

### QUESTION 3

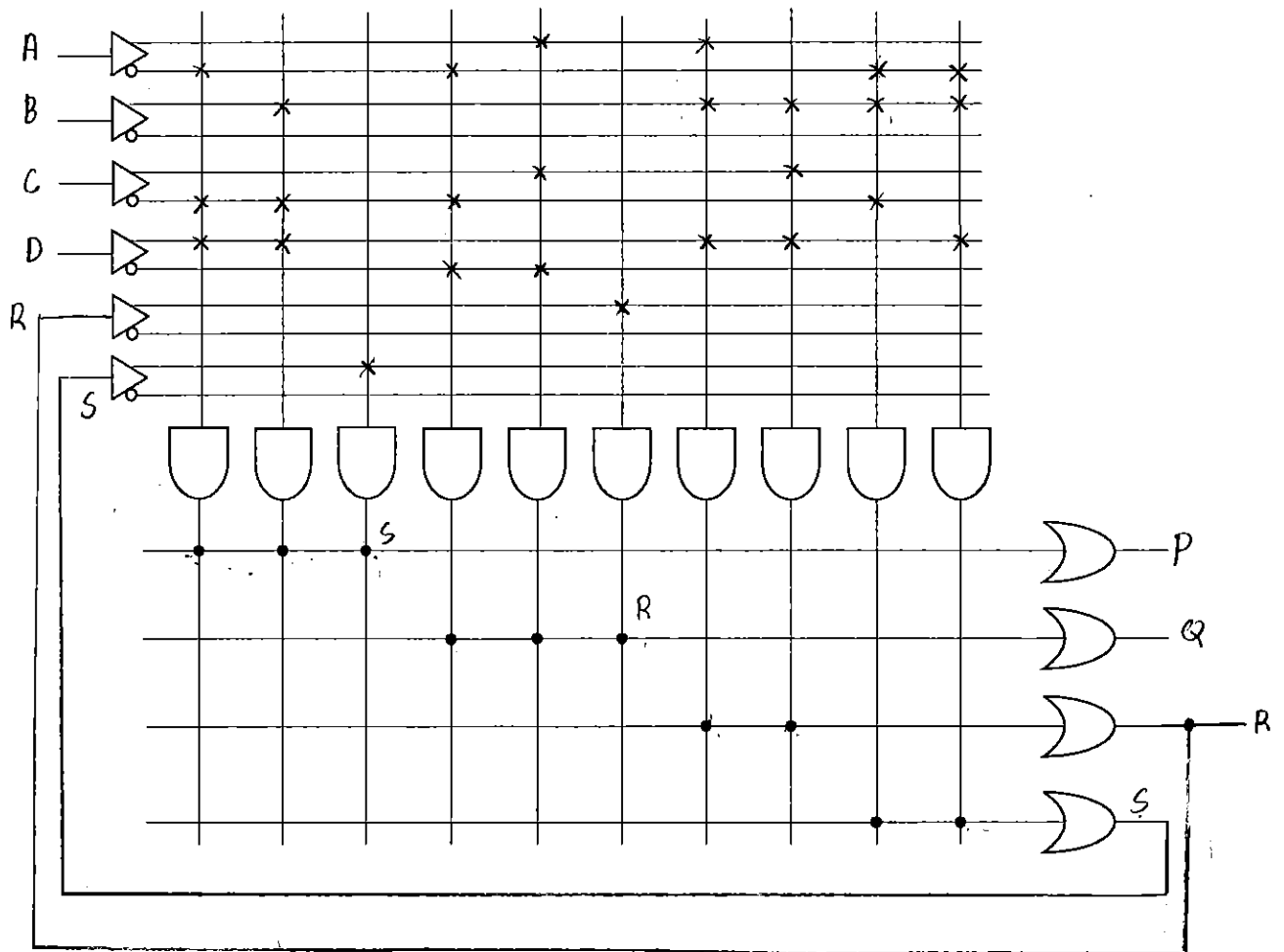
Theme: PAL, K-map

Use the given PAL device to realize the following functions:

$$P(A, B, C, D) = \sum m(1, 4, 5, 7, 13)$$

$$Q(A, B, C, D) = \sum m(0, 4, 7, 10, 13, 14, 15)$$

$$R(A, B, C, D) = \sum m(7, 13, 15)$$



$$P = \bar{A}\bar{C}D + B\bar{C}D + \underbrace{\bar{A}B\bar{C} + \bar{A}BD}_S$$

$$S = \bar{A}B\bar{C} + \bar{A}BD$$

$$P = \bar{A}\bar{C}D + B\bar{C}D + S$$

$$Q = \bar{A}\bar{C}\bar{D} + \underbrace{ABD + BCD}_R + AC\bar{D} = \bar{A}\bar{C}\bar{D} + AC\bar{D} + R$$

$$R = ABD + BCD$$

A	B	C	D	P	Q	R
0	0	0	0	0	1	0
0	0	0	1	1	0	0
0	0	1	0	0	0	0
0	0	1	1	0	0	0
0	1	0	0	1	1	0
0	1	0	1	1	0	0
0	1	1	0	0	0	0
0	1	1	1	1	1	1
1	0	0	0	0	0	0
1	0	0	1	0	0	0
1	0	1	0	0	1	0
1	0	1	1	0	0	0
1	1	0	0	0	0	0
1	1	0	1	1	1	1
1	1	1	0	0	1	0
1	1	1	1	0	1	1

P

AB	CD				
	$\bar{C}\bar{D}$	$\bar{C}D$	$C\bar{D}$	$CD$	
$\bar{A}\bar{B}$	00	0	1	0	0
$\bar{A}B$	01	1	1	1	0
$AB$	11	0	1	0	0
$A\bar{B}$	10	0	0	0	0

R

AB	$\bar{C}D$				
	00	01	11	10	
$\bar{A}\bar{B}$	00	0	0	0	0
$\bar{A}B$	01	0	0	1	0
$AB$	11	0	1	1	0
$A\bar{B}$	10	0	0	0	0

$$\Rightarrow P = \bar{A}\bar{C}D + B\bar{C}D + \bar{A}B\bar{C} + \bar{A}BD \Rightarrow R = ABD + BCD$$

Q

AB	$\bar{C}D$				
	00	01	11	10	
$\bar{A}\bar{B}$	00	1	0	0	0
$\bar{A}B$	01	1	0	1	0
$AB$	11	0	1	1	1
$A\bar{B}$	10	0	0	0	1

$$P = \bar{A}\bar{C}D + B\bar{C}D + \bar{A}B\bar{C} + \bar{A}BD = \bar{A}\bar{C}D + B\bar{C}D + S$$

$$\Rightarrow Q = \bar{A}\bar{C}D + ABD + BCD + ACD = \bar{A}\bar{C}D + ACD + R$$

$$R = ABD + B\bar{C}D$$

$$S = \bar{A}B\bar{C} + \bar{A}BD$$

$$\Rightarrow Q = \bar{A}\bar{C}D + ABD + BCD + ACD$$