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Question 1:

a)

1. All squares have four sides
2. Every square has four sides
3. If an object is a square, then it has four sides
4. If J is a square, then J has four sides
5. For every square J, J has four sides

b)

1. All positive numbers have a positive square root
2. For every positive number e, there is a square root for e
3. For every positive number e there is a positive number r such that e is the square root of r.

c)

1. There is a real number r such that the product of r leaves the number unchanged
2. There is a real number r with the property that for every real number s, that r times s equals s.

Question 2:

a. {(w, a), (w, b), (x, a), (x, b), (y, a), (y, b), (z, a), (z, b)}

A X B has 4*2 = 8 elements.

b. {(a, w), (b, w), (a, x), (b, x), (a, y), (b, y), (a, z), (b, z)}

B X A has 4*2 = 8 elements.

c. {(w, w), (w, x), (w, y), (w, z), (x, w), (x, x), (x, y), (x, z), (y, w), (y, x), (y, y), (y, z), (z, w), (z, x), (z, y), (z, z)}

A X A has 4*4 = 16 elements.

d. {(a, a), (a, b), (b, a), (b, b)}

B X B has 2*2 = 4 elements.

Question 3:

0000, 0001, 0010, 0100, 1000

Question 4:

a) If you have the flu, you miss the final examination

b) If you have the flu, you do not pass the course

c) You have the flu, or you miss the final examination, or you pass the course.

d) If you have the flu, you do not pass the course, or if you miss the final examination you do not pass the course.

e) You have the flu and you miss the final examination, or you do not miss the final examination and you pass the course.

5.

a)

P	~p	p ^ ~p
T	F	F
F	T	F

b)

p	~p	p v ~p
T	F	T
F	T	T

c)

p	q	r	~q	p v ~q	(p v ~q) -> r
T	T	T	F	T	T
T	T	F	F	T	F
T	F	F	T	T	F
F	F	F	T	T	F
F	T	T	F	F	T
F	F	T	T	T	T
F	T	F	F	F	T
T	F	T	T	T	T

d)

p	q	p v q	p ^ q	(p v q) -> (p ^ q)
T	T	T	T	T
T	F	T	F	F
F	T	T	F	F
F	F	F	F	T

e)

p	q	p -> q	q -> p	(p -> q) -> (q -> p)
T	T	T	T	T
T	F	F	T	T
F	T	T	F	F
F	F	T	T	T

Question 6.

a)

~(p v (~p ^ q))

~p v ~(~p ^ q) de Morgan's laws

~P v ~~(p ^ ~q) de Morgan's laws

~p v (p ^ ~q) double negative law

(~p v p) ^ (~p v ~q) distributive law

t ^ (~p v ~q) negation law

~p v ~q discard and true

b)

(p ^ q) -> (p v q)

~(p ^ q) v (p v q) representation of if then as or

~p v ~q v p v q de Morgan's Law

~p v p v ~q v q communitive laws

t v t negation laws

t universal bounds laws

c)

p -> (q v r)

~p v (q v r) representation of if then as or

(~p v q) v r associative laws

~(p ^ ~q) v r de Morgan's Law

(p ^ ~q) -> r representation of or as if then

d)

p -> (q -> r)

~p v (~q v r) representation of if then as or

(~p v ~q) v r associative laws

~(p ^ q) v r de Morgan's law

(p ^ q) -> r representation of or as if then