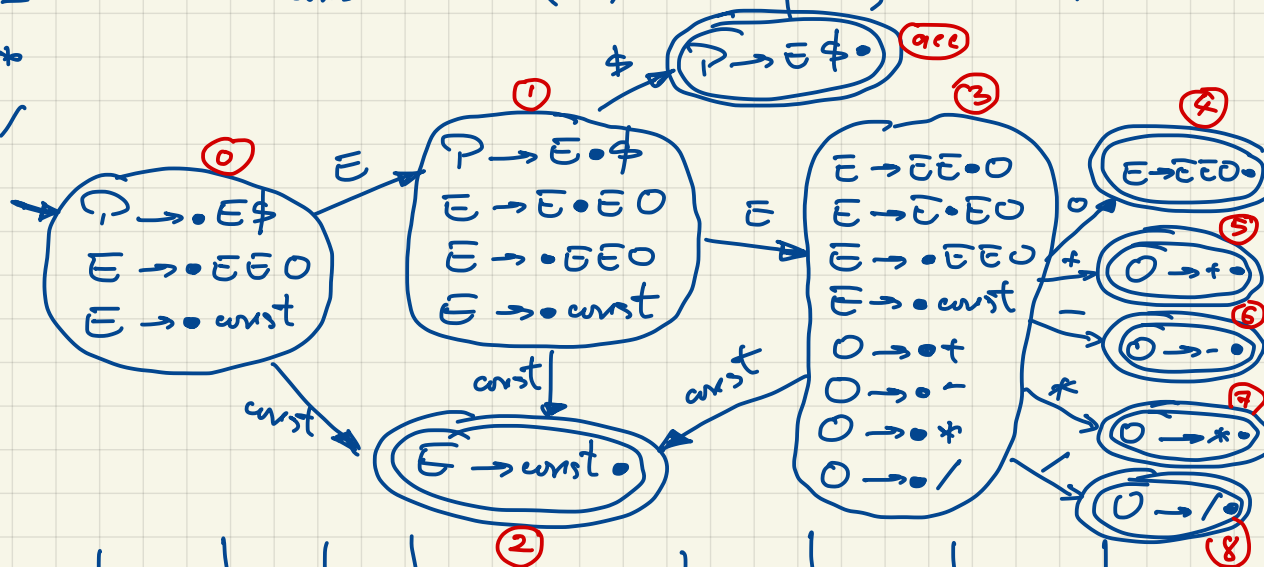# A2 – sol.

(win. 2023)

① @

0. $P \rightarrow E \$$
1. $E \rightarrow E E O$ ⎤
2. $E \rightarrow const$ ⎦
3. $O \rightarrow +$
4. $O \rightarrow -$
5. $O \rightarrow *$
6. $O \rightarrow /$

	FIRST	FOLLOW
E	const	const, +, -, *, /, $
O	+, -, *, /	const, +, -, *, /, $

const $\in$ FIRST(E) $\Rightarrow$ conflict, not LL(1)

$P \rightarrow E \$ \cdot$ (acc)

state machine diagram with states ⓪①②③④⑤⑥⑦⑧

State 0: $P \rightarrow \cdot E \$$, $E \rightarrow \cdot E E O$, $E \rightarrow \cdot const$

State 1: $P \rightarrow E \cdot \$$, $E \rightarrow E \cdot E O$, $E \rightarrow \cdot E E O$, $E \rightarrow \cdot const$

State 3: $E \rightarrow E E \cdot O$, $E \rightarrow E \cdot E O$, $E \rightarrow \cdot E E O$, $E \rightarrow \cdot const$, $O \rightarrow \cdot +$, $O \rightarrow \cdot -$, $O \rightarrow \cdot *$, $O \rightarrow \cdot /$

State 2: $E \rightarrow const \cdot$

State 4: $E \rightarrow E E O \cdot$
State 5: $O \rightarrow + \cdot$
State 6: $O \rightarrow - \cdot$
State 7: $O \rightarrow * \cdot$
State 8: $O \rightarrow / \cdot$

state \ token	+	-	*	/	const	$	E	O
0					s2		s1	
1					s2	acc	s3	
2	r2	r2	r2	r2	r2	r2		
3	s5	s6	s7	s8	s2			s4
4	r1	r1	r1	r1	r1	r1		
5	r3	r3	r3	r3	r3	r3		
6	r4	r4	r4	r4	r4	r4		
7	r5	r5	r5	r5	r5	r5		
8	r6	r6	r6	r6	r6	r6		

no conflicts $\Rightarrow$ SLR(1)

P

E $

E   E   O

E   E   O   E   E   O   +

E   E   O   const   /   const   const   *
        5   6   7

const   E   E   -   const   6   const   7
1

const   E   E   O
2   *

const   const   +
3   4
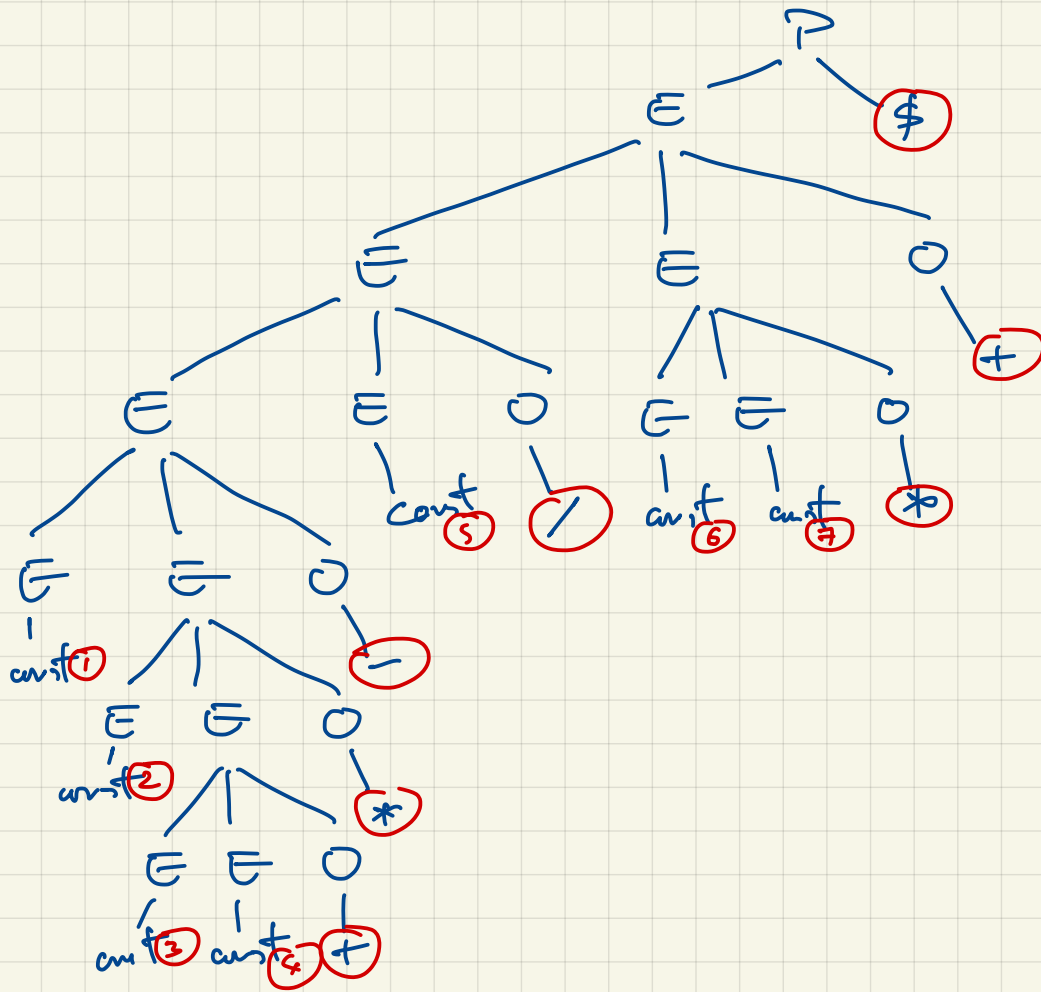
©
0. P → E $
1. E → const X
2. X → E O X
3. X → ε
4. O → +
5. O → -
6. O → *
7. O → /

	FIRST	FOLLOW
E	const	+,-,*,/,$
O	+,-,*,/	+,-,*,/, const,$
X	const	+,-,*,/,$

no conflicts, so it is LL(1)

non-term \ token	+	-	*	/	const	$
E					1	
O	4	5	6	7		
X	3	3	3	3	2	3

ⓓ

Parse tree:
- P
  - E
    - const ①
    - X
      - E
        - const ②
        - X
          - E
            - const ③
            - X
              - E
                - const ④
                - X → ε
              - O → +
              - X → ε
          - O → *
          - X → ε
      - O → -
      - X
        - E
          - const ⑤
        - O → /
        - X
          - E
            - const ⑥
            - X
              - E
                - const ⑦
                - X → ε
              - O → *
              - X → ε
          - O → +
          - X → ε
  - $

② ⓐ
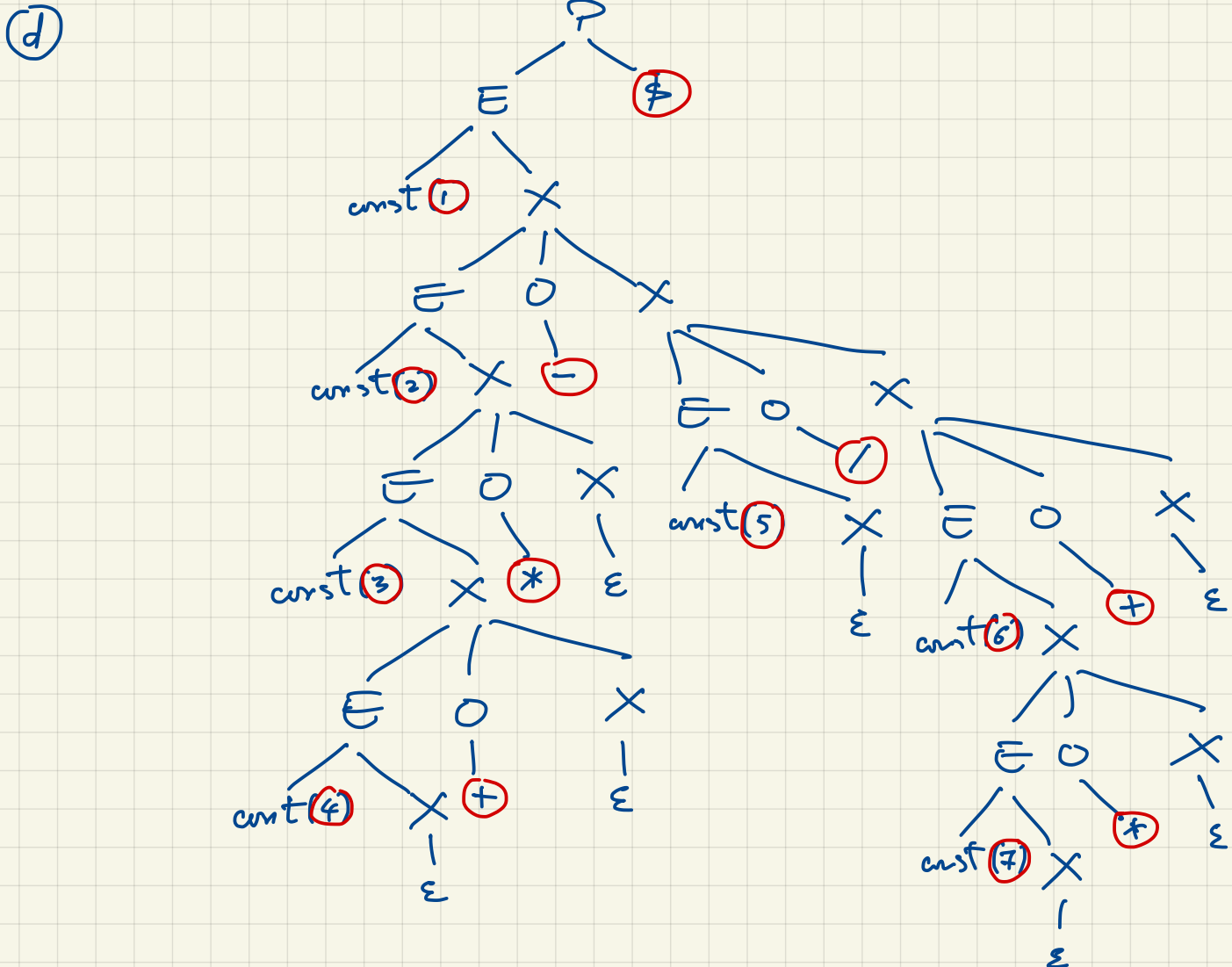
$S \rightarrow A_1 P_1 . R \, e \, A_2 P_2$ $S.val \leftarrow A_1.val \times (P_1.val + R.val \times 10^{-1}) \times 10^{A_2.val \times P_2.val}$

$P_1 \rightarrow P_2 D$ $P_1.val \leftarrow 10 \times P_2.val + D$

$P \rightarrow D$ $P.val \leftarrow D.val$

$R_1 \rightarrow D R_2$ $R_1.val \leftarrow D_{val} + R_2.val \times 10^{-1}$

$R \rightarrow D$ $R.val \leftarrow D.val$

$D \rightarrow i, \ 0 \le i \le 9$ $D.val \leftarrow i$

$A \rightarrow + \mid - \mid \varepsilon$ $A.val = +1 \mid -1 \mid +1$

ⓑ