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1a:

p	Q	$p \to Q$	$\bar{p}$	$\bar{p} \vee Q$	E
0	0	1	1	1	1
0	1	1	1	1	1
1	0	0	0	0	1
1	1	1	0	1	1

$E = (p \to Q) \equiv (\bar{p} \vee Q)$

The expression is always true. Tautology.

1b.

p	Q	r	$\bar{p}$	A	B	C
0	0	0	1	1	1	1
0	1	0	1	1	1	1
0	0	1	1	1	1	1
0	1	1	1	1	1	1
1	0	0	0	0	1	1
1	1	0	0	0	0	0
1	0	1	0	1	1	1
1	1	1	0	1	1	1

$A = (r \vee \bar{p})$

$B = (Q \to (r \vee \bar{p}))$

$C = (p \to (Q \to (r \vee \bar{p})))$

1c.

p	Q	$p \vee Q$	$p \wedge Q$	E
0	0	0	0	1
0	1	1	0	0
1	0	1	0	0
1	1	1	1	1

$E = (p \vee Q) \to (p \wedge Q)$

2a.

p	Q	$\otimes$
0	0	0
0	1	1
1	0	1
1	1	0

2b. $p \otimes Q \equiv Q \otimes p$

so $p \otimes Q$ is commutative.

To show it's associative, assume $p \otimes (Q \otimes r)$. It doesn't matter which order the XOR is performed and $p \otimes (Q \otimes r) \equiv Q \otimes (p \otimes r)$ so it's also associative.

3. sum-of-products 1

a:
row 1: $\bar{p}\bar{q}r$
row 4: $p\bar{q}\bar{r}$
row 5: $p\bar{q}r$
row 6: $pq\bar{r}$
row 7: pqr

b:
row 0: $\bar{p}\bar{q}\bar{r}$
row 1: $\bar{p}\bar{q}r$
row 2: $\bar{p}q\bar{r}$

a: $\bar{p}\bar{q}r + p\bar{q}\bar{r} + p\bar{q}r + pq\bar{r} + pqr$
b: $\bar{p}\bar{q}\bar{r} + \bar{p}\bar{q}r + \bar{p}q\bar{r}$

4. product of sums 0

a:
row 0: $(\bar{p} + \bar{q} + \bar{r})$
row 2: $(\bar{p} + q + \bar{r})$
row 3: $(\bar{p} + q + r)$

b:
row 3: $(\bar{p} + q + r)$
row 4: $(p + \bar{q} + \bar{r})$
row 5: $(p + \bar{q} + r)$
row 6: $(p + q + \bar{r})$
row 7: $(p + q + r)$

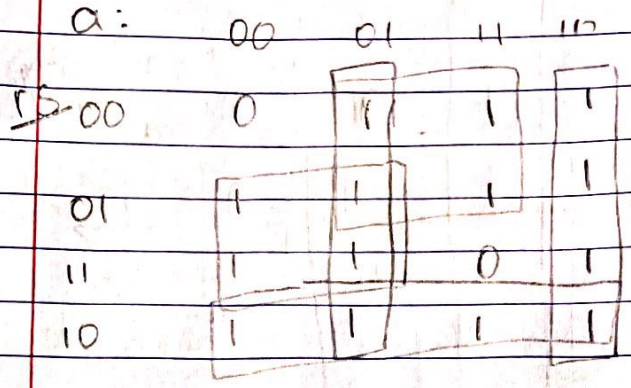
a: $(\bar{p} + \bar{q} + \bar{r})(\bar{p} + q + \bar{r})(\bar{p} + q + r)$
b: $(\bar{p} + q + r)(p + \bar{q} + \bar{r})(p + \bar{q} + r)(p + q + \bar{r})(p + q + r)$

z:
row 0: $(\bar{x} + \bar{y} + \bar{c})$
row 3: $(\bar{x} + y + c)$
row 5: $(x + \bar{y} + c)$
row 6: $(x + y + \bar{c})$

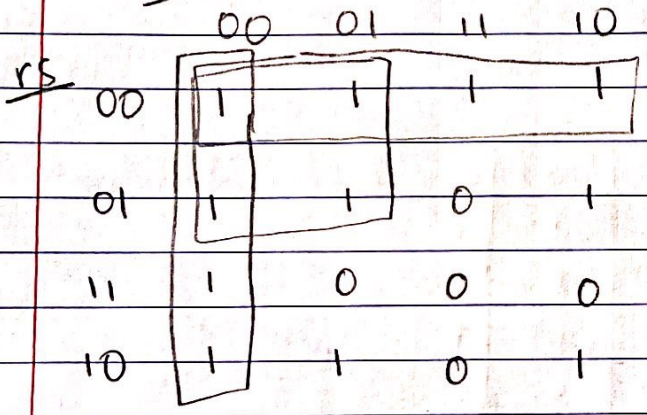
z: $(\bar{x} + \bar{y} + \bar{c})(\bar{x} + y + c)(x + \bar{y} + c)(x + y + \bar{c})$

5.

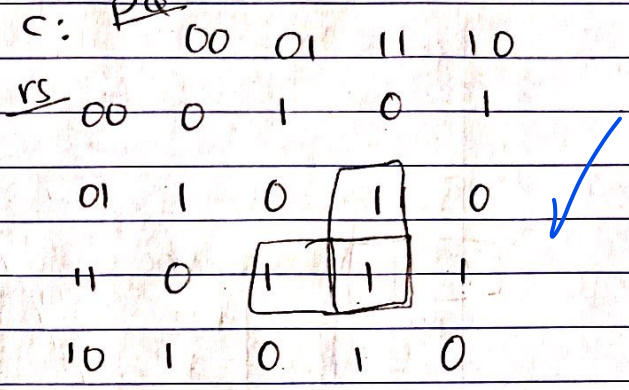
a:



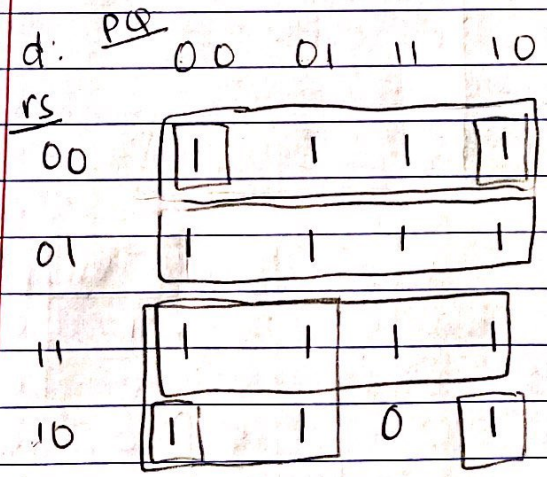
b:



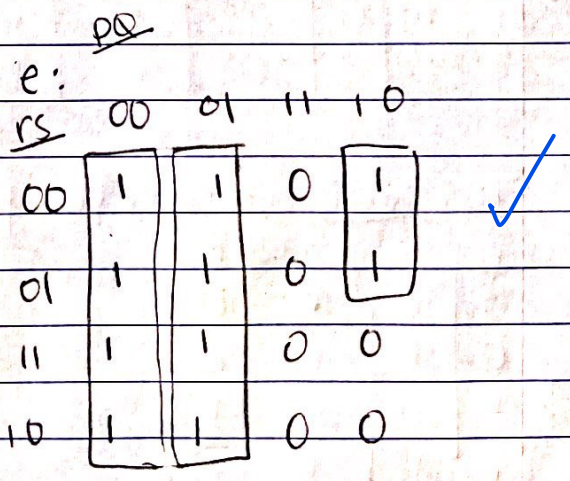
c:



d:



e:



6.

a: $r\bar{s} + \bar{p}s + \bar{r}s + qr + p\bar{q}$

b: $\bar{p}\bar{r} + \bar{p}\bar{q} + \bar{p}\bar{q}$

c: $ps + rsq$

d: $\bar{q}\bar{s} + s + \bar{p}r$

e: $\bar{p}\bar{q} + \bar{p}q + \bar{r}p\bar{q}$

We use all the prime implicants to create sums above.

7a: tautology

7b: Tautology

p	q	r	p→q	q→r	+	p→r	E
0	0	0	1	1	1	1	1
0	1	0	1	0	0	1	1
0	0	1	1	1	1	1	1
0	1	1	1	1	1	1	1
1	0	0	0	1	0	0	1
1	1	0	1	0	0	0	1
1	0	1	0	1	0	1	1
1	1	1	1	1	1	1	1

7c. NOT a tautology

p	q	p→q	E
0	0	1	0
0	1	1	0
1	0	0	1
1	1	1	0

7d. NOT a tautology

p	q	r	q+r	p≡q+r	pr	q→pr	E
0	0	0	0	1	0	1	1
0	1	0	1	0	0	0	1
0	0	1	1	0	0	1	1
0	1	1	1	0	0	0	1
1	0	0	0	0	0	1	1
1	1	0	1	1	0	0	0
1	0	1	1	1	1	1	1
1	1	1	1	1	1	1	1

8. DeMorgan's law

$\neg(P \vee Q) \equiv \neg P \wedge \neg Q$

$\neg(P \wedge Q) \equiv \neg P \vee \neg Q$

8a: $\overline{(PQ + \bar{P}r)}$

$\bar{P}\bar{Q} \wedge \bar{\bar{P}}\bar{r}$

$\boxed{(\bar{P} + \bar{Q})(P + r)}$

8b. $\overline{\bar{P} + Q(\overline{r+\bar{s}})}$

$(\bar{\bar{P}})(\overline{Q(\overline{r+\bar{s}})})$

$(P)(\bar{Q} + (\overline{r+\bar{s}}))$

$\boxed{(P)(Q + r + \bar{s}))}$