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Section: (B)

Q.1

Which of the following are propositions?

- a) Buy Premium Bonds!
- b) The Apple Macintosh is a 16 bit computer.
- c) There is a largest even number.
- d) Why are we here?
- e) $8 + 7 = 13$
- f) $a + b = 13$

Answer: b and c are both prepositions.

Q.2

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

Write as simply as you can:

- (a) $\neg p$

- (b) $\neg q$
- (c) $p \wedge q$
- (d) $p \vee q$
- (e) $\neg p \wedge q$
- (f) $\neg p \wedge \neg q$

Answer: (d) $x < 50$ or $x > 40$. This is true for all values of x .

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"

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"

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"

Answer: In A part the definition correspond to the proposition $\neg p$ is .

- a) "Everybody dislikes Maths"

In B part the definition correspond to the proposition $\neg p$ is

- a) "Neither 2 nor 3 is the answer"

- b) "The answer is not 2 and it is not 3"

In C parrrt the definition correspond to the proposition $\neg p$ is

- a) "Someone in my class is short or fat"

Q.4

Construct truth tables for:

- a) $\neg p \vee \neg q$
- b) $q \wedge (\neg p \vee q)$
- c) $p \wedge (q \vee r)$
- d) $(p \wedge q) \vee r$

Answer:

P	q	$\neg p$	v	$\neg q$
T	T	F	F	T
T	F	F	T	F
F	F	T	T	F
F	F	T	T	T

Q.5

Use truth tables to show that:

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

Answer: In each case, the result is F,F,F,F,T,T,F,F

Q.6

Use the laws of logical propositions to prove that:

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

State carefully which law you are using at each stage.

Answer:

$$\begin{aligned}
 (z \wedge w) \vee (\neg z \wedge w) \vee (z \wedge \neg w) &= (z \wedge w) \vee (z \wedge \neg w) \vee (\neg z \wedge w) && \text{Commutative Law} \\
 &= (z \wedge (w \vee \neg w)) \vee (\neg z \wedge w) && \text{Distributive Law} \\
 &= (z \wedge T) \vee (\neg z \wedge w) && \text{Complement Law} \\
 &= z \vee (\neg z \wedge w) && \text{Identity Law} \\
 &= (z \vee \neg z) \wedge (z \vee w) && \text{Distributive Law}
 \end{aligned}$$

$$= \mathbf{T} \wedge (z \vee w)$$

Complement Law

$$= (z \vee w) \quad \mathbf{T}$$

Commutative Law

$$= z \vee w$$

Identity Law