# Test 2 Term 1 Solutions

Tue Nov 6 2018

1) $S$ = sleepy  $W$ = slow  $I$ = inefficient  $B$ = go to bed reasonable time

a) $S \to (W \wedge I)$

b) $(W \wedge I) \to S$

c) $\neg B \to S$

2)

$$\frac{\begin{array}{c}\neg B \to S \\ S \to (W \wedge I)\end{array}}{\neg B \to (W \wedge I)}$$

Modus Ponens

3) "A & B are Equivalent" $\equiv$ $\underline{A \leftrightarrow B \text{ is tautology}}$

It means

<u>Example</u> $p \leftrightarrow p$

4) ~~(a)~~ (c) it's cold out there

6) $[(p \vee q) \wedge r] \vee (p \wedge q \wedge r)$ Dist.

$(p \wedge r) \vee (q \wedge r) \vee (p \wedge q \wedge r)$ <u>Done</u>

5 $[\neg(p \vee q) \wedge \neg(r \vee s \vee t)] \vee \neg(p \vee q)$

$\neg(p \vee q) \wedge [\neg(r \vee s \vee t) \vee T]$

$\neg(p \vee q) \wedge T$

$\neg(p \vee q)$

$\neg p \wedge \neg q$

Hence option b

$(p \wedge q) \vee q$ Dist.

$(p \vee T) \wedge q$

$T \wedge q$

$q$

(7) a) $(p \to q) \to \neg q$ Cond Elim

$\neg(\neg p \vee q) \vee \neg q$ De Morgan

$(p \wedge \neg q) \vee \neg q$ Q.I.

$(p \wedge \neg q) \vee (\neg q \wedge T)$

$(p \vee T) \wedge \neg q$ Dist.

$T \wedge \neg q$

$\neg q$ Contingent

$\neg q = \neg q \wedge \neg q = \neg q \vee \neg q$

$= \neg q \wedge T = \neg q \vee F$

b) $p \to \neg p$ Cond Elim

$\neg p \vee \neg p$

$\neg p$ Contingent.

c) $[(p \to r) \to (p \wedge q)] \wedge r \wedge \neg q$

$[\neg(\neg p \vee r) \vee (p \wedge q)] \wedge r \wedge \neg q$ Cond Elim

$[(p \wedge \neg r) \vee (p \wedge q)] \wedge r \wedge \neg q$ De Morgan

$p \wedge (\neg r \vee q) \wedge r \wedge \neg q$ Dist Law

$p \wedge [\underbrace{(\neg r \wedge r)}_{F} \vee (q \wedge r)] \wedge \neg q$ Dist Law

$p \wedge (r \wedge \boxed{q) \wedge \neg q}$

$p \wedge r \wedge F$ $F$ Contradiction

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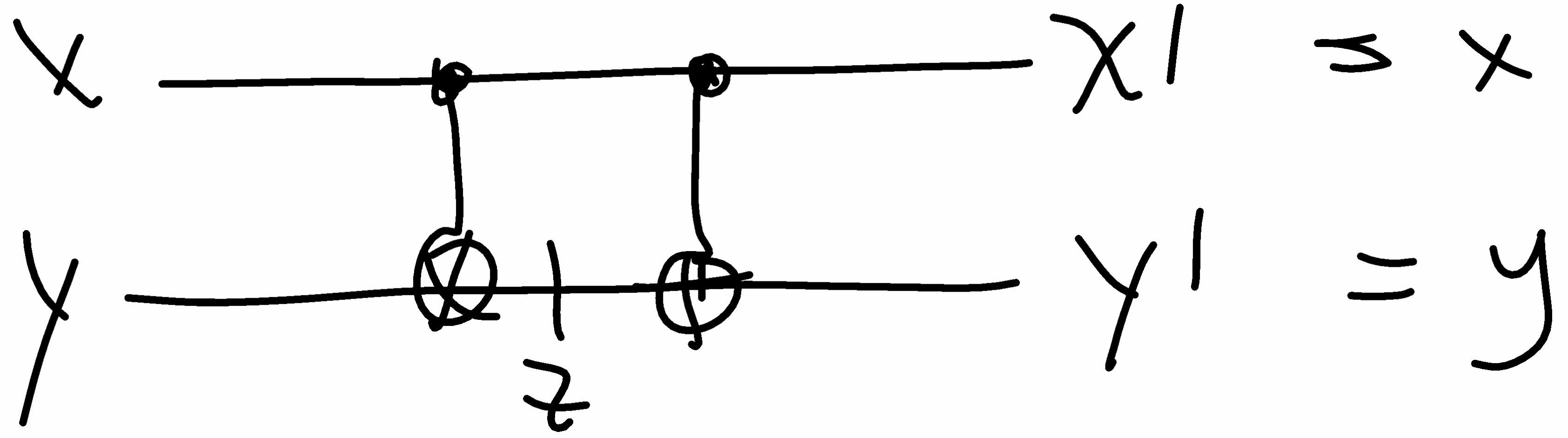


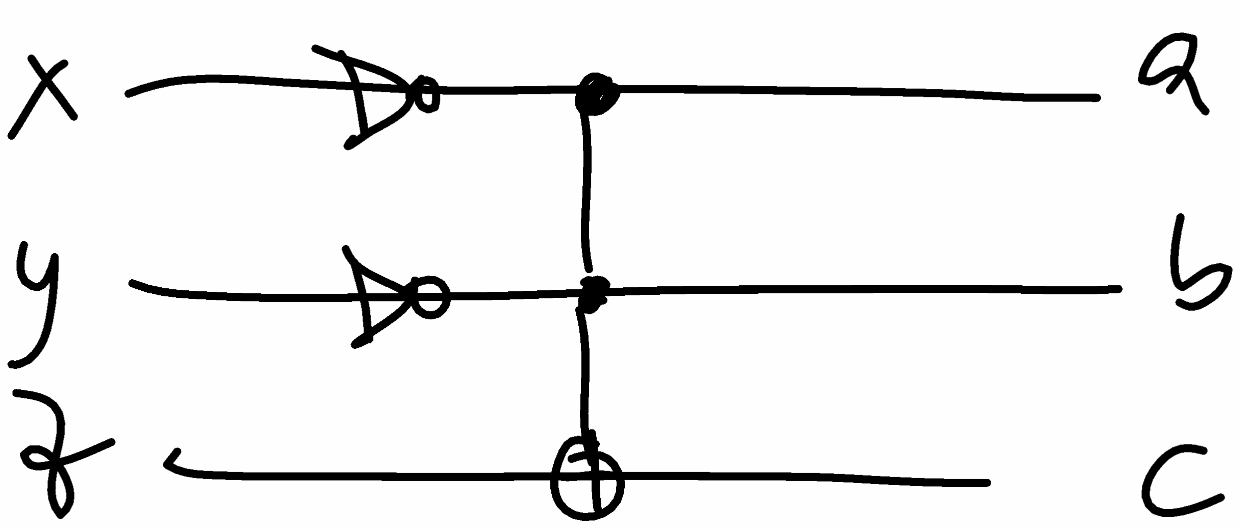

a) $z = x \oplus y$

b) $x' = x$

$$\boxed{y' = x \oplus (x \oplus y) = \overset{F}{(x \oplus x)} \oplus y = y}$$

c) CNOT Why? Because

a)




$c = z \oplus (x \wedge y)$

a) $\underline{\underline{x=1}}$ : $a = 1$ , $b = y$ , $c = z \oplus y$

b) $\underline{\underline{y=1}}$ : $a = x$ , $b = 1$ , $c = z \oplus x$

c) $z = 0$ : $a = \neg x$ , $b = \neg y$ , $c = \neg x \wedge \neg y = \neg(x \vee y)$

c) $z = 0$ : $a = x$ , $b = y$ , $c = x \wedge y$

h) [⊕ 9d)

9d)