap !(b), !(b) \multimap !(a) : \ !(b) \vdash !(b)
} \ \star
}{
a, !(a) \multimap !(b), !(b) \multimap !(a) : \ !(a) \multimap !(b) \vdash !(b)
} \ \multimap
}{
a, !(a) \multimap !(b), !(b) \multimap !(a) : \ \cdot \vdash !(b)
} \ D_C
}{
!(a) \multimap !(b), !(b) \multimap !(a) : \ \cdot \vdash !(a) \multimap !(b)
} \ \star
}{
!(a) \multimap !(b), !(b) \multimap !(a) : \ \cdot \vdash !(!(a) \multimap !(b))
} \ !
\quad
\cfrac{
\cfrac{
\cfrac{
\cfrac{
\overline{b, !(a) \multimap !(b), !(b) \multimap !(a) : \ \cdot \vdash b}
}{
b, !(a) \multimap !(b), !(b) \multimap !(a) : \ \cdot \vdash !(b)
} \ !
\quad
\cfrac{
\cfrac{
\overline{a, b, !(a) \multimap !(b), !(b) \multimap !(a) : \ \cdot \vdash a}
}{
a, b, !(a) \multimap !(b), !(b) \multimap !(a) : \ \cdot \vdash !(a)
} \ !
}{
b, !(a) \multimap !(b), !(b) \multimap !(a) : \ !(a) \vdash !(a)
} \ \star
}{
b, !(a) \multimap !(b), !(b) \multimap !(a) : \ !(b) \multimap !(a) \vdash !(a)
} \ \multimap
}{
b, !(a) \multimap !(b), !(b) \multimap !(a) : \ \cdot \vdash !(a)
} \ D_C
}{
!(a) \multimap !(b), !(b) \multimap !(a) : \ \cdot \vdash !(b) \multimap !(a)
} \ \star
}{
!(a) \multimap !(b), !(b) \multimap !(a) : \ \cdot \vdash !(!(b) \multimap !(a))
} \ !
}{
!(a) \multimap !(b), !(b) \multimap !(a) : \ \cdot \vdash !(!(a) \multimap !(b)) \otimes !(!(b) \multimap !(a))
} \ \otimes
$$
$$
\cfrac{
!(a) \multimap !(b), !(b) \multimap !(a) : \ \cdot \vdash !(!(a) \multimap !(b)) \otimes !(!(b) \multimap !(a))
}{
\cdot : \ !(!(a) \multimap !(b)), !(!(b) \multimap !(a)) \vdash !(!(a) \multimap !(b)) \otimes !(!(b) \multimap !(a))
} \ \star
$$

file: KLE-cbv/KLE020+1.p (266 ms)

$$
\cfrac{
  \cfrac{
    \cfrac{
      \cfrac{a, !(a) \multimap !(b), !(b) \multimap !(a) : \ \cdot \vdash a}
            {a, !(a) \multimap !(b), !(b) \multimap !(a) : \ \cdot \vdash !(a)} \; !
      \qquad
      \cfrac{
        \cfrac{
          \cfrac{a, b, !(a) \multimap !(b), !(b) \multimap !(a) : \ \cdot \vdash b}
                {a, b, !(a) \multimap !(b), !(b) \multimap !(a) : \ \cdot \vdash !(b)} \; !
        }{a, !(a) \multimap !(b), !(b) \multimap !(a) : \ !(b) \vdash !(b)} \; \star
      }{}
    }{a, !(a) \multimap !(b), !(b) \multimap !(a) : \ !(a) \multimap !(b) \vdash !(b)} \; \multimap
  }{a, !(a) \multimap !(b), !(b) \multimap !(a) : \ \cdot \vdash !(b)} \; D_C
}{}
$$

$$
\cfrac{
  \cfrac{
    \cfrac{a, !(a) \multimap !(b), !(b) \multimap !(a) : \ \cdot \vdash !(b)}
          {!(a) \multimap !(b), !(b) \multimap !(a) : \ \cdot \vdash !(a) \multimap !(b)} \; \star
  }{!(a) \multimap !(b), !(b) \multimap !(a) : \ \cdot \vdash !(!(a) \multimap !(b))} \; !
}{\cdot : \ !(!(a) \multimap !(b)) \otimes !(!(b) \multimap !(a)) \vdash !(!(a) \multimap !(b))} \; \star
$$

file: KLE-cbv/KLE021+1.p (246 ms)

$$
\cfrac{
  \cfrac{b, !(a) \multimap !(b), !(b) \multimap !(a) : \ \cdot \vdash b}
        {b, !(a) \multimap !(b), !(b) \multimap !(a) : \ \cdot \vdash !(b)} \; !
  \qquad
  \cfrac{
    \cfrac{
      \cfrac{a, b, !(a) \multimap !(b), !(b) \multimap !(a) : \ \cdot \vdash a}
            {a, b, !(a) \multimap !(b), !(b) \multimap !(a) : \ \cdot \vdash !(a)} \; !
    }{b, !(a) \multimap !(b), !(b) \multimap !(a) : \ !(a) \vdash !(a)} \; \star
  }{}
}{b, !(a) \multimap !(b), !(b) \multimap !(a) : \ !(b) \multimap !(a) \vdash !(a)} \; \multimap
$$

$$
\cfrac{
  \cfrac{
    \cfrac{b, !(a) \multimap !(b), !(b) \multimap !(a) : \ !(b) \multimap !(a) \vdash !(a)}
          {b, !(a) \multimap !(b), !(b) \multimap !(a) : \ \cdot \vdash !(a)} \; D_C
  }{!(a) \multimap !(b), !(b) \multimap !(a) : \ \cdot \vdash !(b) \multimap !(a)} \; \star
}{
  \cfrac{!(a) \multimap !(b), !(b) \multimap !(a) : \ \cdot \vdash !(!(b) \multimap !(a))}
        {\cdot : \ !(!(a) \multimap !(b)) \otimes !(!(b) \multimap !(a)) \vdash !(!(b) \multimap !(a))} \; \star
} \; !
$$

file: KLE-cbv/KLE022+1.p (227 ms)

$$
\cfrac{
  \cfrac{a, !(a) \multimap !(b), !(b) \multimap !(a) : \ \cdot \vdash a}
        {a, !(a) \multimap !(b), !(b) \multimap !(a) : \ \cdot \vdash !(a)} \; !
  \qquad
  \cfrac{
    \cfrac{
      \cfrac{a, b, !(a) \multimap !(b), !(b) \multimap !(a) : \ \cdot \vdash b}
            {a, b, !(a) \multimap !(b), !(b) \multimap !(a) : \ \cdot \vdash !(b)} \; !
    }{a, !(a) \multimap !(b), !(b) \multimap !(a) : \ !(b) \vdash !(b)} \; \star
  }{}
}{a, !(a) \multimap !(b), !(b) \multimap !(a) : \ !(a) \multimap !(b) \vdash !(b)} \; \multimap
$$

$$
\cfrac{
  \cfrac{a, !(a) \multimap !(b), !(b) \multimap !(a) : \ !(a) \multimap !(b) \vdash !(b)}
        {a, !(a) \multimap !(b), !(b) \multimap !(a) : \ \cdot \vdash !(b)} \; D_C
}{\cdot : \ !(a), !(!(a) \multimap !(b)) \otimes !(!(b) \multimap !(a)) \vdash !(b)} \; \star
$$

file: KLE-cbv/KLE023+1.p (231 ms)

$$
\cfrac{
  \cfrac{b, !(a) \multimap !(b), !(b) \multimap !(a) : \ \cdot \vdash b}
        {b, !(a) \multimap !(b), !(b) \multimap !(a) : \ \cdot \vdash !(b)} \; !
  \qquad
  \cfrac{
    \cfrac{
      \cfrac{a, b, !(a) \multimap !(b), !(b) \multimap !(a) : \ \cdot \vdash a}
            {a, b, !(a) \multimap !(b), !(b) \multimap !(a) : \ \cdot \vdash !(a)} \; !
    }{b, !(a) \multimap !(b), !(b) \multimap !(a) : \ !(a) \vdash !(a)} \; \star
  }{}
}{b, !(a) \multimap !(b), !(b) \multimap !(a) : \ !(b) \multimap !(a) \vdash !(a)} \; \multimap
$$

$$
\cfrac{
  \cfrac{b, !(a) \multimap !(b), !(b) \multimap !(a) : \ !(b) \multimap !(a) \vdash !(a)}
        {b, !(a) \multimap !(b), !(b) \multimap !(a) : \ \cdot \vdash !(a)} \; D_C
}{\cdot : \ !(b), !(!(a) \multimap !(b)) \otimes !(!(b) \multimap !(a)) \vdash !(a)} \; \star
$$

59

file: KLE-cbv/KLE024+1.p (45 ms)

$$
\cfrac{
\cfrac{
\cfrac{
\cfrac{\overline{a:\ \cdot\vdash a}}{a:\ \cdot\vdash !(a)}\ !
}{\cdot:\ \cdot\vdash !(a)\multimap !(a)}\ \star
}{\cdot:\ \cdot\vdash !(!(a)\multimap !(a))}\ !
\qquad
\cfrac{
\cfrac{
\cfrac{\overline{a:\ \cdot\vdash a}}{a:\ \cdot\vdash !(a)}\ !
}{\cdot:\ \cdot\vdash !(a)\multimap !(a)}\ \star
}{\cdot:\ \cdot\vdash !(!(a)\multimap !(a))}\ !
}{\cdot:\ \cdot\vdash !(!(a)\multimap !(a))\otimes !(!(a)\multimap !(a))}\ \otimes
$$

file: KLE-cbv/KLE025+1.p (330 ms)

$$
\cfrac{
\cfrac{
\cfrac{
\cfrac{\overline{b,!(a)\multimap !(b),!(b)\multimap !(a):\ \cdot\vdash b}}{b,!(a)\multimap !(b),!(b)\multimap !(a):\ \cdot\vdash !(b)}\ !
\quad
\cfrac{
\cfrac{\overline{a,b,!(a)\multimap !(b),!(b)\multimap !(a):\ \cdot\vdash a}}{a,b,!(a)\multimap !(b),!(b)\multimap !(a):\ \cdot\vdash !(a)}\ !
}{b,!(a)\multimap !(b),!(b)\multimap !(a):\ !(a)\vdash !(a)}\ \star
}{b,!(a)\multimap !(b),!(b)\multimap !(a):\ !(b)\multimap !(a)\vdash !(a)}\ \multimap
}{b,!(a)\multimap !(b),!(b)\multimap !(a):\ \cdot\vdash !(a)}\ D_C
}{\cfrac{!(a)\multimap !(b),!(b)\multimap !(a):\ \cdot\vdash !(b)\multimap !(a)}{!(a)\multimap !(b),!(b)\multimap !(a):\ \cdot\vdash !(!(b)\multimap !(a))}\ !}\ \star
\qquad
\cfrac{
\cfrac{
\cfrac{\overline{a,!(a)\multimap !(b),!(b)\multimap !(a):\ \cdot\vdash a}}{a,!(a)\multimap !(b),!(b)\multimap !(a):\ \cdot\vdash !(a)}\ !
\quad
\cfrac{
\cfrac{\overline{a,b,!(a)\multimap !(b),!(b)\multimap !(a):\ \cdot\vdash b}}{a,b,!(a)\multimap !(b),!(b)\multimap !(a):\ \cdot\vdash !(b)}\ !
}{a,!(a)\multimap !(b),!(b)\multimap !(a):\ !(b)\vdash !(b)}\ \star
}{a,!(a)\multimap !(b),!(b)\multimap !(a):\ !(a)\multimap !(b)\vdash !(b)}\ \multimap
}{a,!(a)\multimap !(b),!(b)\multimap !(a):\ \cdot\vdash !(b)}\ D_C
}{\cfrac{!(a)\multimap !(b),!(b)\multimap !(a):\ \cdot\vdash !(a)\multimap !(b)}{!(a)\multimap !(b),!(b)\multimap !(a):\ \cdot\vdash !(!(a)\multimap !(b))}\ !}\ \star
}{
\cfrac{!(a)\multimap !(b),!(b)\multimap !(a):\ \cdot\vdash !(!(b)\multimap !(a))\otimes !(!(a)\multimap !(b))}{\cdot:\ !(!(a)\multimap !(b))\otimes !(!(b)\multimap !(a))\vdash !(!(b)\multimap !(a))\otimes !(!(a)\multimap !(b))}\ \star
}\ \otimes
$$

file: KLE-cbv/KLE026+1.p (747 ms)

file: KLE-cbv/KLE027+1.p (1710 ms)

file: KLE-cbv/KLE028+1.p (533 ms)

file: KLE-cbv/KLE029+1.p (1149 ms)

file: KLE-cbv/KLE030+1.p (7326 ms)

file: KLE-cbv/KLE031+1.p (59927 ms)

file: KLE-cbv/KLE032+1.p (483 ms)

file: KLE-cbv/KLE033+1.p (909 ms)

file: KLE-cbv/KLE034+1.p (401 ms)

file: KLE-cbv/KLE035+1.p (370 ms)

file: KLE-cbv/KLE036+1.p (420 ms)

file: KLE-cbv/KLE037+1.p (404 ms)

61

$$\frac{\overline{a,b,!(a)\multimap !(b),!(b)\multimap !(a):\ \cdot \vdash b}}{\dfrac{a,b,!(a)\multimap !(b),!(b)\multimap !(a):\ \cdot \vdash !(b)}{a,b,!(a)\multimap !(b),!(b)\multimap !(a):\ !(b)\vdash !(c)\oplus !(b)}\oplus_1}\,!$$

file: KLE-cbv/KLE038+1.p (1244 ms)

file: KLE-cbv/KLE039+1.p (98 ms)

$$\dfrac{\dfrac{\dfrac{\overline{a,b,c:\ \cdot\vdash a}}{a,b,c:\ \cdot\vdash !(a)}\,!\quad\dfrac{\overline{a,b,c:\ \cdot\vdash b}}{a,b,c:\ \cdot\vdash !(b)}\,!}{a,b,c:\ \cdot\vdash !(a)\otimes !(b)}\otimes\quad\dfrac{\overline{a,b,c:\ \cdot\vdash c}}{a,b,c:\ \cdot\vdash !(c)}\,!}{\dfrac{a,b,c:\ \cdot\vdash !(a)\otimes !(b)\otimes !(c)}{\dfrac{\cdot:\ \cdot\vdash !(a)\otimes !(b)\otimes !(c)\multimap !(a)\otimes !(b)\otimes !(c)}{\cdot:\ \cdot\vdash !(!(a)\otimes !(b)\otimes !(c)\multimap !(a)\otimes !(b)\otimes !(c))}\,!}\star}\otimes$$

file: KLE-cbv/KLE040+1.p (100 ms)

file: KLE-cbv/KLE041+1.p (114 ms)

$$\dfrac{\dfrac{\dfrac{\dfrac{\overline{a,b:\ \cdot\vdash b}}{a,b:\ \cdot\vdash !(b)}\,!\quad\dfrac{\overline{a,b:\ \cdot\vdash a}}{a,b:\ \cdot\vdash !(a)}\,!}{a,b:\ \cdot\vdash !(b)\otimes !(a)}\otimes}{\dfrac{\cdot:\ \cdot\vdash !(a)\otimes !(b)\multimap !(b)\otimes !(a)}{\cdot:\ \cdot\vdash !(!(a)\otimes !(b)\multimap !(b)\otimes !(a))}\,!}\star}{\cdot:\ \cdot\vdash !(!(a)\otimes !(b)\multimap !(b)\otimes !(a))\otimes !(!(b)\otimes !(a)\multimap !(a)\otimes !(b))}}\dfrac{\dfrac{\dfrac{\overline{a,b:\ \cdot\vdash a}}{a,b:\ \cdot\vdash !(a)}\,!\quad\dfrac{\overline{a,b:\ \cdot\vdash b}}{a,b:\ \cdot\vdash !(b)}\,!}{a,b:\ \cdot\vdash !(a)\otimes !(b)}\otimes}{\dfrac{\cdot:\ \cdot\vdash !(b)\otimes !(a)\multimap !(a)\otimes !(b)}{\cdot:\ \cdot\vdash !(!(b)\otimes !(a)\multimap !(a)\otimes !(b))}\,!}\star}\otimes$$

file: KLE-cbv/KLE042+1.p (123 ms)

$$\dfrac{\dfrac{\dfrac{\dfrac{\overline{a:\ \cdot\vdash a}}{a:\ \cdot\vdash !(a)}\,!}{a:\ \cdot\vdash !(b)\oplus !(a)}\oplus_1\quad\dfrac{\dfrac{\overline{b:\ \cdot\vdash b}}{b:\ \cdot\vdash !(b)}\,!}{b:\ \cdot\vdash !(b)\oplus !(a)}\oplus_1}{\dfrac{\cdot:\ \cdot\vdash !(a)\oplus !(b)\multimap !(b)\oplus !(a)}{\cdot:\ \cdot\vdash !(!(a)\oplus !(b)\multimap !(b)\oplus !(a))}\,!}\star}{\cdot:\ \cdot\vdash !(!(a)\oplus !(b)\multimap !(b)\oplus !(a))\otimes !(!(b)\oplus !(a)\multimap !(a)\oplus !(b))}\dfrac{\dfrac{\dfrac{\overline{b:\ \cdot\vdash b}}{b:\ \cdot\vdash !(b)}\,!}{b:\ \cdot\vdash !(a)\oplus !(b)}\oplus_1\quad\dfrac{\dfrac{\overline{a:\ \cdot\vdash a}}{a:\ \cdot\vdash !(a)}\,!}{a:\ \cdot\vdash !(a)\oplus !(b)}\oplus_1}{\dfrac{\cdot:\ \cdot\vdash !(b)\oplus !(a)\multimap !(a)\oplus !(b)}{\cdot:\ \cdot\vdash !(!(b)\oplus !(a)\multimap !(a)\oplus !(b))}\,!}\star}\otimes$$

file: KLE-cbv/KLE043+1.p (210 ms)

62

$$\cfrac{\cfrac{\cfrac{\cfrac{\overline{a,b:\ \cdot\vdash a}}{a,b:\ \cdot\vdash !(a)}\ ^!\quad\cfrac{\overline{a,b:\ \cdot\vdash b}}{a,b:\ \cdot\vdash !(b)}\ ^!}{a,b:\ \cdot\vdash !(a)\otimes !(b)}\ ^\otimes}{a,b:\ \cdot\vdash !(a)\otimes !(b)\oplus !(a)\otimes !(c)}\ ^{\oplus_1}\quad\cfrac{\cfrac{\cfrac{\overline{a,c:\ \cdot\vdash a}}{a,c:\ \cdot\vdash !(a)}\ ^!\quad\cfrac{\overline{a,c:\ \cdot\vdash c}}{a,c:\ \cdot\vdash !(c)}\ ^!}{a,c:\ \cdot\vdash !(a)\otimes !(c)}\ ^\otimes}{a,c:\ \cdot\vdash !(a)\otimes !(b)\oplus !(a)\otimes !(c)}\ ^{\oplus_1}}{\cfrac{\cdot:\ \cdot\vdash !(a)\otimes !(b)\oplus !(c)\multimap !(a)\otimes !(b)\oplus !(a)\otimes !(c)}{\cdot:\ \cdot\vdash !(!(a)\otimes !(b)\oplus !(c)\multimap !(a)\otimes !(b)\oplus !(a)\otimes !(c))}\ ^!}\ ^\star$$

$$\cfrac{\cfrac{\cfrac{\overline{a,b:\ \cdot\vdash a}}{a,b:\ \cdot\vdash !(a)}\ ^!\quad\cfrac{\cfrac{\overline{a,b:\ \cdot\vdash b}}{a,b:\ \cdot\vdash !(b)}\ ^!}{a,b:\ \cdot\vdash !(b)\oplus !(c)}\ ^{\oplus_1}}{a,b:\ \cdot\vdash !(a)\otimes !(b)\oplus !(a)\otimes !(c)}\ ^\otimes\quad\cfrac{\cfrac{\overline{a,c:\ \cdot\vdash a}}{a,c:\ \cdot\vdash !(a)}\ ^!\quad\cfrac{\cfrac{\overline{a,c:\ \cdot\vdash c}}{a,c:\ \cdot\vdash !(c)}\ ^!}{a,c:\ \cdot\vdash !(b)\oplus !(c)}\ ^{\oplus_1}}{a,c:\ \cdot\vdash !(a)\otimes !(b)\oplus !(c)}\ ^\otimes}{\cfrac{\cdot:\ \cdot\vdash !(a)\otimes !(b)\oplus !(a)\otimes !(c)\multimap !(a)\otimes !(b)\oplus !(c)}{\cdot:\ \cdot\vdash !(!(a)\otimes !(b)\oplus !(a)\otimes !(c)\multimap !(a)\otimes !(b)\oplus !(c))}\ ^!}\ ^\star$$

$$\cdot:\ \cdot\vdash !(!(a)\otimes !(b)\oplus !(c)\multimap !(a)\otimes !(b)\oplus !(a)\otimes !(c))\otimes !(!(a)\otimes !(b)\oplus !(a)\otimes !(c)\multimap !(a)\otimes !(b)\oplus !(c))\quad ^\otimes$$

file: KLE-cbv/KLE044+1.p (224 ms)

$$\cdot:\ \cdot\vdash !(!(a)\oplus !(b)\otimes !(c)\multimap !(a)\oplus !(b)\otimes !(a)\oplus !(c))\otimes !(!(a)\oplus !(b)\otimes !(a)\oplus !(c)\multimap !(a)\oplus !(b)\otimes !(c))\quad ^\otimes$$

file: KLE-cbv/KLE045+1.p (83 ms)

$$\cfrac{\cfrac{\cfrac{\cfrac{\overline{a:\ \cdot\vdash a}}{a:\ \cdot\vdash !(a)}\ ^!}{\cdot:\ \cdot\vdash !(a)\otimes !(a)\multimap !(a)}\ ^\star}{\cdot:\ \cdot\vdash !(!(a)\otimes !(a)\multimap !(a))}\ ^!\quad\cfrac{\cfrac{\cfrac{\cfrac{\overline{a:\ \cdot\vdash a}}{a:\ \cdot\vdash !(a)}\ ^!\quad\cfrac{\overline{a:\ \cdot\vdash a}}{a:\ \cdot\vdash !(a)}\ ^!}{a:\ \cdot\vdash !(a)\otimes !(a)}\ ^\otimes}{\cdot:\ \cdot\vdash !(a)\multimap !(a)\otimes !(a)}\ ^\star}{\cdot:\ \cdot\vdash !(!(a)\multimap !(a)\otimes !(a))}\ ^!}{\cdot:\ \cdot\vdash !(!(a)\otimes !(a)\multimap !(a))\otimes !(!(a)\multimap !(a)\otimes !(a))}\ ^\otimes$$

file: KLE-cbv/KLE046+1.p (77 ms)

$$\cfrac{\cfrac{\cfrac{\cfrac{\overline{a:\ \cdot\vdash a}}{a:\ \cdot\vdash !(a)}\ ^!\quad\cfrac{\overline{a:\ \cdot\vdash a}}{a:\ \cdot\vdash !(a)}\ ^!}{\cdot:\ \cdot\vdash !(a)\oplus !(a)\multimap !(a)}\ ^\star}{\cdot:\ \cdot\vdash !(!(a)\oplus !(a)\multimap !(a))}\ ^!\quad\cfrac{\cfrac{\cfrac{\cfrac{\overline{a:\ \cdot\vdash a}}{a:\ \cdot\vdash !(a)}\ ^!}{a:\ \cdot\vdash !(a)\oplus !(a)}\ ^{\oplus_1}}{\cdot:\ \cdot\vdash !(a)\multimap !(a)\oplus !(a)}\ ^\star}{\cdot:\ \cdot\vdash !(!(a)\multimap !(a)\oplus !(a))}\ ^!}{\cdot:\ \cdot\vdash !(!(a)\oplus !(a)\multimap !(a))\otimes !(!(a)\multimap !(a)\oplus !(a))}\ ^\otimes$$

file: KLE-cbv/KLE047+1.p (110 ms)

$$
\cfrac{
  \cfrac{
    \cfrac{\overline{a:\ \cdot \vdash a}}{a:\ \cdot \vdash\, !(a)}\ ^{!}
    \quad
    \cfrac{\overline{a,b:\ \cdot \vdash a}}{a,b:\ \cdot \vdash\, !(a)}\ ^{!}
  }{
    \cfrac{\cdot:\ \cdot \vdash\, !(a) \otimes !(a) \oplus !(b) \multimap !(a)}{\cdot:\ \cdot \vdash\, !(!(a) \otimes !(a) \oplus !(b) \multimap !(a))}\ ^{!}
  }\ ^{\star}
  \qquad
  \cfrac{
    \cfrac{
      \cfrac{\overline{a:\ \cdot \vdash a}}{a:\ \cdot \vdash\, !(a)}\ ^{!}
      \quad
      \cfrac{\cfrac{\overline{a:\ \cdot \vdash a}}{a:\ \cdot \vdash\, !(a)}\ ^{!}}{a:\ \cdot \vdash\, !(a) \oplus !(b)}\ ^{\oplus_1}
    }{
      \cfrac{a:\ \cdot \vdash\, !(a) \otimes !(a) \oplus !(b)}{\cfrac{\cdot:\ \cdot \vdash\, !(a) \multimap !(a) \otimes !(a) \oplus !(b)}{\cdot:\ \cdot \vdash\, !(!(a) \multimap !(a) \otimes !(a) \oplus !(b))}\ ^{!}}\ ^{\otimes}
    }\ ^{\star}
  }{}
}{
  \cdot:\ \cdot \vdash\, !(!(a) \otimes !(a) \oplus !(b) \multimap !(a)) \otimes !(!(a) \multimap !(a) \otimes !(a) \oplus !(b))
}\ ^{\otimes}
$$

file: KLE-cbv/KLE048+1.p (106 ms)

$$
\cfrac{
  \cfrac{
    \cfrac{\overline{a:\ \cdot \vdash a}}{a:\ \cdot \vdash\, !(a)}\ ^{!}
    \quad
    \cfrac{\overline{a,b:\ \cdot \vdash a}}{a,b:\ \cdot \vdash\, !(a)}\ ^{!}
  }{
    \cfrac{\cdot:\ \cdot \vdash\, !(a) \oplus !(a) \otimes !(b) \multimap !(a)}{\cdot:\ \cdot \vdash\, !(!(a) \oplus !(a) \otimes !(b) \multimap !(a))}\ ^{!}
  }\ ^{\star}
  \qquad
  \cfrac{
    \cfrac{\cfrac{\overline{a:\ \cdot \vdash a}}{a:\ \cdot \vdash\, !(a)}\ ^{!}}{a:\ \cdot \vdash\, !(a) \oplus !(a) \otimes !(b)}\ ^{\oplus_1}
  }{
    \cfrac{\cdot:\ \cdot \vdash\, !(a) \multimap !(a) \oplus !(a) \otimes !(b)}{\cdot:\ \cdot \vdash\, !(!(a) \multimap !(a) \oplus !(a) \otimes !(b))}\ ^{!}
  }\ ^{\star}
}{
  \cdot:\ \cdot \vdash\, !(!(a) \oplus !(a) \otimes !(b) \multimap !(a)) \otimes !(!(a) \multimap !(a) \oplus !(a) \otimes !(b))
}\ ^{\otimes}
$$

file: KLE-cbv/KLE049+1.p (135 ms)

$$
\cfrac{
  \cfrac{
    \cfrac{
      \cfrac{\overline{a,!(a) \multimap !(b):\ \cdot \vdash a}}{a,!(a) \multimap !(b):\ \cdot \vdash\, !(a)}\ ^{!}
      \quad
      \cfrac{\cfrac{\overline{a,b,!(a) \multimap !(b):\ \cdot \vdash b}}{a,b,!(a) \multimap !(b):\ \cdot \vdash\, !(b)}\ ^{!}}{a,!(a) \multimap !(b):\ \ !(b) \vdash\, !(b)}\ ^{\star}
    }{
      \cfrac{a,!(a) \multimap !(b):\ \ !(a) \multimap !(b) \vdash\, !(b)}{\cfrac{a,!(a) \multimap !(b):\ \cdot \vdash\, !(b)}{\cfrac{a:\ \cdot \vdash\, !(!(a) \multimap !(b)) \multimap !(b)}{a:\ \cdot \vdash\, !(!(!(a) \multimap !(b)) \multimap !(b))}\ ^{!}}\ ^{\star}}\ ^{D_C}
    }\ ^{\multimap}
    \qquad
    \cfrac{
      \cfrac{\overline{a,b:\ \cdot \vdash b}}{a,b:\ \cdot \vdash\, !(b)}\ ^{!}
    }{
      \cfrac{a,b:\ \cdot \vdash\, !(a) \multimap !(b)}{\cfrac{a,b:\ \cdot \vdash\, !(!(a) \multimap !(b))}{\cfrac{a:\ \cdot \vdash\, !(b) \multimap !(!(a) \multimap !(b))}{a:\ \cdot \vdash\, !(!(b) \multimap !(!(a) \multimap !(b)))}\ ^{!}}\ ^{\star}}\ ^{!}
    }\ ^{\star}
  }{
    \cfrac{a:\ \cdot \vdash\, !(!(!(a) \multimap !(b)) \multimap !(b)) \otimes !(!(b) \multimap !(!(a) \multimap !(b)))}{\cdot:\ \ !(a) \vdash\, !(!(!(a) \multimap !(b)) \multimap !(b)) \otimes !(!(b) \multimap !(!(a) \multimap !(b)))}\ ^{\star}
  }\ ^{\otimes}
}{}
$$

file: KLE-cbv/KLE050+1.p (258 ms)

64

$$\cfrac{\cfrac{\cfrac{\overline{b, !(a) \multimap !(b) : \ \cdot \vdash b}}{b, !(a) \multimap !(b) : \ \cdot \vdash !(b)} \ !}{\cfrac{b : \ \cdot \vdash !(!(a) \multimap !(b)) \multimap !(b)}{b : \ \cdot \vdash !(!(!(a) \multimap !(b)) \multimap !(b))} \ !} \star \qquad \cfrac{\cfrac{\cfrac{\cfrac{\overline{a, b : \ \cdot \vdash b}}{a, b : \ \cdot \vdash !(b)} \ !}{b : \ \cdot \vdash !(a) \multimap !(b)} \star}{b : \ \cdot \vdash !(!(a) \multimap !(b))} \ !}{\cfrac{b : \ \cdot \vdash !(b) \multimap !(!(a) \multimap !(b))}{b : \ \cdot \vdash !(!(b) \multimap !(!(a) \multimap !(b)))} \ !} \star}{\cfrac{b : \ \cdot \vdash !(!(!(a) \multimap !(b)) \multimap !(b)) \otimes !(!(b) \multimap !(!(a) \multimap !(b)))}{\cdot : \ !(b) \vdash !(!(!(a) \multimap !(b)) \multimap !(b)) \otimes !(!(b) \multimap !(!(a) \multimap !(b)))} \star} \otimes$$

file: KLE-cbv/KLE051+1.p (299 ms)

$$\cfrac{\cfrac{\cfrac{\cfrac{\cfrac{\cfrac{\cfrac{\cfrac{\overline{a, !(a) \multimap \mathbf{0}, !(a) \multimap !(b) : \ \cdot \vdash a}}{a, !(a) \multimap \mathbf{0}, !(a) \multimap !(b) : \ \cdot \vdash !(a)} \ ! \quad \overline{a, !(a) \multimap \mathbf{0}, !(a) \multimap !(b) : \ \mathbf{0} \vdash \mathbf{0}}}{a, !(a) \multimap \mathbf{0}, !(a) \multimap !(b) : \ !(a) \multimap \mathbf{0} \vdash \mathbf{0}} \star}{a, !(a) \multimap \mathbf{0}, !(a) \multimap !(b) : \ \cdot \vdash \mathbf{0}} \ \multimap \ D_C}{\cfrac{!(a) \multimap \mathbf{0}, !(a) \multimap !(b) : \ \cdot \vdash !(a) \multimap \mathbf{0}}{!(a) \multimap \mathbf{0}, !(a) \multimap !(b) : \ \cdot \vdash !(!(a) \multimap \mathbf{0})} \ !} \star}{\cfrac{!(a) \multimap \mathbf{0} : \ \cdot \vdash !(!(a) \multimap !(b)) \multimap !(!(a) \multimap \mathbf{0})}{!(a) \multimap \mathbf{0} : \ \cdot \vdash !(!(!(a) \multimap !(b)) \multimap !(!(a) \multimap \mathbf{0}))} \ !} \star \quad \cfrac{\cfrac{\cfrac{\cfrac{\cfrac{\overline{a, !(a) \multimap \mathbf{0} : \ \cdot \vdash a}}{a, !(a) \multimap \mathbf{0} : \ \cdot \vdash !(a)} \ ! \quad \overline{a, !(a) \multimap \mathbf{0} : \ \mathbf{0} \vdash !(b)}}{a, !(a) \multimap \mathbf{0} : \ !(a) \multimap \mathbf{0} \vdash !(b)} \star}{a, !(a) \multimap \mathbf{0} : \ \cdot \vdash !(b)} \ \multimap \ D_C}{\cfrac{!(a) \multimap \mathbf{0} : \ \cdot \vdash !(a) \multimap !(b)}{!(a) \multimap \mathbf{0} : \ \cdot \vdash !(!(a) \multimap !(b))} \ !} \star}{\cfrac{!(a) \multimap \mathbf{0} : \ \cdot \vdash !(!(a) \multimap \mathbf{0}) \multimap !(!(a) \multimap !(b))}{!(a) \multimap \mathbf{0} : \ \cdot \vdash !(!(!(a) \multimap \mathbf{0}) \multimap !(!(a) \multimap !(b)))} \ !} \star}{\cfrac{!(a) \multimap \mathbf{0} : \ \cdot \vdash !(!(!(a) \multimap !(b)) \multimap !(!(a) \multimap \mathbf{0})) \otimes !(!(!(a) \multimap \mathbf{0}) \multimap !(!(a) \multimap !(b)))}{\cdot : \ !(!(a) \multimap \mathbf{0}) \vdash !(!(!(a) \multimap !(b)) \multimap !(!(a) \multimap \mathbf{0})) \otimes !(!(!(a) \multimap \mathbf{0}) \multimap !(!(a) \multimap !(b)))} \star} \otimes$$

file: KLE-cbv/KLE052+1.p (398 ms)

file: KLE-cbv/KLE053+1.p (91 ms)

65

$$
\cfrac{
  \cfrac{
    \cfrac{
      \cfrac{\overline{a,b:\ \cdot \vdash a}}{a,b:\ \cdot \vdash !(a)}\ !
    }{b:\ \cdot \vdash !(a)\otimes !(b)\multimap !(a)}\ \star
  }{b:\ \cdot \vdash !(!(a)\otimes !(b)\multimap !(a))}\ !
  \qquad
  \cfrac{
    \cfrac{
      \cfrac{
        \cfrac{\overline{a,b:\ \cdot \vdash a}}{a,b:\ \cdot \vdash !(a)}\ !
        \quad
        \cfrac{\overline{a,b:\ \cdot \vdash b}}{a,b:\ \cdot \vdash !(b)}\ !
      }{a,b:\ \cdot \vdash !(a)\otimes !(b)}\ \otimes
    }{b:\ \cdot \vdash !(a)\multimap !(a)\otimes !(b)}\ \star
  }{b:\ \cdot \vdash !(!(a)\multimap !(a)\otimes !(b))}\ !
}{
  \cfrac{
    b:\ \cdot \vdash !(!(a)\otimes !(b)\multimap !(a))\otimes !(!(a)\multimap !(a)\otimes !(b))
  }{\cdot:\ !(b)\vdash !(!(a)\otimes !(b)\multimap !(a))\otimes !(!(a)\multimap !(a)\otimes !(b))}\ \star
}\ \otimes
$$

file: KLE-cbv/KLE054+1.p (103 ms)

$$
\cfrac{
  \cfrac{
    \cfrac{
      \cfrac{\overline{a,b:\ \cdot \vdash b}}{a,b:\ \cdot \vdash !(b)}\ !
      \quad
      \cfrac{\overline{b:\ \cdot \vdash b}}{b:\ \cdot \vdash !(b)}\ !
    }{b:\ \cdot \vdash !(a)\oplus !(b)\multimap !(b)}\ \star
  }{b:\ \cdot \vdash !(!(a)\oplus !(b)\multimap !(b))}\ !
  \qquad
  \cfrac{
    \cfrac{
      \cfrac{
        \cfrac{\overline{b:\ \cdot \vdash b}}{b:\ \cdot \vdash !(b)}\ !
      }{b:\ \cdot \vdash !(a)\oplus !(b)}\ \oplus_1
    }{b:\ \cdot \vdash !(b)\multimap !(a)\oplus !(b)}\ \star
  }{b:\ \cdot \vdash !(!(b)\multimap !(a)\oplus !(b))}\ !
}{
  \cfrac{
    b:\ \cdot \vdash !(!(a)\oplus !(b)\multimap !(b))\otimes !(!(b)\multimap !(a)\oplus !(b))
  }{\cdot:\ !(b)\vdash !(!(a)\oplus !(b)\multimap !(b))\otimes !(!(b)\multimap !(a)\oplus !(b))}\ \star
}\ \otimes
$$

file: KLE-cbv/KLE055+1.p (239 ms)

$$
\cfrac{
  \cfrac{
    \cfrac{\overline{a,b,!(b)\multimap\mathbf{0}:\ \cdot \vdash b}}{a,b,!(b)\multimap\mathbf{0}:\ \cdot \vdash !(b)}\ !
  }{
    \cfrac{!(b)\multimap\mathbf{0}:\ \cdot \vdash !(a)\otimes !(b)\multimap !(b)}{!(b)\multimap\mathbf{0}:\ \cdot \vdash !(!(a)\otimes !(b)\multimap !(b))}\ !
  }\ \star
  \qquad
  \cfrac{
    \cfrac{
      \cfrac{
        \cfrac{\overline{b,!(b)\multimap\mathbf{0}:\ \cdot \vdash b}}{b,!(b)\multimap\mathbf{0}:\ \cdot \vdash !(b)}\ !
        \quad
        \overline{b,!(b)\multimap\mathbf{0}:\ \mathbf{0}\vdash !(a)\otimes !(b)}\ \star
      }{b,!(b)\multimap\mathbf{0}:\ !(b)\multimap\mathbf{0}\vdash !(a)\otimes !(b)}\ \multimap
    }{b,!(b)\multimap\mathbf{0}:\ \cdot \vdash !(a)\otimes !(b)}\ D_C
  }{
    \cfrac{!(b)\multimap\mathbf{0}:\ \cdot \vdash !(b)\multimap !(a)\otimes !(b)}{!(b)\multimap\mathbf{0}:\ \cdot \vdash !(!(b)\multimap !(a)\otimes !(b))}\ !
  }\ \star
}{
  \cfrac{
    !(b)\multimap\mathbf{0}:\ \cdot \vdash !(!(a)\otimes !(b)\multimap !(b))\otimes !(!(b)\multimap !(a)\otimes !(b))
  }{\cdot:\ !(!(b)\multimap\mathbf{0})\vdash !(!(a)\otimes !(b)\multimap !(b))\otimes !(!(b)\multimap !(a)\otimes !(b))}\ \star
}\ \otimes
$$

file: KLE-cbv/KLE056+1.p (293 ms)

66

$$\cfrac{\cfrac{\cfrac{\cfrac{}{a,!(b)\multimap \mathbf{0}:\ \cdot \vdash a}}{a,!(b)\multimap \mathbf{0}:\ \cdot \vdash !(a)}\ ! \quad \cfrac{\cfrac{\cfrac{\cfrac{}{b,!(b)\multimap \mathbf{0}:\ \cdot \vdash b}}{b,!(b)\multimap \mathbf{0}:\ \cdot \vdash !(b)}\ ! \quad \cfrac{}{b,!(b)\multimap \mathbf{0}:\ \mathbf{0}\vdash !(a)}\ \star}{b,!(b)\multimap \mathbf{0}:\ !(b)\multimap \mathbf{0}\vdash !(a)}\multimap}{b,!(b)\multimap \mathbf{0}:\ \cdot \vdash !(a)}\ D_C}{!(b)\multimap \mathbf{0}:\ \cdot \vdash !(a)\oplus !(b)\multimap !(a)}\ \star}{!(b)\multimap \mathbf{0}:\ \cdot \vdash !(!(a)\oplus !(b)\multimap !(a))}\ !\quad \cfrac{\cfrac{\cfrac{\cfrac{}{a,!(b)\multimap \mathbf{0}:\ \cdot \vdash a}}{a,!(b)\multimap \mathbf{0}:\ \cdot \vdash !(a)}\ !}{a,!(b)\multimap \mathbf{0}:\ \cdot \vdash !(a)\oplus !(b)}\ \oplus_1}{!(b)\multimap \mathbf{0}:\ \cdot \vdash !(a)\multimap !(a)\oplus !(b)}\ \star}{!(b)\multimap \mathbf{0}:\ \cdot \vdash !(!(a)\multimap !(a)\oplus !(b))}\ !}{\cfrac{!(b)\multimap \mathbf{0}:\ \cdot \vdash !(!(a)\oplus !(b)\multimap !(a))\otimes !(!(a)\multimap !(a)\oplus !(b))}{\cdot :\ !(!(b)\multimap \mathbf{0})\vdash !(!(a)\oplus !(b)\multimap !(a))\otimes !(!(a)\multimap !(a)\oplus !(b))}\ \star}\ \otimes}$$

file: KLE-cbv/KLE057+1.p (85 ms)

$$\cfrac{\cfrac{\cfrac{\cfrac{\cfrac{\cfrac{}{a,!(a)\multimap \mathbf{0}:\ \cdot \vdash a}}{a,!(a)\multimap \mathbf{0}:\ \cdot \vdash !(a)}\ ! \quad \cfrac{}{a,!(a)\multimap \mathbf{0}:\ \mathbf{0}\vdash \mathbf{0}}\ \star}{a,!(a)\multimap \mathbf{0}:\ !(a)\multimap \mathbf{0}\vdash \mathbf{0}}\multimap}{a,!(a)\multimap \mathbf{0}:\ \cdot \vdash \mathbf{0}}\ D_C}{a:\ \cdot \vdash !(!(a)\multimap \mathbf{0})\multimap \mathbf{0}}\ \star}{a:\ \cdot \vdash !(!(!(a)\multimap \mathbf{0})\multimap \mathbf{0})}\ !}{\cdot :\ \cdot \vdash !(a)\multimap !(!(!(a)\multimap \mathbf{0})\multimap \mathbf{0})}\ \star}{\cdot :\ \cdot \vdash !(!(a)\multimap !(!(!(a)\multimap \mathbf{0})\multimap \mathbf{0}))}\ !$$

file: KLE-cbv/KLE058+1.p (557 ms)

file: KLE-cbv/KLE059+1.p (400 ms)

file: KLE-cbv/KLE060+1.p (434 ms)

file: KLE-cbv/KLE061+1.p (71 ms)

$$\cfrac{\cfrac{\cfrac{\cfrac{\cfrac{\cfrac{}{a,!(a)\multimap \mathbf{0}:\ \cdot \vdash a}}{a,!(a)\multimap \mathbf{0}:\ \cdot \vdash !(a)}\ ! \quad \cfrac{}{a,!(a)\multimap \mathbf{0}:\ \mathbf{0}\vdash \mathbf{0}}\ \star}{a,!(a)\multimap \mathbf{0}:\ !(a)\multimap \mathbf{0}\vdash \mathbf{0}}\multimap}{a,!(a)\multimap \mathbf{0}:\ \cdot \vdash \mathbf{0}}\ D_C}{\cdot :\ \cdot \vdash !(a)\otimes !(!(a)\multimap \mathbf{0})\multimap \mathbf{0}}\ \star}{\cdot :\ \cdot \vdash !(!(a)\otimes !(!(a)\multimap \mathbf{0})\multimap \mathbf{0})}\ !$$

67

$$
\cfrac{
\cfrac{
\cfrac{
\cfrac{
\cfrac{
\overline{a, !(!(a) \multimap !(a)) \multimap \mathbf{0}, !(!(!(!(a) \multimap !(a)) \multimap \mathbf{0}) \multimap \mathbf{0}) \multimap \mathbf{0} : \ \cdot \vdash a}
}{a, !(!(a) \multimap !(a)) \multimap \mathbf{0}, !(!(!(!(a) \multimap !(a)) \multimap \mathbf{0}) \multimap \mathbf{0}) \multimap \mathbf{0} : \ \cdot \vdash !(a)} \ {}^{!}}
{!(!(a) \multimap !(a)) \multimap \mathbf{0}, !(!(!(!(a) \multimap !(a)) \multimap \mathbf{0}) \multimap \mathbf{0}) \multimap \mathbf{0} : \ \cdot \vdash !(a) \multimap !(a)} \ {}^{\star}}
{!(!(a) \multimap !(a)) \multimap \mathbf{0}, !(!(!(!(a) \multimap !(a)) \multimap \mathbf{0}) \multimap \mathbf{0}) \multimap \mathbf{0} : \ \cdot \vdash !(!(a) \multimap !(a))} \ {}^{!} \quad
\overline{!(!(a) \multimap !(a)) \multimap \mathbf{0}, !(!(!(!(a) \multimap !(a)) \multimap \mathbf{0}) \multimap \mathbf{0}) \multimap \mathbf{0} : \ \mathbf{0} \vdash \mathbf{0}} \ {}^{\star}
}{!(!(a) \multimap !(a)) \multimap \mathbf{0}, !(!(!(!(a) \multimap !(a)) \multimap \mathbf{0}) \multimap \mathbf{0}) \multimap \mathbf{0} : \ !(!(a) \multimap !(a)) \multimap \mathbf{0} \vdash \mathbf{0}} \ {}^{\multimap}
}{
\cfrac{
\cfrac{
!(!(a) \multimap !(a)) \multimap \mathbf{0}, !(!(!(!(a) \multimap !(a)) \multimap \mathbf{0}) \multimap \mathbf{0}) \multimap \mathbf{0} : \ \cdot \vdash \mathbf{0}
}{!(!(!(!(a) \multimap !(a)) \multimap \mathbf{0}) \multimap \mathbf{0}) \multimap \mathbf{0} : \ \cdot \vdash !(!(!(a) \multimap !(a)) \multimap \mathbf{0}) \multimap \mathbf{0}} \ {}^{\star}}
{!(!(!(!(a) \multimap !(a)) \multimap \mathbf{0}) \multimap \mathbf{0}) \multimap \mathbf{0} : \ \cdot \vdash !(!(!(!(a) \multimap !(a)) \multimap \mathbf{0}) \multimap \mathbf{0})} \ {}^{!} \quad
\overline{!(!(!(!(a) \multimap !(a)) \multimap \mathbf{0}) \multimap \mathbf{0}) \multimap \mathbf{0} : \ \mathbf{0} \vdash \mathbf{0}} \ {}^{\star}
} \ {}_{D_C}
$$

$$
\cfrac{
\cfrac{
\cfrac{!(!(!(!(a) \multimap !(a)) \multimap \mathbf{0}) \multimap \mathbf{0}) \multimap \mathbf{0} : \ !(!(!(!(a) \multimap !(a)) \multimap \mathbf{0}) \multimap \mathbf{0}) \multimap \mathbf{0} \vdash \mathbf{0}}{!(!(!(!(a) \multimap !(a)) \multimap \mathbf{0}) \multimap \mathbf{0}) \multimap \mathbf{0} : \ \cdot \vdash \mathbf{0}} \ {}_{D_C}}
{\cdot : \ \cdot \vdash !(!(!(!(!(a) \multimap !(a)) \multimap \mathbf{0}) \multimap \mathbf{0}) \multimap \mathbf{0}) \multimap \mathbf{0}} \ {}^{\star}}
{\cdot : \ \cdot \vdash !(!(!(!(!(!(a) \multimap !(a)) \multimap \mathbf{0}) \multimap \mathbf{0}) \multimap \mathbf{0}) \multimap \mathbf{0})} \ {}^{!}
$$

$$
\cfrac{
\cfrac{
\cfrac{\overline{a, b : \ \cdot \vdash a}}{a, b : \ \cdot \vdash !(a)} \ {}^{!} \quad
\cfrac{\overline{a, !(b) \multimap \mathbf{0} : \ \cdot \vdash a}}{a, !(b) \multimap \mathbf{0} : \ \cdot \vdash !(a)} \ {}^{!}
}{\cdot : \ \cdot \vdash !(a) \otimes !(b) \oplus !(!(b) \multimap \mathbf{0}) \multimap !(a)} \ {}^{\star}}
{\cdot : \ \cdot \vdash !(!(a) \otimes !(b) \oplus !(!(b) \multimap \mathbf{0}) \multimap !(a))} \ {}^{!}
$$

$$
\cfrac{
\cfrac{
\cfrac{\overline{a : \ \cdot \vdash a}}{a : \ \cdot \vdash !(a)} \ {}^{!} \quad
\cfrac{
\cfrac{
\cfrac{\overline{b, !(b) \multimap \mathbf{0} : \ \cdot \vdash b}}{b, !(b) \multimap \mathbf{0} : \ \cdot \vdash !(b)} \ {}^{!} \quad
\overline{b, !(b) \multimap \mathbf{0} : \ \mathbf{0} \vdash !(a)} \ {}^{\star}
}{b, !(b) \multimap \mathbf{0} : \ !(b) \multimap \mathbf{0} \vdash !(a)} \ {}^{\multimap}}
{b, !(b) \multimap \mathbf{0} : \ \cdot \vdash !(a)} \ {}_{D_C}
}{\cdot : \ \cdot \vdash !(a) \oplus !(b) \otimes !(!(b) \multimap \mathbf{0}) \multimap !(a)} \ {}^{\star}}
{\cdot : \ \cdot \vdash !(!(a) \oplus !(b) \otimes !(!(b) \multimap \mathbf{0}) \multimap !(a))} \ {}^{!}
\quad
\cfrac{
\cfrac{
\cfrac{\overline{a : \ \cdot \vdash a}}{a : \ \cdot \vdash !(a)} \ {}^{!}}
{a : \ \cdot \vdash !(a) \oplus !(b) \otimes !(!(b) \multimap \mathbf{0})} \ {}^{\oplus_1}}
{\cdot : \ \cdot \vdash !(a) \multimap !(a) \oplus !(b) \otimes !(!(b) \multimap \mathbf{0})} \ {}^{\star}}
{\cdot : \ \cdot \vdash !(!(a) \multimap !(a) \oplus !(b) \otimes !(!(b) \multimap \mathbf{0}))} \ {}^{!}
}{\cdot : \ \cdot \vdash !(!(a) \oplus !(b) \otimes !(!(b) \multimap \mathbf{0}) \multimap !(a)) \otimes !(!(a) \multimap !(a) \oplus !(b) \otimes !(!(b) \multimap \mathbf{0}))} \ {}^{\otimes}
$$

68

$$\cfrac{\cfrac{\cfrac{\cfrac{\cfrac{\cfrac{\overline{a,b,!(b)\multimap\mathbf{0}:\ \cdot\vdash b}}{a,b,!(b)\multimap\mathbf{0}:\ \cdot\vdash !(b)}\ ! \quad \overline{a,b,!(b)\multimap\mathbf{0}:\ \mathbf{0}\vdash !(b)\otimes !(!(b)\multimap\mathbf{0})}\ \star}{a,b,!(b)\multimap\mathbf{0}:\ !(b)\multimap\mathbf{0}\vdash !(b)\otimes !(!(b)\multimap\mathbf{0})}\ \multimap}{a,b,!(b)\multimap\mathbf{0}:\ \cdot\vdash !(b)\otimes !(!(b)\multimap\mathbf{0})}\ D_C}{\cdot:\ \cdot\vdash !(a)\otimes !(b)\otimes !(!(b)\multimap\mathbf{0})\multimap !(b)\otimes !(!(b)\multimap\mathbf{0})}\ \star}{\cdot:\ \cdot\vdash !(!(a)\otimes !(b)\otimes !(!(b)\multimap\mathbf{0})\multimap !(b)\otimes !(!(b)\multimap\mathbf{0}))}\ !}{\quad} \qquad \cfrac{\cfrac{\cfrac{\cfrac{\overline{b,!(b)\multimap\mathbf{0}:\ \cdot\vdash b}}{b,!(b)\multimap\mathbf{0}:\ \cdot\vdash !(b)}\ ! \quad \overline{b,!(b)\multimap\mathbf{0}:\ \mathbf{0}\vdash !(a)\otimes !(b)\otimes !(!(b)\multimap\mathbf{0})}\ \star}{b,!(b)\multimap\mathbf{0}:\ !(b)\multimap\mathbf{0}\vdash !(a)\otimes !(b)\otimes !(!(b)\multimap\mathbf{0})}\ \multimap}{b,!(b)\multimap\mathbf{0}:\ \cdot\vdash !(a)\otimes !(b)\otimes !(!(b)\multimap\mathbf{0})}\ D_C}{\cdot:\ \cdot\vdash !(b)\otimes !(!(b)\multimap\mathbf{0})\multimap !(a)\otimes !(b)\otimes !(!(b)\multimap\mathbf{0})}\ \star}{\cdot:\ \cdot\vdash !(!(b)\otimes !(!(b)\multimap\mathbf{0})\multimap !(a)\otimes !(b)\otimes !(!(b)\multimap\mathbf{0}))}\ !}{\cdot:\ \cdot\vdash !(!(a)\otimes !(b)\otimes !(!(b)\multimap\mathbf{0})\multimap !(b)\otimes !(!(b)\multimap\mathbf{0}))\otimes !(!(b)\otimes !(!(b)\multimap\mathbf{0})\multimap !(a)\otimes !(b)\otimes !(!(b)\multimap\mathbf{0}))}\ \otimes$$

file: KLE-cbv/KLE068+1.p `fail` (46 ms)

file: KLE-cbv/KLE069+1.p (timeout!)

file: KLE-cbv/KLE070+1.p (303 ms)

file: KLE-cbv/KLE071+1.p (89 ms)

$$\cfrac{\cfrac{\cfrac{\cfrac{\cfrac{\cfrac{\cfrac{\overline{a,b,!(a)\oplus !(!(b)\multimap\mathbf{0})\multimap\mathbf{0}:\ \cdot\vdash a}}{a,b,!(a)\oplus !(!(b)\multimap\mathbf{0})\multimap\mathbf{0}:\ \cdot\vdash !(a)}\ !}{a,b,!(a)\oplus !(!(b)\multimap\mathbf{0})\multimap\mathbf{0}:\ \cdot\vdash !(a)\oplus !(!(b)\multimap\mathbf{0})}\ \oplus_1 \quad \overline{a,b,!(a)\oplus !(!(b)\multimap\mathbf{0})\multimap\mathbf{0}:\ \mathbf{0}\vdash\mathbf{0}}\ \star}{a,b,!(a)\oplus !(!(b)\multimap\mathbf{0})\multimap\mathbf{0}:\ !(a)\oplus !(!(b)\multimap\mathbf{0})\multimap\mathbf{0}\vdash\mathbf{0}}\ \multimap}{a,b,!(a)\oplus !(!(b)\multimap\mathbf{0})\multimap\mathbf{0}:\ \cdot\vdash\mathbf{0}}\ D_C}{a,b:\ \cdot\vdash !(!(a)\oplus !(!(b)\multimap\mathbf{0})\multimap\mathbf{0})\multimap\mathbf{0}}\ \star}{a,b:\ \cdot\vdash !(!(!(a)\oplus !(!(b)\multimap\mathbf{0})\multimap\mathbf{0})\multimap\mathbf{0})}\ !}{\cdot:\ \cdot\vdash !(a)\otimes !(b)\multimap !(!(!(a)\oplus !(!(b)\multimap\mathbf{0})\multimap\mathbf{0})\multimap\mathbf{0})}\ \star}{\cdot:\ \cdot\vdash !(!(a)\otimes !(b)\multimap !(!(!(a)\oplus !(!(b)\multimap\mathbf{0})\multimap\mathbf{0})\multimap\mathbf{0}))}\ !$$

file: KLE-cbv/KLE072+1.p (311 ms)

file: KLE-cbv/KLE073+1.p (292 ms)

$$
\cfrac{
  \cfrac{
    \cfrac{
      \cfrac{\overline{a,!(a) \oplus !(b) \multimap \mathbf{0}: \ \cdot \vdash a}}{a,!(a) \oplus !(b) \multimap \mathbf{0}: \ \cdot \vdash !(a)} \ {}^{!}
    }{a,!(a) \oplus !(b) \multimap \mathbf{0}: \ \cdot \vdash !(a) \oplus !(b)} \ {}^{\oplus_1}
    \qquad
    \cfrac{\overline{a,!(a) \oplus !(b) \multimap \mathbf{0}: \ \mathbf{0} \vdash !(b)}}{} \ {}^{\star}
  }{a,!(a) \oplus !(b) \multimap \mathbf{0}: \ !(a) \oplus !(b) \multimap \mathbf{0} \vdash !(b)} \ {}^{\multimap}
}{
  \cfrac{
    \cfrac{
      \cfrac{
        \cfrac{a,!(a) \oplus !(b) \multimap \mathbf{0}: \ \cdot \vdash !(b)}{!(a) \oplus !(b) \multimap \mathbf{0}: \ \cdot \vdash !(a) \multimap !(b)} \ {}^{\star}
      }{!(a) \oplus !(b) \multimap \mathbf{0}: \ \cdot \vdash !(!(a) \multimap !(b))} \ {}^{!}
    }{\cdot: \ \cdot \vdash !(!(a) \oplus !(b) \multimap \mathbf{0}) \multimap !(!(a) \multimap !(b))} \ {}^{\star}
  }{\cdot: \ \cdot \vdash !(!(!(a) \oplus !(b) \multimap \mathbf{0}) \multimap !(!(a) \multimap !(b)))} \ {}^{!}
} \ {}^{D_C}
$$

70

file: KLE-cbv/KLE080+1.p (109 ms)

$$
\cfrac{
\cfrac{
\cfrac{a, b, !(a) \multimap !(!(b) \multimap \mathbf{0}), !(b) \multimap \mathbf{0}: \ \cdot \vdash b}{a, b, !(a) \multimap !(!(b) \multimap \mathbf{0}), !(b) \multimap \mathbf{0}: \ \cdot \vdash !(b)} \ !
\quad
a, b, !(a) \multimap !(!(b) \multimap \mathbf{0}), !(b) \multimap \mathbf{0}: \ \mathbf{0} \vdash \mathbf{0} \ \star
}{
\cfrac{
\cfrac{a, b, !(a) \multimap !(!(b) \multimap \mathbf{0}), !(b) \multimap \mathbf{0}: \ !(b) \multimap \mathbf{0} \vdash \mathbf{0}}{a, b, !(a) \multimap !(!(b) \multimap \mathbf{0}), !(b) \multimap \mathbf{0}: \ \cdot \vdash \mathbf{0}} \ D_C
}{
\cfrac{
\cfrac{a, b, !(a) \multimap !(!(b) \multimap \mathbf{0}): \ \cdot \vdash a}{a, b, !(a) \multimap !(!(b) \multimap \mathbf{0}): \ \cdot \vdash !(a)} \ !
\quad
a, b, !(a) \multimap !(!(b) \multimap \mathbf{0}): \ !(!(b) \multimap \mathbf{0}) \vdash \mathbf{0} \ \star
}{a, b, !(a) \multimap !(!(b) \multimap \mathbf{0}): \ !(a) \multimap !(!(b) \multimap \mathbf{0}) \vdash \mathbf{0}} \ \multimap
} \ \multimap
} \ D_C
}{
\cfrac{
\cfrac{
\cfrac{a, b, !(a) \multimap !(!(b) \multimap \mathbf{0}): \ \cdot \vdash \mathbf{0}}{a, b: \ \cdot \vdash !(!(a) \multimap !(!(b) \multimap \mathbf{0})) \multimap \mathbf{0}} \ \star
}{a, b: \ \cdot \vdash !(!(!(a) \multimap !(!(b) \multimap \mathbf{0})) \multimap \mathbf{0})} \ !
}{\cdot : \ \cdot \vdash !(a) \otimes !(b) \multimap !(!(!(a) \multimap !(!(b) \multimap \mathbf{0})) \multimap \mathbf{0})} \ \star
}{\cdot : \ \cdot \vdash !(!(a) \otimes !(b) \multimap !(!(!(a) \multimap !(!(b) \multimap \mathbf{0})) \multimap \mathbf{0}))} \ !
$$

file: KLE-cbv/KLE081+1.p (293 ms)

file: KLE-cbv/KLE082+1.p (384 ms)

file: KLE-cbv/KLE083+1.p (timeout!)

file: KLE-cbv/KLE084+1.p (timeout!)

file: KLE-cbv/KLE085+1.p (timeout!)

$$
\cfrac{
  \cfrac{
    \cfrac{
      \cfrac{
        \cfrac{}{a, b, !(a) \oplus !(!(b) \multimap \mathbf{0}) \multimap \mathbf{0} : \ \cdot \vdash a}
      }{a, b, !(a) \oplus !(!(b) \multimap \mathbf{0}) \multimap \mathbf{0} : \ \cdot \vdash !(a)} \ !
    }{a, b, !(a) \oplus !(!(b) \multimap \mathbf{0}) \multimap \mathbf{0} : \ \cdot \vdash !(a) \oplus !(!(b) \multimap \mathbf{0})} \ \oplus_1
    \qquad
    \cfrac{}{a, b, !(a) \oplus !(!(b) \multimap \mathbf{0}) \multimap \mathbf{0} : \ \mathbf{0} \vdash \mathbf{0}} \ \star
  }{
    \cfrac{
      \cfrac{
        \cfrac{a, b, !(a) \oplus !(!(b) \multimap \mathbf{0}) \multimap \mathbf{0} : \ !(a) \oplus !(!(b) \multimap \mathbf{0}) \multimap \mathbf{0} \vdash \mathbf{0}}{a, b, !(a) \oplus !(!(b) \multimap \mathbf{0}) \multimap \mathbf{0} : \ \cdot \vdash \mathbf{0}} \ D_C
      }{!(a) \oplus !(!(b) \multimap \mathbf{0}) \multimap \mathbf{0} : \ \cdot \vdash !(a) \otimes !(b) \multimap \mathbf{0}} \ \star
    }{!(a) \oplus !(!(b) \multimap \mathbf{0}) \multimap \mathbf{0} : \ \cdot \vdash !(!(a) \otimes !(b) \multimap \mathbf{0})} \ !
  }{} \ \multimap
}{
  \cfrac{
    \cdot : \ \cdot \vdash !(!(a) \oplus !(!(b) \multimap \mathbf{0}) \multimap \mathbf{0}) \multimap !(!(a) \otimes !(b) \multimap \mathbf{0})
  }{\cdot : \ \cdot \vdash !(!(!(a) \oplus !(!(b) \multimap \mathbf{0}) \multimap \mathbf{0}) \multimap !(!(a) \otimes !(b) \multimap \mathbf{0}))} \ !
} \ \star
$$

4.2 LCL Problems

4.3 SYJ Problems

$$
\cfrac{
  \cfrac{
    \cfrac{}{a : \ \cdot \vdash a}
  }{a : \ \cdot \vdash !(a)} \ !
}{\cdot : \ !(a) \vdash !(a)} \ \star
$$

$$
\cfrac{
  \cfrac{
    \cfrac{
      \cfrac{
        \cfrac{
          \cfrac{
            \cfrac{}{a, !(a) \multimap \mathbf{0} : \ \cdot \vdash a}
          }{a, !(a) \multimap \mathbf{0} : \ \cdot \vdash !(a)} \ !
          \qquad
          \cfrac{}{a, !(a) \multimap \mathbf{0} : \ \mathbf{0} \vdash \mathbf{0}} \ \star
        }{a, !(a) \multimap \mathbf{0} : \ !(a) \multimap \mathbf{0} \vdash \mathbf{0}} \ \multimap
      }{a, !(a) \multimap \mathbf{0} : \ \cdot \vdash \mathbf{0}} \ D_C
    }{a : \ \cdot \vdash !(!(a) \multimap \mathbf{0}) \multimap \mathbf{0}} \ \star
  }{a : \ \cdot \vdash !(!(!(a) \multimap \mathbf{0}) \multimap \mathbf{0})} \ !
}{\cdot : \ !(a) \vdash !(!(!(a) \multimap \mathbf{0}) \multimap \mathbf{0})} \ \star
$$

$$
\cfrac{
  \cfrac{
    \cfrac{
      \cfrac{
        \cfrac{
          \cfrac{}{a, !(a) \multimap !(b) : \ \cdot \vdash a}
        }{a, !(a) \multimap !(b) : \ \cdot \vdash !(a)} \ !
        \qquad
        \cfrac{
          \cfrac{
            \cfrac{}{a, b, !(a) \multimap !(b) : \ \cdot \vdash b}
          }{a, b, !(a) \multimap !(b) : \ \cdot \vdash !(b)} \ !
        }{a, !(a) \multimap !(b) : \ !(b) \vdash !(b)} \ \star
      }{a, !(a) \multimap !(b) : \ !(a) \multimap !(b) \vdash !(b)} \ \multimap
    }{a, !(a) \multimap !(b) : \ \cdot \vdash !(b)} \ D_C
  }{!(a) \multimap !(b) : \ \cdot \vdash !(a) \multimap !(b)} \ \star
}{
  \cfrac{!(a) \multimap !(b) : \ \cdot \vdash !(!(a) \multimap !(b))}{\cdot : \ !(!(a) \multimap !(b)) \vdash !(!(a) \multimap !(b))} \ \star
} \ !
$$

file: ILLTP-cbv/SYJ/SYJ105+1.002.p (322 ms)

file: ILLTP-cbv/SYJ/SYJ105+1.003.p (timeout!)

file: ILLTP-cbv/SYJ/SYJ105+1.004.p (timeout!)

file: ILLTP-cbv/SYJ/SYJ106+1.p (1691 ms)

file: ILLTP-cbv/SYJ/SYJ107+1.001.p (95 ms)

$$
\cfrac{
  \cfrac{
    \cfrac{\cfrac{\overline{b, c : \ \cdot \vdash b}}{b, c : \ \cdot \vdash !(b)}\ ! \quad \cfrac{\overline{b, c : \ \cdot \vdash c}}{b, c : \ \cdot \vdash !(c)}\ !}{b, c : \ \cdot \vdash !(b) \otimes !(c)}\ \otimes
  }{b, c : \ \cdot \vdash !(a) \oplus !(b) \otimes !(c)}\ \oplus_1
  \quad
  \cfrac{\cfrac{\overline{a, c : \ \cdot \vdash a}}{a, c : \ \cdot \vdash !(a)}\ !}{a, c : \ \cdot \vdash !(a) \oplus !(b) \otimes !(c)}\ \oplus_1
  \quad
  \cfrac{
    \cfrac{\cfrac{\overline{b, c : \ \cdot \vdash b}}{b, c : \ \cdot \vdash !(b)}\ ! \quad \cfrac{\overline{b, c : \ \cdot \vdash c}}{b, c : \ \cdot \vdash !(c)}\ !}{b, c : \ \cdot \vdash !(b) \otimes !(c)}\ \otimes
  }{b, c : \ \cdot \vdash !(a) \oplus !(b) \otimes !(c)}\ \oplus_1
}{\cdot : \ !(c), !(b) \oplus !(a) \oplus !(b) \vdash !(a) \oplus !(b) \otimes !(c)}\ \star
$$

file: ILLTP-cbv/SYJ/SYJ107+1.002.p (368 ms)

file: ILLTP-cbv/SYJ/SYJ107+1.003.p (109902 ms)

Not shown due to LaTeX restrictions.

file: ILLTP-cbv/SYJ/SYJ107+1.004.p (175469 ms)

Not shown due to LaTeX restrictions.

file: ILLTP-cbv/SYJ/SYJ201+1.001.p (25851 ms)

Not shown due to LaTeX restrictions.

file: ILLTP-cbv/SYJ/SYJ201+1.002.p (timeout!)

file: ILLTP-cbv/SYJ/SYJ201+1.003.p (timeout!)

file: ILLTP-cbv/SYJ/SYJ201+1.004.p (timeout!)

file: ILLTP-cbv/SYJ/SYJ201+1.005.p (timeout!)

file: ILLTP-cbv/SYJ/SYJ201+1.006.p (timeout!)

```
file: ILLTP-cbv/SYJ/SYJ201+1.007.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ201+1.008.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ201+1.009.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ201+1.010.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ201+1.011.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ201+1.012.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ201+1.013.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ201+1.014.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ201+1.015.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ201+1.016.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ201+1.017.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ201+1.018.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ201+1.019.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ201+1.020.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ202+1.001.p (42 ms)
```

$$
\cfrac{\cfrac{\cfrac{\cfrac{}{o11, o21 : \ \cdot \vdash o11}}{o11, o21 : \ \cdot \vdash !(o11)} \ !}{o11, o21 : \ \cdot \vdash !(o11) \oplus !(o21)} \ \oplus_1}{\cdot : \ !(o11), !(o21) \vdash !(o11) \oplus !(o21)} \ \star
$$

```
file: ILLTP-cbv/SYJ/SYJ202+1.002.p (383 ms)
```

```
file: ILLTP-cbv/SYJ/SYJ202+1.003.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ202+1.004.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ202+1.005.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ202+1.006.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ202+1.007.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ202+1.008.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ202+1.009.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ202+1.010.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ202+1.011.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ202+1.012.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ202+1.013.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ202+1.014.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ202+1.015.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ202+1.016.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ202+1.017.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ202+1.018.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ202+1.019.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ202+1.020.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ203+1.001.p (314 ms)
```

$$
\cfrac{
  \cfrac{
    \cfrac{
      \cfrac{
        \cfrac{
          \cfrac{
            \cfrac{\overline{p1, !(p1) \oplus !(!(p1) \multimap !(f)) \multimap !(f) : \cdot \vdash p1}}{p1, !(p1) \oplus !(!(p1) \multimap !(f)) \multimap !(f) : \cdot \vdash !(p1)}\;! }{p1, !(p1) \oplus !(!(p1) \multimap !(f)) \multimap !(f) : \cdot \vdash !(p1) \oplus !(!(p1) \multimap !(f))}\;\oplus_1
          \quad
          \cfrac{\cfrac{\overline{f, p1, !(p1) \oplus !(!(p1) \multimap !(f)) \multimap !(f) : \cdot \vdash f}}{f, p1, !(p1) \oplus !(!(p1) \multimap !(f)) \multimap !(f) : \cdot \vdash !(f)}\;!}{p1, !(p1) \oplus !(!(p1) \multimap !(f)) \multimap !(f) : \; !(f) \vdash !(f)}\;\star
        }{p1, !(p1) \oplus !(!(p1) \multimap !(f)) \multimap !(f) : \; !(p1) \oplus !(!(p1) \multimap !(f)) \multimap !(f) \vdash !(f)}\;\multimap
      }{p1, !(p1) \oplus !(!(p1) \multimap !(f)) \multimap !(f) : \cdot \vdash !(f)}\;D_C
    }{!(p1) \oplus !(!(p1) \multimap !(f)) \multimap !(f) : \cdot \vdash !(p1) \multimap !(f)}\;\star
    }{!(p1) \oplus !(!(p1) \multimap !(f)) \multimap !(f) : \cdot \vdash !(!(p1) \multimap !(f))}\;!
    }{!(p1) \oplus !(!(p1) \multimap !(f)) \multimap !(f) : \cdot \vdash !(p1) \oplus !(!(p1) \multimap !(f))}\;\oplus_1
    \quad
    \cfrac{\cfrac{\overline{f, !(p1) \oplus !(!(p1) \multimap !(f)) \multimap !(f) : \cdot \vdash f}}{f, !(p1) \oplus !(!(p1) \multimap !(f)) \multimap !(f) : \cdot \vdash !(f)}\;!}{!(p1) \oplus !(!(p1) \multimap !(f)) \multimap !(f) : \; !(f) \vdash !(f)}\;\star
  }{!(p1) \oplus !(!(p1) \multimap !(f)) \multimap !(f) : \; !(p1) \oplus !(!(p1) \multimap !(f)) \multimap !(f) \vdash !(f)}\;\multimap
  }{!(p1) \oplus !(!(p1) \multimap !(f)) \multimap !(f) : \cdot \vdash !(f)}\;D_C
}{\cdot : \; !(!(p1) \oplus !(!(p1) \multimap !(f)) \multimap !(f)) \vdash !(f)}\;\star
$$

```
file: ILLTP-cbv/SYJ/SYJ203+1.002.p (1879 ms)
```

```
file: ILLTP-cbv/SYJ/SYJ203+1.003.p (18347 ms)
```

```
file: ILLTP-cbv/SYJ/SYJ203+1.004.p (180259 ms)
```

```
file: ILLTP-cbv/SYJ/SYJ203+1.005.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ203+1.006.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ203+1.007.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ203+1.008.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ203+1.009.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ203+1.010.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ203+1.011.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ203+1.012.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ203+1.013.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ203+1.014.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ203+1.015.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ203+1.016.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ203+1.017.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ203+1.018.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ203+1.019.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ203+1.020.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ204+1.001.p (118 ms)
```

$$
\cfrac{
\cfrac{
\cfrac{
\cfrac{
\cfrac{p1,!(p1) \multimap !(p0),!(p1) \multimap !(!(p1) \multimap !(p0)): \cdot \vdash p1}{p1,!(p1) \multimap !(p0),!(p1) \multimap !(!(p1) \multimap !(p0)): \cdot \vdash !(p1)} \; !
\quad
\cfrac{
\cfrac{p0,p1,!(p1) \multimap !(p0),!(p1) \multimap !(!(p1) \multimap !(p0)): \cdot \vdash p0}{p0,p1,!(p1) \multimap !(p0),!(p1) \multimap !(!(p1) \multimap !(p0)): \cdot \vdash !(p0)} \; !}{p1,!(p1) \multimap !(p0),!(p1) \multimap !(!(p1) \multimap !(p0)): \; !(p0) \vdash !(p0)} \; \star
}{p1,!(p1) \multimap !(p0),!(p1) \multimap !(!(p1) \multimap !(p0)): \; !(p1) \multimap !(p0) \vdash !(p0)} \; \multimap}{p1,!(p1) \multimap !(p0),!(p1) \multimap !(!(p1) \multimap !(p0)): \cdot \vdash !(p0)} \; D_C
}{\quad}
$$

$$
\cfrac{
\cfrac{
\cfrac{p1,!(p1) \multimap !(!(p1) \multimap !(p0)): \cdot \vdash p1}{p1,!(p1) \multimap !(!(p1) \multimap !(p0)): \cdot \vdash !(p1)} \; !
\qquad
\cfrac{\cdots}{p1,!(p1) \multimap !(!(p1) \multimap !(p0)): \; !(!(p1) \multimap !(p0)) \vdash !(p0)} \; \star
}{p1,!(p1) \multimap !(!(p1) \multimap !(p0)): \; !(p1) \multimap !(!(p1) \multimap !(p0)) \vdash !(p0)} \; \multimap
}{
\cfrac{p1,!(p1) \multimap !(!(p1) \multimap !(p0)): \cdot \vdash !(p0)}{\cdot: \; !(p1),!(!(p1) \multimap !(!(p1) \multimap !(p0))) \vdash !(p0)} \; \star
} \; D_C
$$

```
file: ILLTP-cbv/SYJ/SYJ204+1.002.p (584 ms)
```



```
file: ILLTP-cbv/SYJ/SYJ204+1.003.p (2539 ms)
```



```
file: ILLTP-cbv/SYJ/SYJ204+1.004.p (13396 ms)
```



```
file: ILLTP-cbv/SYJ/SYJ204+1.005.p (58079 ms)
```

Not shown due to LaTeX restrictions.

```
file: ILLTP-cbv/SYJ/SYJ204+1.006.p (269913 ms)
```

Not shown due to LaTeX restrictions.

```
file: ILLTP-cbv/SYJ/SYJ204+1.007.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ204+1.008.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ204+1.009.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ204+1.010.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ204+1.011.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ204+1.012.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ204+1.013.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ204+1.014.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ204+1.015.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ204+1.016.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ204+1.017.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ204+1.018.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ204+1.019.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ204+1.020.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ205+1.001.p (33281 ms)
```

```
file: ILLTP-cbv/SYJ/SYJ205+1.002.p (98201 ms)
```

```
file: ILLTP-cbv/SYJ/SYJ205+1.003.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ205+1.004.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ205+1.005.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ205+1.006.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ205+1.007.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ205+1.008.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ205+1.009.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ205+1.010.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ205+1.011.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ205+1.012.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ205+1.013.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ205+1.014.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ205+1.015.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ205+1.016.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ205+1.017.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ205+1.018.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ205+1.019.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ205+1.020.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ206+1.001.p (59 ms)
```

$$
\cfrac{\cfrac{\cfrac{\cfrac{\overline{a1:\ \cdot\vdash a1}}{a1:\ \cdot\vdash !(a1)}\ !}{\cdot:\ \cdot\vdash !(a1)\multimap !(a1)}\ \star}{\cdot:\ \cdot\vdash !(!(a1)\multimap !(a1))}\ !\quad\cfrac{\cfrac{\cfrac{\overline{a1:\ \cdot\vdash a1}}{a1:\ \cdot\vdash !(a1)}\ !}{\cdot:\ \cdot\vdash !(a1)\multimap !(a1)}\ \star}{\cdot:\ \cdot\vdash !(!(a1)\multimap !(a1))}\ !}{\cdot:\ \cdot\vdash !(!(a1)\multimap !(a1))\otimes !(!(a1)\multimap !(a1))}\ \otimes
$$

```
file: ILLTP-cbv/SYJ/SYJ206+1.002.p (617 ms)
```

77

(proof derivations — illegible)

```
file: ILLTP-cbv/SYJ/SYJ206+1.003.p (28881 ms)
```

```
file: ILLTP-cbv/SYJ/SYJ206+1.004.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ206+1.005.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ206+1.006.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ206+1.007.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ206+1.008.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ206+1.009.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ206+1.010.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ206+1.011.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ206+1.012.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ206+1.013.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ206+1.014.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ206+1.015.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ206+1.016.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ206+1.017.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ206+1.018.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ206+1.019.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ206+1.020.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ207+1.001.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ207+1.002.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ207+1.003.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ207+1.004.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ207+1.005.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ207+1.006.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ207+1.007.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ207+1.008.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ207+1.009.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ207+1.010.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ207+1.011.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ207+1.012.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ207+1.013.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ207+1.014.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ207+1.015.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ207+1.016.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ207+1.017.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ207+1.018.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ207+1.019.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ207+1.020.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ208+1.001.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ208+1.002.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ208+1.003.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ208+1.004.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ208+1.005.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ208+1.006.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ208+1.007.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ208+1.008.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ208+1.009.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ208+1.010.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ208+1.011.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ208+1.012.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ208+1.013.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ208+1.014.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ208+1.015.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ208+1.016.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ208+1.017.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ208+1.018.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ208+1.019.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ208+1.020.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ209+1.001.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ209+1.002.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ209+1.003.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ209+1.004.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ209+1.005.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ209+1.006.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ209+1.007.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ209+1.008.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ209+1.009.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ209+1.010.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ209+1.011.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ209+1.012.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ209+1.013.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ209+1.014.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ209+1.015.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ209+1.016.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ209+1.017.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ209+1.018.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ209+1.019.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ209+1.020.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ210+1.001.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ210+1.002.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ210+1.003.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ210+1.004.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ210+1.005.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ210+1.006.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ210+1.007.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ210+1.008.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ210+1.009.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ210+1.010.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ210+1.011.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ210+1.012.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ210+1.013.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ210+1.014.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ210+1.015.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ210+1.016.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ210+1.017.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ210+1.018.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ210+1.019.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ210+1.020.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ211+1.001.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ211+1.002.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ211+1.003.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ211+1.004.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ211+1.005.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ211+1.006.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ211+1.007.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ211+1.008.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ211+1.009.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ211+1.010.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ211+1.011.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ211+1.012.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ211+1.013.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ211+1.014.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ211+1.015.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ211+1.016.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ211+1.017.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ211+1.018.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ211+1.019.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ211+1.020.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ212+1.001.p (565 ms)
```



```
file: ILLTP-cbv/SYJ/SYJ212+1.002.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ212+1.003.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ212+1.004.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ212+1.005.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ212+1.006.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ212+1.007.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ212+1.008.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ212+1.009.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ212+1.010.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ212+1.011.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ212+1.012.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ212+1.013.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ212+1.014.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ212+1.015.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ212+1.016.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ212+1.017.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ212+1.018.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ212+1.019.p (timeout!)
```

```
file: ILLTP-cbv/SYJ/SYJ212+1.020.p (timeout!)
```

4.4 SYN Problems

```
file: ILLTP-cbv/SYN/SYN001+1.p (241 ms)
```

$$
\cfrac{
\cfrac{
\cfrac{
\cfrac{
\cfrac{
\cfrac{\overline{p, !(!(p) \multimap !(p)) \otimes !(!(p) \multimap !(p)) \multimap \mathbf{0} : \cdot \vdash p}}{p, !(!(p) \multimap !(p)) \otimes !(!(p) \multimap !(p)) \multimap \mathbf{0} : \cdot \vdash !(p)} \;!}
{!(!(p) \multimap !(p)) \otimes !(!(p) \multimap !(p)) \multimap \mathbf{0} : \cdot \vdash !(p) \multimap !(p)} \;\star}
{!(!(p) \multimap !(p)) \otimes !(!(p) \multimap !(p)) \multimap \mathbf{0} : \cdot \vdash !(!(p) \multimap !(p))} \;!
\quad
\cfrac{
\cfrac{
\cfrac{\overline{p, !(!(p) \multimap !(p)) \otimes !(!(p) \multimap !(p)) \multimap \mathbf{0} : \cdot \vdash p}}{p, !(!(p) \multimap !(p)) \otimes !(!(p) \multimap !(p)) \multimap \mathbf{0} : \cdot \vdash !(p)} \;!}
{!(!(p) \multimap !(p)) \otimes !(!(p) \multimap !(p)) \multimap \mathbf{0} : \cdot \vdash !(p) \multimap !(p)} \;\star}
{!(!(p) \multimap !(p)) \otimes !(!(p) \multimap !(p)) \multimap \mathbf{0} : \cdot \vdash !(!(p) \multimap !(p))} \;!
}{!(!(p) \multimap !(p)) \otimes !(!(p) \multimap !(p)) \multimap \mathbf{0} : \cdot \vdash !(!(p) \multimap !(p)) \otimes !(!(p) \multimap !(p))} \;\otimes
\quad
\overline{!(!(p) \multimap !(p)) \otimes !(!(p) \multimap !(p)) \multimap \mathbf{0} : \mathbf{0} \vdash \mathbf{0}} \;\star}
{!(!(p) \multimap !(p)) \otimes !(!(p) \multimap !(p)) \multimap \mathbf{0} : \; !(!(p) \multimap !(p)) \otimes !(!(p) \multimap !(p)) \multimap \mathbf{0} \vdash \mathbf{0}} \;\multimap}
{!(!(p) \multimap !(p)) \otimes !(!(p) \multimap !(p)) \multimap \mathbf{0} : \cdot \vdash \mathbf{0}} \;D_C}
{\cdot : \cdot \vdash !(!(!(p) \multimap !(p)) \otimes !(!(p) \multimap !(p)) \multimap \mathbf{0}) \multimap \mathbf{0}} \;\star}
{\cdot : \cdot \vdash !(!(!(!(p) \multimap !(p)) \otimes !(!(p) \multimap !(p)) \multimap \mathbf{0}) \multimap \mathbf{0})} \;!
$$

```
file: ILLTP-cbv/SYN/SYN007+1.014.p (timeout!)
```

```
file: ILLTP-cbv/SYN/SYN040+1.p (timeout!)
```

```
file: ILLTP-cbv/SYN/SYN041+1.p (timeout!)
```

```
file: ILLTP-cbv/SYN/SYN044+1.p (825 ms)
```

```
file: ILLTP-cbv/SYN/SYN045+1.p (225 ms)
```

```
file: ILLTP-cbv/SYN/SYN046+1.p (timeout!)
```

```
file: ILLTP-cbv/SYN/SYN047+1.p (timeout!)
```

```
file: ILLTP-cbv/SYN/SYN387+1.p fail (18 ms)
```

```
file: ILLTP-cbv/SYN/SYN388+1.p (timeout!)
```

```
file: ILLTP-cbv/SYN/SYN389+1.p (timeout!)
```

```
file: ILLTP-cbv/SYN/SYN390+1.p (52 ms)
```

$$
\cfrac{
\cfrac{
\cfrac{
\cfrac{\overline{p : \cdot \vdash p}}{p : \cdot \vdash !(p)} \;!}
{\cdot : \cdot \vdash !(p) \multimap !(p)} \;\star}
{\cdot : \cdot \vdash !(!(p) \multimap !(p))} \;!
\quad
\cfrac{
\cfrac{
\cfrac{\overline{p : \cdot \vdash p}}{p : \cdot \vdash !(p)} \;!}
{\cdot : \cdot \vdash !(p) \multimap !(p)} \;\star}
{\cdot : \cdot \vdash !(!(p) \multimap !(p))} \;!
}{\cdot : \cdot \vdash !(!(p) \multimap !(p)) \otimes !(!(p) \multimap !(p))} \;\otimes
$$

```
file: ILLTP-cbv/SYN/SYN391+1.p (438 ms)
```

$$\overline{\cdot:\ \cdot \vdash \mathbf{1}}$$

$$
\cfrac{
\cfrac{
\cfrac{
\cfrac{
\cfrac{\overline{a,b:\ \cdot \vdash b}}{a,b:\ \cdot \vdash\ !(b)}\ !
}{a,b:\ \cdot \vdash\ !(a) \multimap\ !(b)}\ \star
}{a,b:\ \cdot \vdash\ !(!(a) \multimap\ !(b))}\ !
\quad
\cfrac{
\cfrac{
\cfrac{\overline{a,b:\ \cdot \vdash a}}{a,b:\ \cdot \vdash\ !(a)}\ !
}{a,b:\ \cdot \vdash\ !(b) \multimap\ !(a)}\ \star
}{a,b:\ \cdot \vdash\ !(!(b) \multimap\ !(a))}\ !
}{a,b:\ \cdot \vdash\ !(!(a) \multimap\ !(b)) \otimes\ !(!(b) \multimap\ !(a))}\ \otimes
}{\cdot:\ \cdot \vdash\ !(a) \otimes\ !(b) \multimap\ !(!(a) \multimap\ !(b)) \otimes\ !(!(b) \multimap\ !(a))}\ \star
}{\cdot:\ \cdot \vdash\ !(!(a) \otimes\ !(b) \multimap\ !(!(a) \multimap\ !(b)) \otimes\ !(!(b) \multimap\ !(a)))}\ !
$$

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