

4) a) $p = \text{"Kangaroos live in Australia"}$
 $q = \text{"Kangaroos are marsupials"}$
 $p \wedge q$

$\therefore q$ Simplification
 b) $p = \text{"Hotter than 100 degrees today"}$
 $q = \text{"Pollution is dangerous"}$
 $\neg p$
 $p \vee q$

\therefore Disjunctive syllogism
 c) Let p be the proposition "Linda is an excellent swimmer"
 $q = \text{"Can work as a lifeguard"}$
 p
 $p \rightarrow q$
 q Modus ponens

d) $p = \text{"Steve will work at a computer company this summer"}$
 $q = \text{"Steve will be a beach bum"}$

p
 $p \vee q$ Addition
 e) $p = \text{"I exercise every day"}$
 $q = \text{"I am an athlete"}$

$p \rightarrow q$
 q
 $\therefore p$ Modus tollens

f) $q = \text{"I work all night on homework"}$
 $p = \text{"I answer all the exercises"}$
 $r = \text{"I understand the material"}$

$q \rightarrow p$
 $p \rightarrow r$
 $\therefore q \rightarrow r$ Hypothetical syllogism

$$\begin{aligned}
 5a) \quad & \neg r \rightarrow \neg s \\
 & p \rightarrow u \\
 & \neg t \rightarrow \neg r \\
 & u \rightarrow s \\
 & t \rightarrow q
 \end{aligned}$$

$$\boxed{p \rightarrow s}$$

$$p \rightarrow s$$

$$\neg t \rightarrow \neg s$$

$$t \rightarrow q$$

$$s \rightarrow t$$

$$p \rightarrow t$$

$$\therefore p \rightarrow q$$

Hypothetical Syllogism
Hypothetical Syllogism

Contrapositive Rule
Hypothetical Syllogism

Hypothetical Syllogism

$$\begin{aligned}
 b) \quad & p \rightarrow (q \wedge r) \\
 & s \rightarrow r \\
 & r \rightarrow p
 \end{aligned}$$

$$\boxed{s \rightarrow q}$$

$$r \rightarrow (q \wedge r)$$

$$s \rightarrow (q \wedge r)$$

$$\therefore s \rightarrow q$$

Hypothetical Syllogism

Hypothetical Syllogism

Conditional Simplification

6)

$$3a) (p \vee \neg r) \wedge \neg q \vee (\neg p \wedge (q \vee r))$$

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

De Morgan's Law

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

Rewrite/hypothesis

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

distributive law

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

distributive law

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

distributive law

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

Absorption law

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

Demorgan's law

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

Associative law

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

Identity law

$$\neg(r \vee q) \vee \neg p$$

Demorgan's

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

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

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

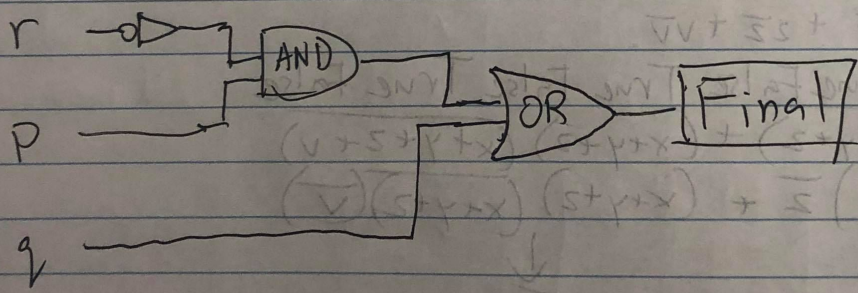
Demorgan's Law

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

Identity law

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

b)



1a) $a_3 = 0$ most significant bit of A $a_2 = 1$ $a_1 = 1$ $a_0 = 1$ least significant bit of A
 $b_3 = 1$ most significant bit of B $b_2 = 1$ $b_1 = 1$ $b_0 = 1$ least significant bit of B

$$f = ((a_3 \wedge \neg b_3) \vee (\neg a_3 \wedge b_3)) \wedge ((a_2 \wedge \neg b_2) \vee (\neg a_2 \wedge b_2)) \wedge ((a_1 \wedge \neg b_1) \vee (\neg a_1 \wedge b_1)) \wedge ((a_0 \wedge \neg b_0) \vee (\neg a_0 \wedge b_0))$$

b) $a_2 a_1 a_0$

$b_2 b_1 b_0$

~~$a_2 a_1 a_0$~~

$$\downarrow (a_0 \oplus b_0) \leftarrow C_0$$

$$\downarrow (a_0 b_0 \oplus a_1 \oplus b_1) \leftarrow C_1$$

$$(a_1 a_0 b_0 \oplus a_1 a_0 b_1 \oplus a_2 \oplus b_2) \leftarrow C_2$$

$$c) a_9 \oplus a_8 \oplus a_7 \oplus a_6 \oplus a_5 \oplus a_4 \oplus a_3 \oplus a_2 \oplus a_1 \oplus a_0$$

2a) $x\bar{y} + 2v$

True False True True

$$b) (x+y)(\bar{x}+z)(\bar{y}+\bar{z})(x+v)$$

True True False True False False True True

$$c) x\bar{x} + y\bar{y} + z\bar{z} + v\bar{v}$$

True False True False True False True False

$$d) (x+y)(\bar{x}+y+z) + (x+y+z)(\bar{x}+y+z+v)$$

$$(x+y)(\bar{x}+y)\bar{z} + (x+y+z)(\bar{x}+y+z)(\bar{v})$$

$$\downarrow$$

$$\cdot \bar{F}$$

$$\downarrow$$

$$\cdot \bar{F}$$

Demorgan's law, contradiction.

3.