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MATH-245

TEST #1

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1. Ans. $X = \{5, 6\}$, $Y = \{a, b\}$, $Z = \{c\}$

(a) $X \times Y = \{(5, a), (5, b), (6, a), (6, b)\}$

(b) $Y \times Y = \{(a, a), (a, b), (b, a), (b, b)\}$

(c) $Y \times Z = \{(a, c), (b, c)\}$

(d) $X \times Y \times Z = \{(5, a, c), (5, b, c), (6, a, c), (6, b, c)\}$

2. Ans. P : You run 10 laps daily
Q : You are healthy
R : You take multi-vitamins.

¬P : You don't run 10 laps daily.
¬Q : You are not healthy
¬R : You don't take multi-vitamins

(a) $P \wedge \neg Q$

Ans. You run 10 laps daily and you are not healthy.

(b) $\neg P \vee \neg R$

Ans. You don't run 10 laps daily or you don't take multi-vitamins.

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(c) $p \to (\neg r \wedge \neg q)$

Ans. If you run 10 laps daily, then you don't take multi-vitamins and you are not healthy.

4 Ans. (a) Let the statement "The function is differentiable" be p.

And the statement "The function is continuous" be q.

The given conditional statement i.e. "If a function is differentiable then it is continuous" is if-then statement which can be written as $p \to q$.

~~[illegible]~~ The converse of the conditional statement, can be written as :- $q \to p$

Converse of the given statement is "If a function is continuous then it is differentiable".

The inverse of the conditional statement is given by $\sim p \to \sim q$ ~~$\sim p \to \sim q$~~

So the inverse of the given statement is "If a function is not differentiable then it is not continuous".

The contrapositive of the conditional statement is given by :- $\sim q \to \sim p$

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So, the contrapositive of the given statement is "If a function is not continuous then it is not differentiable".

(b) Contrapositive : $\sim q \Rightarrow \sim p$

~~[illegible]~~ $x \leq 2$ and $x \geq -2$ then, $|x| \leq 2$

Inverse statement :- if $|x| \leq 2$, then

$-2 \leq x \leq 2$

Contrapositive statement :-

if $-2 \leq x \leq 2$ then $|x| \leq 2$

5. Ans. (a) Given statement :- $(p \wedge q) \wedge \sim(p \vee q)$

Truth table :-

p	q	$p \wedge q$	$p \vee q$	$\sim(p \vee q)$	$(p \wedge q) \wedge \sim(p \vee q)$
T	T	T	T	F	F
T	F	F	T	F	F
F	T	F	T	F	F
F	F	F	F	T	F

Since all the entries of the last column are false, the given statement is a contradiction.

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(b) Given statement :- $(p \vee \sim q) \rightarrow (p \wedge q)$

Truth table :-

p	q	$\sim q$	$p \vee \sim q$	$p \wedge q$	$(p \vee \sim q) \rightarrow (p \wedge q)$
T	T	F	T	T	T
T	F	T	T	F	F
F	T	F	F	F	T
F	F	T	T	F	F

Since entries of the last column contain both True & False, the given statement is contingency.

3. Ans (a) $3 < x \leq 5$

Negation of the statement will be :-

$3 \geq x > 5$

(b) John will not use the treadmill to lift weights.

(c) You will fix my computer and I will not pay you \$50.

6. Ans (a) If the sky is red at morning, it will not rain.

This is a statement of type :- $p \Rightarrow q$.

where p is the sky is red at morning & q is it will rain.

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Contrapositive of this is:-
$\sim q \Rightarrow \sim p$

$\therefore$ It rained therefore the sky may not red at morning.

$\therefore$ It is a valid argument.

(b) It is not a valid argument because $p \Rightarrow q$ is true.

then $\sim p \Rightarrow \sim q$ may not be true. where p is you will find the pencil & q is you will find the cover.

7. Ans:- (a) It is a valid argument.

Let the statements be A & B. If any of the two get satisfied, the result can be the same.

$\therefore$ The argument is correct.

(b) It is a valid argument.

The first statement says that the event of Fred's singing can only happen if the cat doesn't bark.

And the second statement follows the first.

$\therefore$ If the cat won't bark, Fred will sing. $\therefore$ Correct!

8. (a) Ans Statement is true.

Negation of given statement is :-

$\exists x \forall y (3x + y \neq 4)$.

(b) Statement is True.

Negation of given statement is :-
$\forall y \forall x (x - y \neq 2 \text{ or } xy \neq 36)$

(c) The statement is false.

The negation of the given statement is :-
$\exists x (x^2 = 1 \text{ and } x^3 \neq 1)$.

9. Ans. (a) Some dogs are not friendly.
(b) No estimate is accurate.
(c) All discrete mathematics students are athletes.

10. Ans In domain of all people,
$P(x)$ = x is a professional athlete.
$Q(x)$ = x plays soccer.

(a) $\forall x (Q(x))$

=> Every person plays soccer.

(b) $\exists x (\neg P(x))$

There are some people who are not professional athletes.

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(c) $\exists x \, (P(x) \wedge \neg Q(x))$

There are some people who are professional athletes but do not play soccer.

(d) $\forall x \, (Q(x) \rightarrow P(x))$

Every person who plays soccer is a professional athlete.