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Homework 2 — Meghan O'Laughlin

1.

a: variable
b: constant
c: constant
d: constant
e: non-ground atomic formula
f: ground atomic formula
g: ground atomic formula

2.

(csg("CMPT220", S, G) AND snap(S, "L.Van Pelt", A, P))
→ answer(G)

I substituted the course name (S) and student name (N) to demonstrate the truth.

3.

a: (∀x)(∃y)(NOT p(X) OR (p(Y) AND Q(X)))
b: (∃x) NOT P(X) AND ((∃y) p(Y) OR (∃x) Q(X, Z))

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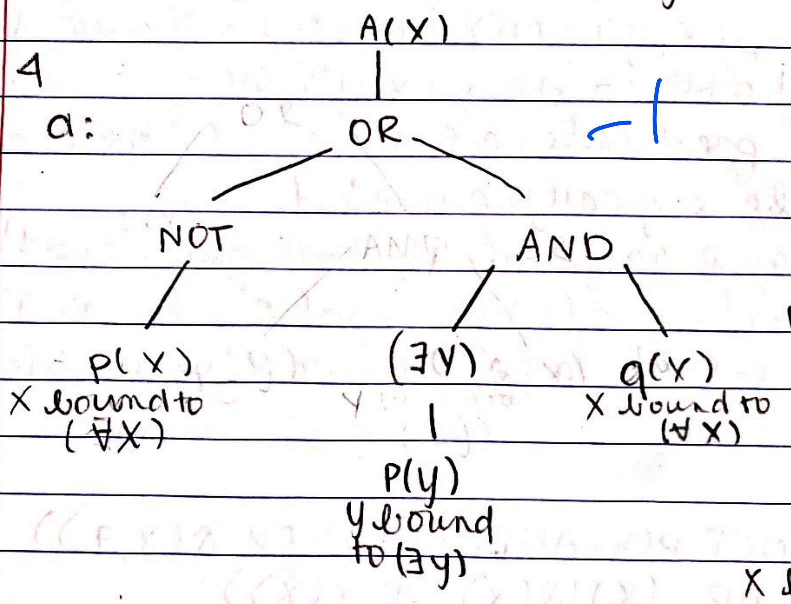
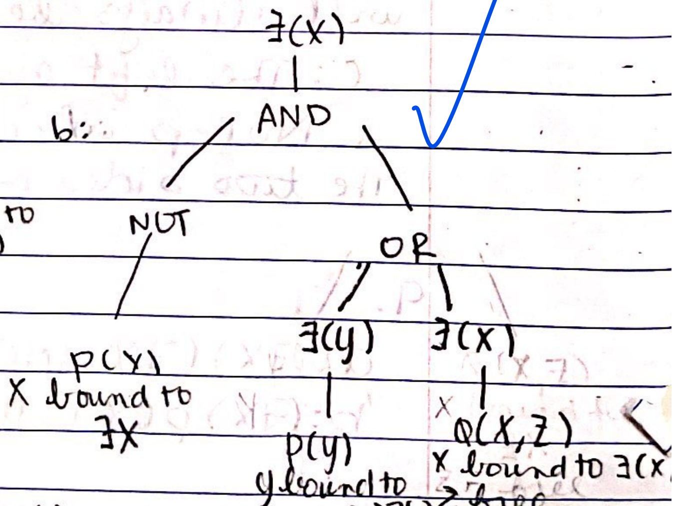
a:

-1



b:



5. (∃X)(NOT p(X) AND ((∃Y) p(Y) OR Q(X, Z)))

6.

1. (∀C) csg(C, S, "A") AND snap(S, "C.Brown", A, P) → answer(G)
2. (∃C) csg(C, S, NOT "A") AND snap(S, "C.Brown", A, P) → answer(G)

-1

7.

a: true: X < Y domain ℝ: for all real numbers X, there exists some Y where Y > X.
false: X is female, Y is male domain: marist house NS; for all females in the house, there are NO males.

b: true: P(X) is false: if P(X) is false then the statement is always true b/c NOT P(X) is false.
false: P(X) is true; if P(X) is true it does not always imply NOT P(X) which is false.

c: true: P(x) is positive; domain ℕ, there exists some X in the domain that is + that implies any X is +
false: P(x) is negative; domain ℝ, there exists some negative number that implies all X are negative which is false in the domain which contains positive numbers.

d: true: P(U,V) = U<V domain ℝ: for all real X, if X<Y AND Y<Z then X<Z is always true.
false: P(U,V) = U or V domain: Y is true, X, Z are false; P(X OR Y) AND P(Y OR Z) → P(X OR Z)
1 AND 1 → 0

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a: The expression is a tautology because OR is commutative and the expression swapped the positions of the predicate but is the same otherwise. Therefore, it is always logically equivalent.

b: p(x, y) is equivalent to p(x, y) so if p(x, y) is true, then p(x, y) AND p(x, y) is true. Therefore if we cross out one of the p(x, y) we get p(x, y) ≡ p(x, y) and since the predicates are the same, the expression will always be logically equivalent.

c: The left side says if p, then false and the right is NOT p which is always false when p. Therefore the two sides are always logically equivalent.

9.

a: (∃X)(∃Y)(NOT p(X) AND p(Y) OR Q(X, Z)) -2
b: (∃X) p(X) OR (X)(Q(X) OR r(X))

10.

a: (∀X)(∀Z) p(X, Z) AND (∃Y)(Q(Y))
b: (∃X)(∀Y)(p(X, Y) OR (∀Q)(∃Z)(p(Q, Z)) -2