1. a)
- $4 \neq \{4\}$, the number 4 is not equivalent to the set $\{4\}$
- $\{1, \{1\}, \{1, \{1\}\}\}$ there are 3 elements in this set
- $\{2\}$ is not an element of $\{1, 2\}$
- $\{1\}$ is a subset of $\{1, \{2\}\}$
- $\{-6, -3, -2, -1, 1, 2, 3, 6\}$

b) converse: If Jose is Jan's cousin, then Ann is Jan's Mother

Inverse: If Ann is not Jan's mother, then Jose is not Jan's cousin

contropositive: If Jose is not Jan's cousin, then ann is not Jan's mother

c) $\sim(\sim p \vee \sim q) \vee (p \wedge \sim q) \equiv p$

$(\sim(\sim p) \vee \sim(\sim q)) \vee (p \wedge \sim q) \equiv$ Demorgans

$(p \vee q) \vee (p \wedge \sim q)$ Double negation x2

$p \vee (q \vee (p \wedge \sim q))$ Associative laws

$p \vee ((q \vee p) \wedge (q \vee \sim q))$ distribution

$p \vee ((q \vee p) \wedge T)$ Negation Law

$p \vee (q \vee p) \wedge (p \vee T)$ Com unique

Adsorption Law

distribution

$\downarrow$

$p \vee (q \vee p) \wedge (p \vee T)$ Dommnatrai low

$p \vee (q \vee p) \wedge T$ Adsorption low

$p \vee T$ Identity low

p

2. a) $p \to \sim q$, $q \to \sim p$, $p \vee q$

p	q	$\sim p$	$\sim q$	$p \to \sim q$	$q \to \sim p$	$p \vee q$
T	T	F	F	F	F	
T	F	F	T	T	T	T
F	T	T	F	T	T	T
F	F	T	T	T	T	F

Invalid

b)

$\forall x \in N,$

$x \geq 2 \to x^2 \geq 4$

$\neg(x^2 \geq 4)$

$\therefore \neg(x \geq 2)$ True, modus tollens c)

Fe = fever $\forall x,\ Flu(x) \rightarrow Fe(x)$

Flu = Flu.

$Fe(x)$

$\therefore\ Flu(x)$

Invalid, converse error

3) a)

a) $\forall x \in R$, if $x+1>0$ then $1<x\leq 0$

b) $\exists x \in R$, if $\neg(x+1>0)$ then $\neg(1<x\leq 0)$

b) a) $\forall x \in H$, if $H(x) \rightarrow L(x)$

H = Humans

L = Love some

b) $\exists x \in H,\ H(x) \rightarrow \neg L(x)$

c) Yes, logically equivalent, because iff is $\Leftrightarrow$ bidirectional

Scanned with CamScanner

d)

2, $\neg C(x) \to \neg G(x)$

3, $\neg C(x) \to Rob(x)$

1, $ROB(x) \to AaT(x)$

$\therefore$ $\neg G(x) \to AaT(x)$

$G(x) \to C(x) \to$

$Rob(x) \to Aat(x)$

Modus Pollens