Tutorial 12

Q1(i) LHS: $y \wedge (x \vee (x' \wedge (y \vee y')))$

$= y \wedge (x \vee (x' \wedge (1)))$

$= y \wedge (x \vee (x'))$

$= y \wedge (1)$

$= y$ = RHS

7. $x \wedge (x \vee y) \equiv x$ $x \vee (x \wedge y) = x$
8. $x \wedge x' = 0$ $x \vee x' = 1$
9. $x \wedge 0 = 0$ $x \vee 1 = 1$
10. $x \wedge 1 = x$ $x \vee 0 = x$

Q1(ii)

LHS: $((x \wedge y') \wedge (z \vee (x \wedge y')))'$

$= (x' \vee y) \vee (z' \wedge (x' \vee y))$

$= x' \vee y \vee (z' \wedge x') \vee (z' \wedge y)$

$= x' \vee (x' \wedge z') \vee y \vee (y \wedge z')$ [Absorption Laws]

$= x' \vee y$ = RHS

2. Simplify the following Boolean functions.

i) $f(x, y) = (x \wedge y') \vee (x' \wedge y) \vee (x \wedge y)$

ii) $f(x, y, z) = (x' \wedge y' \wedge z') \vee (x \wedge y' \wedge z') \vee (x' \wedge y \wedge z') \vee (x \wedge y \wedge z')$

Date

2) i) $f(x,y) = (x\wedge y')\vee(x'\wedge y)\vee(x\wedge y)$

x	y	x'	y'	$(x\wedge y')$	$(x'\wedge y)$	$(x\wedge y)$	$(x\wedge y')\vee(x'\wedge y)$	$f(x,y)$
0	0	1	1	0	0	0	0	0
0	1	1	0	0	1	0	1	1 $x'y$ ✓
1	0	0	1	1	0	0	1	1 xy' ✓
1	1	0	0	0	0	1	0	1 xy ✓

optional: $f(x,y) = x'y + xy' + xy = x'y + x(y'+y) = x'y + x = x + x'y$

$= (x'\wedge y)\vee(x\wedge y')\vee(x\wedge y)$ $= x \vee (x'\wedge y) = (x\vee x')\wedge(x\vee y) = x\vee y$ ✓

$= x' + y$

$= (x \vee y)$

$= x+y$ ✓ or $x \vee y$ ✓

	y'	y ✓
x'	0	1
✓ x	1	1

2^n: $2^0, 2^1, 2^2, 2^3, \dots$

1, 2, 4, 8, ...

Question 2

ii)

x	y	z	x′	y′	z′	$x' \wedge y' \wedge z'$	$x \wedge y' \wedge z'$	$x' \wedge y \wedge z'$	$x \wedge y \wedge z'$	f(x,y,z)
0	0	0	1	1	1	1	0	0	0	1 $x'y'z'$
0	0	1	1	1	0	0	0	0	0	0
0	1	0	1	0	1	0	0	1	0	1 $x'yz'$
0	1	1	1	0	0	0	0	0	0	0
1	0	0	0	1	1	0	1	0	1	1 $xy'z'$
1	0	1	0	1	0	0	0	0	0	0
1	1	0	0	0	1	0	0	0	0	0
1	1	1	0	0	0	0	0	0	0	0

	y'	y'	y	y
x'	1	0	0	1
x	1	0	0	0
	z'	z	z	z'

$$f(x,y,z) = x'y'z' + x'yz' + xy'z'$$

$$= y'z' + x'[illegible]z'$$

$$= y'z' + x'z'$$

optional:

ii) $f(x,y,z) = (x' \wedge y' \wedge z') \vee (x \wedge y' \wedge z') \vee (x' \wedge y \wedge z') \vee (x \wedge y \wedge z')$

$$= (y' \wedge z') \wedge \underbrace{(x' \vee x)}_{=1} \vee (y \wedge z') \wedge \underbrace{(x' \vee x)}_{=1}$$

$$= (y' \wedge z') \vee (y \wedge z')$$

$$= z' \wedge \underbrace{(y' \vee y)}_{=1}$$

$$= z'$$

3 a)

x	y	z	f(x,y,z)
0	0	0	1
0	0	1	1
0	1	0	0
0	1	1	0
1	0	0	1
1	0	1	0
1	1	0	1
1	1	1	0

$f(x,y,z) = x'y'z' + x'y'z + xy'z' + xyz'$

	y'	y'	y	y
x'	1	1	0	0
x	1	0	0	1
	z'	z	z	z'

1	1	0	0
1	0	0	1

3

$f(x,y,z) = \therefore\ x'y' + xz'$ simplify $x'y' + xz' + y'z'$

3 ii)

x	y	z	$f(x,y,z)$
0	0	0	1
0	0	1	1
0	1	0	1
0	1	1	1
1	0	0	0
1	0	1	0
1	1	0	0
1	1	1	1

$$f(x,y,z) = x'y'z' + x'y'z + x'yz' + x'yz + xyz$$

	y'	y'	y	y
x'	1	1	1	1
x	0	0	1	0
	z'	z	z	z'

$$f(x,y,z) = x' + yz$$

4. In the following questions, Karnaugh maps of functions are given, write the simplified Boolean expression for these functions.

i)

	y'	y
x'	1	0
x	0	1

ii)

	y	y'
x	1	1
x'	1	0

(i) $f(x, y) = (x' \wedge y') \vee (x \wedge y)$ or $x'y' + xy$

(ii) $f(x, y) = x \vee y$ or $x + y$

iii)

	y'	y'	y	y
x'	1	1	1	1
x	1	0	0	1
	z'	z	z	z'

iv)

	y'	y'	y	y
x'	1	1	0	1
x	0	1	0	1
	z'	z	z	z'

$2^n : 1, 2, 4, 8, \ldots$

iii)

$f(x, y, z) = x' + z'$

iv)

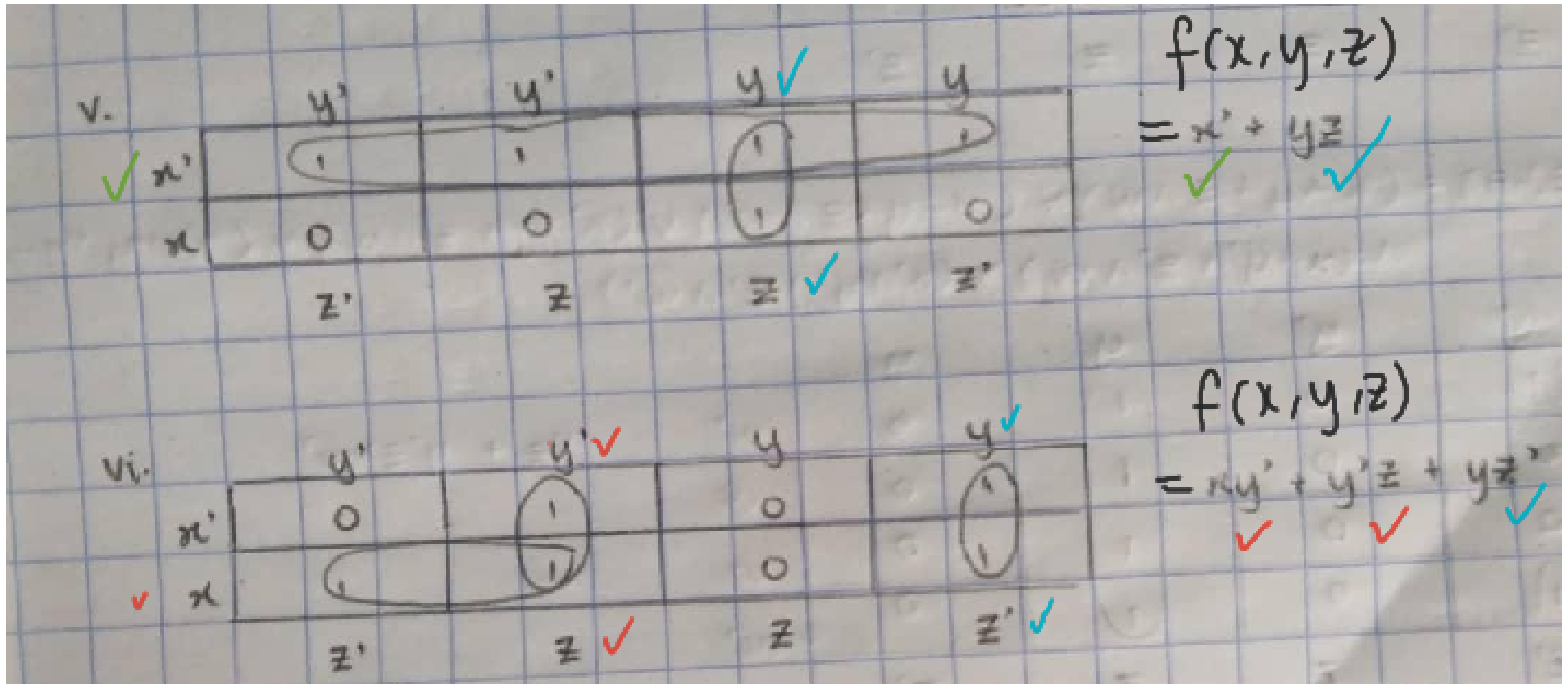
$f(x, y, z) = x'y' + y'z + yz'$

v)

	y'	y'	y	y
x'	1	1	1	1
x	0	0	1	0
	z'	z	z	z'

vi)

	y'	y'	y	y
x'	0	1	0	1
x	1	1	0	1
	z'	z	z	z'

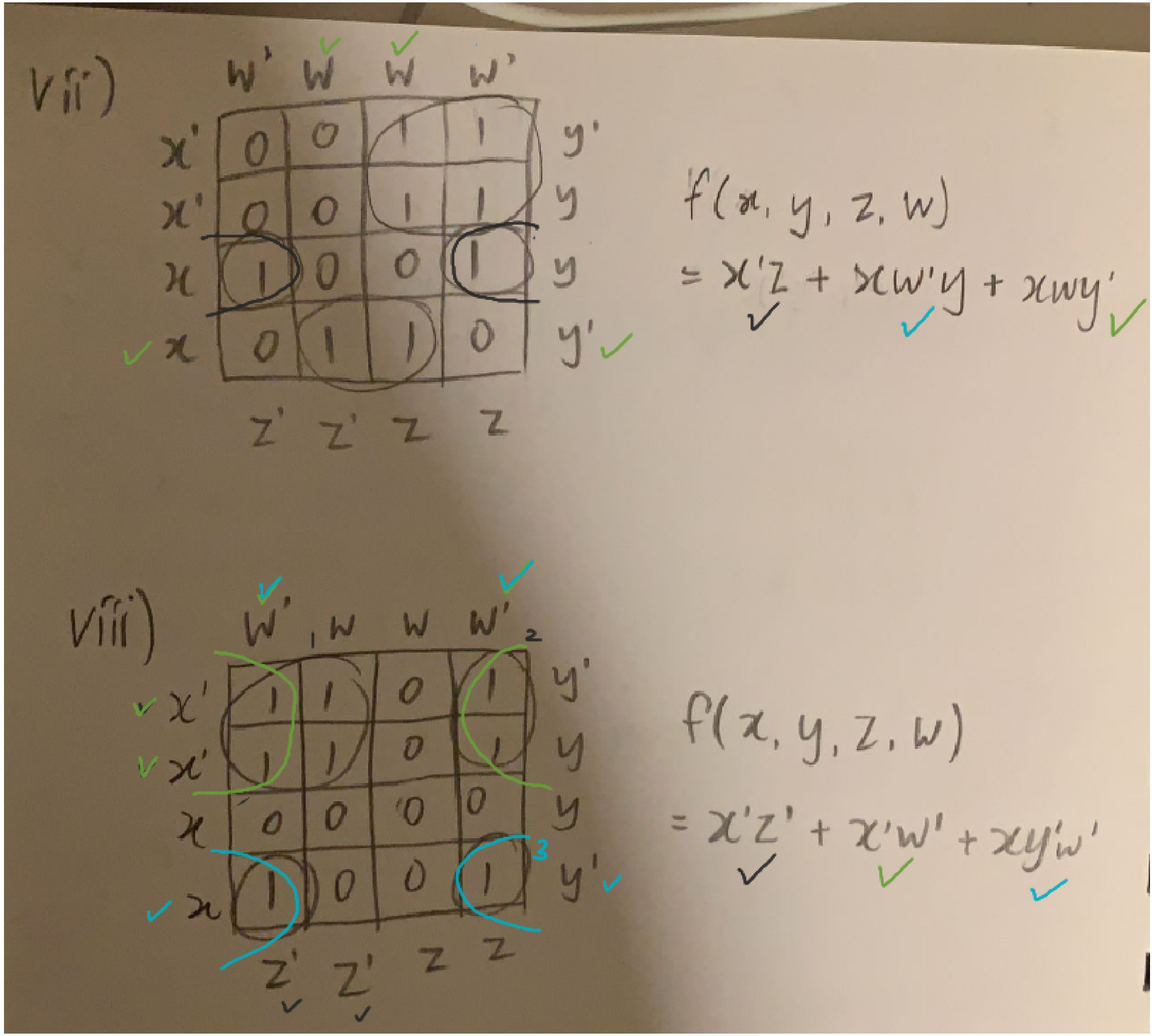


vii)

	w'	w	w	w'	
x'	0	0	1	1	y'
x'	0	0	1	1	y
x	1	0	0	1	y
x	0	1	1	0	y'
	z'	z'	z	z	

viii)

	w'	w	w	w'	
x'	1	1	0	1	y'
x'	1	1	0	1	y
x	0	0	0	0	y
x	1	0	0	1	y'
	z'	z'	z	z	



vii)

	w'	w	w	w'	
x'	0	0	1	1	y'
x'	0	0	1	1	y
x	1	0	0	1	y
x	0	1	1	0	y'
	z'	z'	z	z	

$f(x, y, z, w)$

$= x'z + xw'y + xwy'$

viii)

	w'	w	w	w'	
x'	1	1	0	1	y'
x'	1	1	0	1	y
x	0	0	0	0	y
x	1	0	0	1	y'
	z'	z'	z	z	

$f(x, y, z, w)$

$= x'z' + x'w' + xy'w'$

5. Draw a Karnaugh map for the Boolean expression whose disjunctive normal forms are as follow. Hence find a simplified version of the expression.

i) $f(x, y, z) = (x' \wedge y' \wedge z) \vee (x' \wedge y \wedge z) \vee (x \wedge y \wedge z') \vee (x \wedge y \wedge z)$ 2×4

ii) $f(x, y, z, w) = (x \wedge y \wedge z \wedge w) \vee (x \wedge y \wedge z \wedge w') \vee (x' \wedge y \wedge z \wedge w)$
$\vee (x' \wedge y \wedge z \wedge w') \vee (x \wedge y' \wedge z' \wedge w') \vee (x' \wedge y' \wedge z' \wedge w')$

	y'	y'	y	y
x'	0	1	1	6
x	0	0	1	1
	z'	z	z	z'

$f(x,y,z) = x'z + xy$

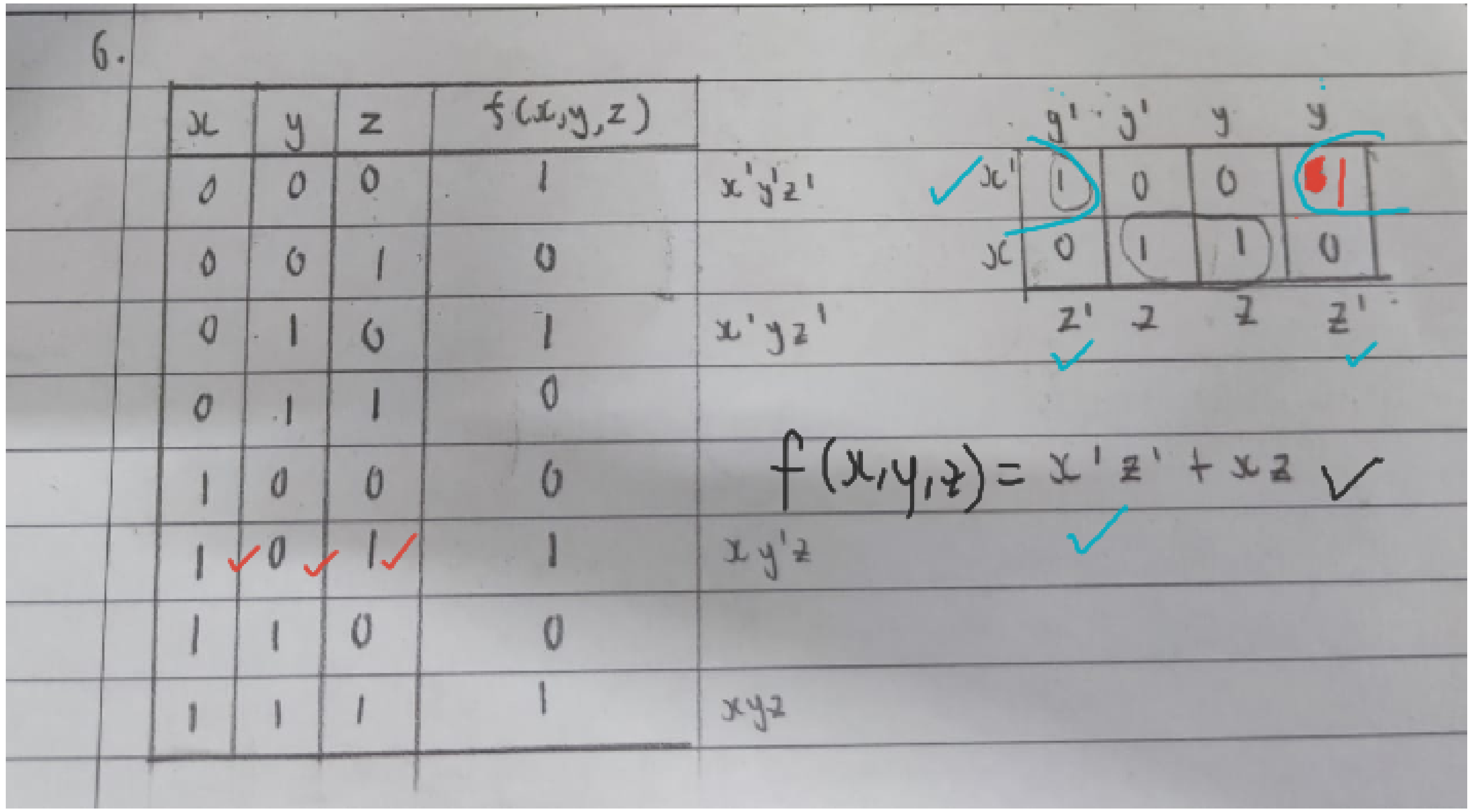
$f(x,y,z,w) = (x \wedge y \wedge z \wedge w) \vee (x \wedge y \wedge z \wedge w') \vee (x' \wedge y \wedge z \wedge w) \vee$
$(x' \wedge y \wedge z \wedge w) \vee (x \wedge y' \wedge z' \wedge w') \vee (x' \wedge y' \wedge z' \wedge w')$

	w'	w	w	w'	
x'	1	0	0	0	y'
x'	0	0	1	1	y
x	0	0	1	1	y
x	1	0	0	0	y'
	z'	z'	z	z	

$f(w,x,y,z) = yz + w'y'z'$ OR $(y \wedge z) \vee (w' \wedge y' \wedge z')$

6. Find the disjunctive normal form of the Boolean function $f(x, y, z)$ with the following truth table and then draw a Karnaugh map to find a simplified version of $f(x, y, z)$.

$$f(x,y,z) = x'y'z' + x'yz' + xy'z + xyz$$



6.

x	y	z	$f(x,y,z)$	
0	0	0	1	$x'y'z'$
0	0	1	0	
0	1	0	1	$x'yz'$
0	1	1	0	
1	0	0	0	
1	0	1	1	$xy'z$
1	1	0	0	
1	1	1	1	xyz

	y'	y'	y	y
x'	1	0	0	1
x	0	1	1	0
	z'	z	z	z'

$$f(x,y,z) = x'z' + xz$$

7. Construct a truth table for the Boolean expression $(x \wedge (y' \vee z)) \vee (x' \wedge (y \vee z'))$ and hence determine its disjunctive normal form. Draw a Karnaugh map and hence find a simplified version of $f(x, y, z)$.

7) Let $S = (x \wedge (y' \vee z)) \vee (x' \wedge (y \vee z'))$

x	y	z	x'	y'	z'	(y' ∨ z)	(y ∨ z')	(x ∧ (y' ∨ z))	(x' ∧ (y ∨ z'))	S
0	0	0	1	1	1	1	1	0	1	1
0	0	1	1	1	0	1	0	0	0	0
0	1	0	1	0	1	0	1	0	1	1
0	1	1	1	0	0	1	1	0	1	1
1	0	0	0	1	1	1	1	1	0	1
1	0	1	0	1	0	1	0	1	0	1
1	1	0	0	0	1	0	1	0	0	0
1	1	1	0	0	0	1	1	1	0	1

dnf of $f(x,y,z) = x'y'z' + x'yz' + x'yz + xy'z' + xy'z + xyz$

	y'	y'	y	y
x'	1	0	1	1
x	1	1	1	0
	z'	z	z	z'

$f(x,y,z) = y'z' + xz + x'y$


Well Done Award
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Thank you ...

Test : $a/50$

Assign. $b/50$

Total CW : $a+b$ $/100$