To be simplify, I converted it to this abbreviation to put it in table

PROGRAM 🡪 a

BEGIN 🡪 b

END. 🡪 $

INTEGER 🡪 i

PRINT 🡪 t

P 🡪 p

Q 🡪 q

R 🡪 r

S 🡪 s

<prog> 🡪 X

<identifier> 🡪 A

<dec-list> 🡪 D

<stat-list> 🡪 L

<more-id-digit> 🡪 M

<dec> 🡪 C

<type> 🡪 Y

<stat> 🡪 Z

<print> 🡪 H

<assign> 🡪 G

<exp> 🡪 E

<term> 🡪 T

<factor> 🡪 F

<number> 🡪 N

<sign> 🡪 O

<more-digit> 🡪 K

<digit> 🡪 J

<id> 🡪 I

**BNF form in abbreviated words:**

X 🡪 a A ; D b L $

A 🡪 I M

M 🡪 J M

M 🡪 **λ**

D 🡪 Y : C ;

C 🡪 A , C

Here I marked as \*

C 🡪 A

* \* these 2 lines above will be written like this to prevent 2 states in same table

W 🡪 A W

W 🡪 , C | **λ**

Y 🡪 i

L 🡪 Z

Here I marked as \*

L 🡪 Z L

* \* these 2 lines above will be written like this to prevent 2 states in same table

L 🡪 Z S

S 🡪 λ | L

Z 🡪H

Z 🡪G

H 🡪 t ( A )

G 🡪 A = E ;

E 🡪 E + T

E 🡪 E - T

Here I marked as \*

E 🡪 T

* I called new state is Q

E 🡪 T Q

Q 🡪 + T Q

Q 🡪 - T Q

Q 🡪 λ

T 🡪 T \* F

T 🡪 T / F

Here I marked as \*

T 🡪 F

* I called new state is R

T 🡪 F R

F 🡪 \* F R

F 🡪 / F R

F 🡪 λ

F 🡪 a A ; D b L $

N 🡪 O J K

O 🡪 + | - | λ

K 🡪 J K

K 🡪 λ

J 🡪 **0 1 2 3 4 5 6 7 8 9**

I 🡪 p | q | r | s

|  |  |  |
| --- | --- | --- |
| **STATE** | **FIRST** | **FOLLOW** |
| **X** | **a** | **$** |
| **A** | **p q r s** | **; , ) = \* / + -** |
| **M** | **λ  p q r s 0 1 2 3 4 5 6 7 8 9** | **; , ) = \* / + -** |
| **D** | **i** | **b** |
| **C** | **p q r s** | **;** |
| **Y** | **i** | **:** |
| **L** | **t  p q r s** | **$** |
| **Z** | **t  p q r s $** | **t  p q r s $** |
| **H** | **t** | **t  p q r s $** |
| **G** | **p q r s** | **t  p q r s $** |
| **E** | **p q r s + - 0 1 2 3 4 5 6 7 8 9 (** | **; )** |
| **New state Q** | **+ - λ** | **; )** |
| **New state R** | **\* / λ** | **; ) + -** |
| **T** | **p q r s + - 0 1 2 3 4 5 6 7 8 9 (** | **; ) + -** |
| **F** | **p q r s + - 0 1 2 3 4 5 6 7 8 9 (** | **; ) \* / + -** |
| **N** | **+ - 0 1 2 3 4 5 6 7 8 9** | **; ) \* / + -** |
| **O** | **+ - λ** | **0 1 2 3 4 5 6 7 8 9** |
| **K** | **λ 0 1 2 3 4 5 6 7 8 9** | **\* / + - ; )** |
| **J** | **0 1 2 3 4 5 6 7 8 9** | **p q r s 0 1 2 3 4 5 6 7 8 9 ; , ) = \* / + -** |
| **I** | **p q r s** | **p q r s 0 1 2 3 4 5 6 7 8 9 ; , ) = \* / + -** |
| **New state W** | **, λ** | **;** |
| **New state S** | **λ t  p q r s** | **$** |

**BNF form :**

<prog> 🡪 PROGRAM <identifier> ; <dec-list> BEGIN <stat-list> END.

<identifier> 🡪 <id> <more-id-digit>

<more-id-digit> 🡪 <digit> <more-id-digit>

<more-id-digit> 🡪 <id> <more-id-digit>

<more-id-digit> 🡪  **λ**

<dec-list> 🡪 <type> : <dec> ;

<dec> 🡪 <identifier> , <dec>

<dec> 🡪 <identifier>

<type> 🡪 INTEGER

<stat-list> 🡪 <stat>

<stat-list> 🡪 <stat> <stat-list>

<stat> 🡪 PRINT

<stat> 🡪 <assign>

<print> 🡪 PRINT ( <identifier> ) ;

<assign> 🡪 <identifier> = <exp> ;

<exp> 🡪 <exp> + <term>

<exp> 🡪 <exp> - <term>

<exp> 🡪 <term>

<term> 🡪 <term> \* <factor>

<term> 🡪 <term> / <factor>

<term> 🡪 <factor>

<factor> 🡪

<factor> 🡪

<number> 🡪 <sign> <digit> <more-digit>

<sign> 🡪 +

<sign> 🡪 -

<sign> 🡪 **λ**

<more-digit> 🡪 <digit> <more-digit>

<more-digit> 🡪 **λ**

<digit> 🡪 0

<digit> 🡪 1

<digit> 🡪 2

<digit> 🡪 3

<digit> 🡪 4

<digit> 🡪 5

<digit> 🡪 6

<digit> 🡪 7

<digit> 🡪 8

<digit> 🡪 9

<id> 🡪 P

<id> 🡪 Q

<id> 🡪 R

<id> 🡪 S

|  |  |  |
| --- | --- | --- |
| **STATE** | **FIRST** | **FOLLOW** |
| **<prog>** | **PROGRAM** | **END.** |
| **<identifier>** | **P Q R S** | **; , ) = \* / + -** |
| **<more-id-digit>** | **λ  P Q R S 0 1 2 3 4 5 6 7 8 9** | **; , ) = \* / + -** |
| **<dec-list>** | **INTEGER** | **BEGIN** |
| **<dec>** | **P Q R S** | **;** |
| **<type>** | **INTEGER** | **:** |
| **<stat-list>** | **PRINT  P Q R S** | **END.** |
| **<stat>** | **PRINT  P Q R S** | **PRINT  P Q R S END.** |
| **<print>** | **PRINT** | **PRINT  P Q R S END.** |
| **<assign>** | **P Q R S** | **PRINT  P Q R S END.** |
| **<expr>** | **P Q R S + - 0 1 2 3 4 5 6 7 8 9 (** | **; )** |
| **New state Q** | **+ - λ** | **; )** |
| **New state R** | **\* / λ** | **; ) + -** |
| **<term>** | **P Q R S + - 0 1 2 3 4 5 6 7 8 9 (** | **; ) + -** |
| **<factor>** | **P Q R S + - 0 1 2 3 4 5 6 7 8 9 (** | **; ) \* / + -** |
| **<number>** | **+ - 0 1 2 3 4 5 6 7 8 9** | **; ) \* / + -** |
| **<sign>** | **+ - λ** | **0 1 2 3 4 5 6 7 8 9** |
| **<more-digit>** | **λ 0 1 2 3 4 5 6 7 8 9** | **\* / + - ; )** |
| **<digit>** | **0 1 2 3 4 5 6 7 8 9** | **P Q R S 0 1 2 3 4 5 6 7 8 9 ; , ) = \* / + -** |
| **<id>** | **P Q R S** | **P Q R S 0 1 2 3 4 5 6 7 8 9 ; , ) = \* / + -** |
| **New state W** | **, λ** | **;** |
| **New state S** | **λ PRINT  P Q R S** | **END.** |