2.(1). 原式 $\equiv (\neg\exists x[P(x)\wedge Q(x)] \Rightarrow \forall x[P(x)\Rightarrow \neg Q(x)]) \wedge$

$(\forall x[P(x)\Rightarrow \neg Q(x)] \Rightarrow \neg\exists x[P(x)\wedge Q(x)])$

$\equiv (\exists x[P(x)\wedge Q(x)] \vee \forall x[\neg P(x)\vee\neg Q(x)]) \wedge$

$(\neg\forall x[\neg P(x)\vee\neg Q(x)] \vee \neg\exists x[P(x)\wedge Q(x)])$

$\equiv (\exists x[P(x)\wedge Q(x)] \vee \forall x[\neg P(x)\vee\neg Q(x)]) \wedge$

$(\exists x[P(x)\wedge Q(x)] \vee \forall x[\neg P(x)\vee\neg Q(x)])$

$\equiv \exists x[P(x)\wedge Q(x)] \vee \neg(\exists x[P(x)\wedge Q(x)])$

$\equiv$ TRUE （原式得证）

(2). 原式 $\equiv (\neg\forall x[P(x)\Rightarrow Q(x)] \Rightarrow \exists x[P(x)\wedge\neg Q(x)]) \wedge$

$(\exists x[P(x)\wedge\neg Q(x)] \Rightarrow \neg\forall x[P(x)\Rightarrow Q(x)])$

$\equiv (\forall x[\neg P(x)\vee Q(x)] \vee \exists x[P(x)\wedge\neg Q(x)]) \wedge$

$(\neg\exists x[P(x)\wedge\neg Q(x)] \vee \neg\forall x[\neg P(x)\vee Q(x)])$

$\equiv (\forall x[\neg P(x)\vee Q(x)] \vee \exists x[P(x)\wedge\neg Q(x)]) \wedge$

$(\forall x[\neg P(x)\vee Q(x)] \vee \exists x[P(x)\wedge\neg Q(x)])$

$\equiv (\forall x[\neg P(x)\vee Q(x)] \vee \neg\forall x[\neg P(x)\vee Q(x)])$

$\equiv$ TRUE. （原式得证）

(3). $P(x)$：x为比负数大的数.

$Q(x)$：x是正数.

前一句话。 $\neg\exists x\ Q(x)\wedge\neg P(x)$.

后一句话： $\forall x\ Q(x)\Rightarrow P(x)$.

$\neg\exists x\, Q(x)\wedge\neg P(x) \Leftrightarrow \forall x\, Q(x)\Rightarrow P(x)$.

$\equiv (\neg\exists x\, Q(x)\wedge\neg P(x) \Rightarrow \forall x\, Q(x)\Rightarrow P(x).) \wedge (\forall x\ Q(x)\Rightarrow P(x) \Rightarrow \neg\exists x\, Q(x)\wedge\neg P(x))$

$\equiv (\exists x[Q(x)\wedge\neg P(x)] \vee \forall x[\neg Q(x)\vee P(x)]) \wedge (\neg\forall x[\neg Q(x)\vee P(x)] \vee \neg\exists x[Q(x)\wedge\neg P(x)])$

$\equiv (\exists x[Q(x)\wedge\neg P(x)] \vee \forall x[\neg Q(x)\vee P(x)]) \wedge (\exists x[Q(x)\wedge\neg P(x)] \vee \forall x[\neg Q(x)\vee P(x)])$

$\equiv (\exists x[Q(x)\wedge\neg P(x)]) \vee (\neg\exists x[Q(x)\wedge\neg P(x)])$

$\equiv$ TRUE （原式得证）

(4). $P(x,y)$. x,y 两角相等

$Q(x,y)$： x,y 是对顶角

前一句话： $\neg[\forall x\forall y\ P(x,y)\Rightarrow Q(x,y)]$

后一句话： $\exists x\exists y\,[P(x,y)\wedge\neg Q(x,y)]$

$$\neg[\forall x\forall y\ P(x,y)\Rightarrow Q(x,y)]\Leftrightarrow[\exists x\exists y\ P(x,y)\wedge\neg Q(x,y)]$$

$$\equiv \neg[\forall x\forall y\ P(x,y)\Rightarrow Q(x,y)]\Rightarrow[\exists x\exists y\ P(x,y)\wedge\neg Q(x,y)]\ \wedge$$

$$[\exists x\exists y\ P(x,y)\wedge\neg Q(x,y)]\Rightarrow\neg[\forall x\forall y\ P(x,y)\Rightarrow Q(x,y)]$$

$$\equiv([\forall x\forall y\ \neg P(x,y)\vee Q(x,y)]\vee[\exists x\exists y\ P(x,y)\wedge\neg Q(x,y)])\ \wedge$$

$$(\forall x\forall y[\neg P(x,y)\vee Q(x,y)]\vee\exists x\exists y\neg[\neg P(x,y)\vee Q(x,y)])$$

$$\equiv(\forall x\forall y[\neg P(x,y)\vee Q(x,y)]\vee\exists x\exists y[P(x,y)\wedge\neg Q(x,y)])$$

$$\equiv\ \forall x\forall y[\neg P(x,y)\vee Q(x,y)]\vee\neg\forall x\forall y[\neg P(x,y)\vee Q(x,y)]$$

$\equiv$ TRUE. (原式得证)

4. ①: $\forall x[N(x)\Rightarrow(GZ(x)\wedge I(x))]$

②. $\forall x[I(x)\Rightarrow(E(x)\vee O(x))]$

③. $\forall x[E(x)\Rightarrow I(S(x))]$

结论(待证) $\forall x\ N(x)\Rightarrow[O(x)\vee I(S(x))]$

化合取范式.

①. $\neg N(x)\vee(GZ(x)\wedge I(x))$

$\equiv(\neg N(x)\vee GZ(x))\wedge(\neg N(x)\vee I(x))$

②. $\neg I(x)\vee E(x)\vee O(x)$

③ $\neg E(x)\vee I(S(x))$.

④. (取反). $N(x)\wedge[\neg O(x)\wedge\neg I(S(x))]$

$\equiv N(x)\wedge\neg O(x)\wedge\neg I(S(x))$.

原子语句.

$\neg N(x)\vee GZ(x)$	(1)	(2)(7)归结得到 $I(x)$.
$\neg N(x)\vee I(x)$	(2)	再与(3)归结得到. $E(x)\vee O(x)$.
$\neg I(x)\vee E(x)\vee O(x)$	(3)	再与(6)归结得到. $E(x)$
$\neg E(x)\vee I(S(x))$	(4)	再与(4)归结得到. $I(S(x))$.
$\neg I(S(x))$.	(5)	最后与(5). 归结得到空语句.
$\neg O(x)$	(6)	空语句与(1)归结也必得到空语句.
$N(x)$.	(7)	

因此目标得证.