1. (2pts) Write the negation of each of the following statements:

a. Some farmer grows only corn.

no farmer grows only corn.

b. Corn is grown only by farmers.

Corn is grown by someone who is not a farmer

1. (2pts) Write the negation of each of the following statements:

   a. Some farmer grows only corn.

   ~~$\exists_x$ (~~ No Farmer grows only corn

   b. Corn is grown only by farmers.

   Some corn is not grown by farmers

1. (2pts) Write the negation of each of the following statements:

a. Some farmer grows only corn.

All farmers don't grow only corn.

b. Corn is grown only by farmers.

There is something, such that it's not a farmer, and it grows corn.

1. (2pts) Write the negation of each of the following statements:

a. Some farmer grows only corn.

$(\exists x)[F(x) \wedge C(y)]$

$C(x)$ - x grows only corn

$(\forall x)[F(x) \rightarrow C(y)']$

Good ✓

b. Corn is grown only by farmers.

$C(x)$ - x grows corn.

$(\forall x)[C(x) \rightarrow F(y)]$

$(\exists x)[C(x) \wedge F'(x)]$ ✓

Well done

1. (2pts) Write the negation of each of the following statements:

   a. Some farmer grows only corn.

   All farmer grows not only corn

   b. Corn is grown only by farmers.

   ~~There~~ Some corn is not grown by farmers

2. (3pts) Using the following predicate symbols, in the domain of "the whole world", write each English language statement as a predicate wff:

   - $C(x)$: x is a Corvette
   - $F(x)$: x is a Ferrari
   - $P(x)$: x is a Porsche
   - $S(x, y)$: x is slower than y

   a. Nothing is both a Corvette and a Ferrari.

   $(\forall x)[C(x) \wedge F(x)]'$

   b. Some Porsches are slower than no Corvette.

   $\cancel{\forall}(\exists x)[P(x) \wedge (\forall y)[S(x,y) \rightarrow C(y)']]$

   c. If there is a Corvette that is slower than a Ferrari, then all Corvettes are slower than all Ferraris.

   $\cancel{\exists x}\ (\exists x)[C(x) \wedge \cancel{\exists y}(\exists y)[F(y) \wedge S(x,y)]]$
   $\rightarrow (\forall x)[C(x) \rightarrow (\forall y)[F(y) \rightarrow S(x,y)]]$

2. (3pts) Using the following predicate symbols, in the domain of "the whole world", write each English language statement as a predicate wff:

- $C(x)$: x is a Corvette
- $F(x)$: x is a Ferrari
- $P(x)$: x is a Porsche
- $S(x, y)$: x is slower than y

a. Nothing is both a Corvette and a Ferrari.

$(\forall x)[C(x) \wedge F(x)]'$ or $(\forall x)[C'(x) \vee F'(x)]$

✓

b. Some Porsches are slower than no Corvette.

$(\exists x)[P(x) \wedge (\forall y)(C(y) \to [S(x,y)]')]$

✓

c. If there is a Corvette that is slower than a Ferrari, then all Corvettes are slower than all Ferraris.

$(\exists x)(\exists y)[C(x) \wedge F(y) \wedge S(x,y)] \longrightarrow (\forall x)[C(x) \to (\forall y)(F(y) \to S(x,y))]$

✓

2. (3pts) Using the following predicate symbols, in the domain of "the whole world", write each English language statement as a predicate wff:

- $C(x)$: x is a Corvette
- $F(x)$: x is a Ferrari
- $P(x)$: x is a Porsche
- $S(x, y)$: x is slower than y

Good work

a. Nothing is both a Corvette and a Ferrari.

$(\forall x)(C(x) \wedge F(x))'$ ✓

b. Some Porsches are slower than no Corvette.

$(\exists x)(P(x) \wedge (\forall y)(C(y) \rightarrow S(x,y)'))$ ✓

$\exists$ $\wedge$ $\rightarrow$ $\forall$ $\forall$

c. If there is a Corvette that is slower than a Ferrari, then all Corvettes are slower than all Ferraris.

$(\exists x)(C(x) \wedge (\exists y)(F(y) \wedge S(x,y))) \Rightarrow (\forall x)(C(x) \rightarrow$
$(\forall y)(F(y) \rightarrow S(x,y)))$ ✓

2. (3pts) Using the following predicate symbols, in the domain of "the whole world", write each English language statement as a predicate wff:

- $C(x)$: x is a Corvette
- $F(x)$: x is a Ferrari
- $P(x)$: x is a Porsche
- $S(x, y)$: x is slower than y

a. Nothing is both a Corvette and a Ferrari.

$\forall_x[\neg C(x) \to F(x)']$

Good

b. Some Porsches are slower than no Corvette.

$\exists_x(P(x) \wedge \forall_y(C(y) \to S(x,y)'))]$

c. If there is a Corvette that is slower than a Ferrari, then all Corvettes are slower than all Ferraris.

$\exists_x[C(x) \wedge \exists_y(F(y) \wedge S(x,y))] \to \forall_x[C(x) \to \forall_y(F(y) \to S(x,y))]$

2. (3pts) Using the following predicate symbols, in the domain of "the whole world", write each English language statement as a predicate wff:

- $C(x)$: x is a Corvette
- $F(x)$: x is a Ferrari
- $P(x)$: x is a Porsche
- $S(x, y)$: x is slower than y

a. Nothing is both a Corvette and a Ferrari.

$\forall(x)[(C(x) \rightarrow F'(x)) \wedge (F(x) \rightarrow C'(x))]$ ✓

b. Some Porsches are slower than no Corvette.

$\exists(x)[P(x) \wedge \forall(y)[C(y) \rightarrow S(y,x)]]$ ✓

c. If there is a Corvette that is slower than a Ferrari, then all Corvettes are slower than all Ferraris.

✓

$\exists(x)[C(x) \wedge \exists(y)[F(y) \wedge S(x,y)]] \rightarrow \forall(x)\forall(y)[(C(x) \wedge F(y)) \rightarrow S(x,y)]$

3. (5pts) Prove (with reasons), or give an interpretation in which it is false:

$$(\forall y)\,[Q(x,y) \longrightarrow P(x)] \Longrightarrow [(\exists y)\,Q(x,y) \to P(x)]$$

1. $(\forall y)[Q(x,y) \to P(x)]$ hyp
2. $(\exists y)\,Q(x,y)$ deduction method
3. $Q(x,y)$ 2, ei
4. $Q(x,y) \to P(x)$ 1, ui
5. $P(x)$ 3, 4, MP

Well done

3. (5pts) Prove (with reasons), or give an interpretation in which it is false:

$$(\forall y)\,[Q(x,y) \longrightarrow P(x)] \Longrightarrow [(\exists y)\,Q(x,y) \rightarrow P(x)]$$

1. $\exists(y)\,Q(x,y)$ hyp

ded. method

2. $Q(x,a)$ ei

3. $\forall(y)[Q(x,y) \rightarrow P(x)]$ hyp

4. $[Q(x,a) \rightarrow P(x)]$ ui

5. $P(x)$ 2, 4 mp

Nice work

3. (5pts) Prove (with reasons), or give an interpretation in which it is false:

$$(\forall y)\,[Q(x,y) \longrightarrow P(x)] \Longrightarrow [(\exists y)\,Q(x,y) \to P(x)]$$

want to get here

1 $(\forall y)[Q(x,y) \to P(x)]$ hyp

2 $(\exists y)\,Q(x,y)$ hyp (ded, method)

3 $Q(x,y)$ 2, ei

4 $Q(x,y) \to P(x)$ 1, ui

5 $P(x)$ 3,4, mp