#GR (4 tipos)

a) $\{a^n / n > 0\}$ GLUD

$V = \{S\}$
$T = \{a\}$ ✓
$P = \{S \to aS / a\}$
$S = S$

GLUE

$V = \{S\}$
$T = \{a\}$
$P = \{S \to Sa / a\}$
$S = S$ ✓

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b) $\{a^n b^m / n > 0, m \geq 0\}$

GLUD

$V = \{S, A, B\}$
$T = \{a, b\}$
$P = \{S \to a / aA$
$\qquad A \to aA / bB / \lambda$ ✓
$S = S \qquad B \to bB / \lambda$

GLUE

$V = \{S, A, B\}$
$T = \{a, b\}$
$P = \{S \to a / Bb / Aa$
$\qquad B \to Bb / Aa$
$\qquad A \to Aa / \lambda \}$ ✓
$S = S$

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c) $\{a^{2n} b(ab)^m / n > 0, m \geq 0\}$

GLUD

$V = \{S, A, B, X, Y\}$
$T = \{a, b\}$
$P = \{S \to aX$
$\qquad A \to aX / bB$
$\qquad B \to bY$
$\qquad X \to aA$
$\qquad Y \to aB / \lambda \}$ ✓
$S = S$

GLUE

$V = \{S, A, B, X, Y, Z\}$
$T = \{a, b\}$
$P = \{S \to Ab$
$\qquad A \to Ba$
$\qquad B \to Ab / Yb$
$\qquad X \to Za$
$\qquad Y \to Xa$
$\qquad Z \to \lambda / Xa \}$ X
$S = S$

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d) $\{a^n b^m c^p / n, m, p > 0\}$

GLUD

$V = \{S, A, B, C\}$
$T = \{a, b, c\}$
$P = \{S \to aA$
$\qquad A \to aA / bB$
$\qquad B \to bB / cC$ ✓
$\qquad C \to cC / \lambda \}$
$S = S$

GLUE

$V = \{S, A, B, C\}$
$T = \{a, b, c\}$
$P = \{S \to Cc$
$\qquad C \to Cc / Bb$
$\qquad B \to Bb / Aa$
$\qquad A \to Aa / \lambda \}$ ✓
$S = S$

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e) $\{(ab)^n (ba)^m / n, m > 0\}$

GLUD

$V = \{S, A, B, X, Y\}$
$T = \{a, b\}$
$P = \{S \to aA$
$\qquad A \to bB / bX$
$\qquad B \to aA$
$\qquad X \to aY / \lambda$
$\qquad Y \to bX$

GLUE

$V = \{S, A, B, X, Y\}$
$T = \{a, b\}$
$P = \{S \to Aa$
$\qquad A \to Bb / Xb$
$\qquad B \to Aa$
$\qquad X \to Ya / \lambda$
$\qquad Y \to Xb \}$
$S = S$

GLC

a) $\{a^i b^j c^k \mid i = j+k, \ j>0, \ k>0\}$

$V = \{S, A, B\}$
$T = \{a, b, c\}$
$P = \{S \to aAc \mid$
$\quad A \to aAc \mid aBb$
$\quad B \to aBb \,/\, \lambda \}$
$S=S$

b) $\{a^i b^j c^k \mid k = i+j, \ i>0, \ j>0\}$

$V = \{S, A, B\}$
$T = \{a, b, c\}$
$P = \{S \to aAc$
$\quad A \to aAc \,/\, bBc$
$\quad B \to bBc \,/\, \lambda\}$

$S=S$

c) $\{a^i b^j c^k \mid j = i+k, \ i, k>0\}$

$V = \{S, A, B\}$
$T = \{a, b, c\}$
$P = \{S \to AB$
$\quad A \to aAb \,/\, b$
$\quad B \to bBc \,/\, \lambda\}$
$S=S$

d) $\{w \in \{a, b\}^* \,/\, \text{qtde de } a = \text{qtde de } b\}$

$V = \{S,$
$T = \{a, b\}$
$P = \{S \to \lambda \mid bA \mid aB$
$\quad A \to aS \mid bAA$
$\quad B \to bS \mid aBB\}$

$S=S$

e) $\{a^n b^{2n} c^m d^{m+2} \mid n\geq 0, \ m\geq 1\}$

$V = \{$
$T = \{$
$P = \{S \to AB$
$\quad A \to aAbb \,/\, \lambda$
$\quad B \to cC \, ddd$
$\quad C \to cC \, d \,/\, \lambda\}$

f) $\{a^i b^m c^i \mid i\geq 0, \ m\geq 1\}$

$V = \{S,$
$T = \{a, b, c\}$
$P = \{S \to aAc \mid bB$
$\quad A \to aAc \mid bB$
$\quad B \to bB \,/\, \lambda\}$
$\qquad\qquad S=S$

g) $\{(01)^m (10)^n \,/\, m\geq 0\}$

$V = \{$
$T = \{0, 1\}$
$P = \{S \to 10S01 \,/\, \lambda\}$

OU
$S \to 1A1$
$A \to 0B0$
$B \to 1A1 / \lambda$
$S=S$

h) $\{0^n 1^m 0^k \,/\, m\geq 0, \ k\geq 1\}$

$V = \{$
$T = \{0, 1\}$
$P = \{S \to AB$
$\quad A \to 0A1 \,/\, \lambda$
$\quad B \to 0B \,/\, 0\}$
$S=S$

i) $\{0^n 1^m 1^{2k} \,/\, m\geq 0, \ k\geq 1\}$

$V = \{$
$T = \{$
$P = \{S \to AB$
$\quad A \to 0A1 \,/\, \lambda$
$\quad B \to 11B \,/\, 11\}$
$S=S$