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❖ **Paper = Discrete Structure**

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❖ **Examination: Midterm Assignment**

Q.1

Which of the following are propositions?

a) Buy Premium Bonds!
Answare No**1**: **Commands are not Statements (Not a Proposition)**

b) The Apple Macintosh is a 16 bit computer.
Answare No**2**: **False**

c) There is a largest even number.
Answare No**3**: **True (Proposition)**

d) Why are we here?
Answare No**4**: **Not a Proposition. It is a Question.**

e) 8 + 7 = 13
Answare No**5**: **False (Not a Proposition)**

f) a + b = 13
Answare No**6**: **Not a Statements . (Not a Proposition) . Because the result can be either true or false.**

Q.2

p is "x < 50"; q is "x > 40".

Write as simply as you can:

(a) ¬p
Answare No**1**: **X is not < (less than) 50**

(b) ¬q
Answare No**2**: **X is not > (Greater than) 40**

(c) $p \wedge q$

Answare No**3**: **X is < 50 and X is > 40**

(d) $p \vee q$

Answare No**4**: **X is < 50 or X is > 40**

(e) $\neg p \wedge q$

Answare No**5**: **X is not < (less than) 50 and X is > 40**

(f) $\neg p \wedge \neg q$

Answare No**6**: **X is not < (less than) 50 and X is not > (Greater than) 40**

Q.3

In each part of this question a proposition p is defined. Which of the statements that follow the definition correspond to the proposition $\neg p$? (There may be more than one correct answer.)

(a): p is "Some people like Maths".

(a) "Some people dislike Maths"
(b) "Everybody dislikes Maths"
(c) "Everybody likes Maths"

Answare No**1**: **Some people dislike Maths.**

b): p is "The answer is either 2 or 3".

(a) "Neither 2 nor 3 is the answer"
(b) "The answer is not 2 or it is not 3"
(c) "The answer is not 2 and it is not 3"

Answare No**2**: **The answer is not 2 or it is not 3.**

c): p is "All people in my class are tall and thin".

(a) "Someone in my class is short and fat"
(b) "No-one in my class is tall and thin"
(c) "Someone in my class is short or fat"

Answare No**3**: **No-one in my class is tall and thin.**

Q.4

Construct truth tables for:

a) $\neg p \vee \neg q$

Answare No**1:**

p	q	$\neg p$	$\neg q$	$\neg p \vee \neg q$
T	T	F	F	F
T	F	F	T	T
F	T	T	F	T
F	F	T	T	T

b) $q \wedge (\neg p \vee q)$

Answare No**2:**

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

c) $p \wedge (q \vee r)$

Answare No**3:**

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

d) $(p \wedge q) \vee r$

Answare No**4:**

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

Q.5

Use truth tables to show that:

$\neg ((p \vee \neg q) \vee (r \wedge (p \vee \neg q))) \equiv \neg p \wedge q$

Answar: **L.H.S**

P	q	r	$\neg p$	$\neg q$	$(p \vee \neg q)$	$r \wedge (p \vee \neg q)$	$((p \vee \neg q) \vee (r \wedge (p \vee \neg q))$	$\neg ((p \vee \neg q) \vee (r \wedge (p \vee \neg q)))$
T	T	T	F	F	T	T	T	F
T	T	F	F	F	T	F	T	F
T	F	T	F	T	T	T	T	F
T	F	F	F	T	T	F	T	F
F	T	T	T	F	F	F	F	T
F	T	F	T	F	F	F	F	T
F	F	T	T	T	T	T	T	F
F	F	F	T	T	T	F	T	F

p	q	¬p	¬p ∧ q
T	**T**	**F**	**F**
T	**T**	**F**	**F**
T	**F**	**F**	**F**
T	**F**	**F**	**F**
F	**T**	**T**	**T**
F	**T**	**T**	**T**
F	**F**	**T**	**F**
F	**F**	**T**	**F**

R.H.S

Q.6

Use the laws of logical propositions to prove that:

$(z \wedge w) \vee (\neg z\ w) \vee (z \wedge \neg w) \equiv z \vee w$

State carefully which law you are using at each stage.

Answar:6

$(z \wedge w) \vee (\neg z \wedge w) \vee (z \wedge \neg w) = (z \wedge w) \vee (z \wedge \neg w) \vee (\neg z \wedge w)$ (Commutative Law)

$= (z \wedge (w \vee \neg w)) \vee (\neg z \wedge w)$ (Distributive Law)

$=(z \wedge T) \vee (\neg z \wedge w)$ (Complement Law)

$= z \vee (\neg z \wedge w)$ (Identity law)

$= (z \vee \neg z) \wedge (z \vee w)$ (Distributive Law)

$= T \wedge (z \vee w)$ (Complement Law)

$= (z \vee w) \wedge T$ (Commutative Law)

$= z \vee w$ (Identity law)