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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) ¬p

(b) ¬q
(c) p ∧ q
(d) p ∨ q
(e) ¬p ∧ q
(f) ¬p ∧¬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 ¬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 ¬p is .

a) "Everybody dislikes Maths"

In B parrt the definition correspond to the proposition ¬p is

a)"Neither 2 nor 3 is the answer"

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

In C parrt the definition correspond to the proposition ¬p is

a) "Someone in my class is short or fat

Q.4

Construct truth tables for:

a) ¬p ∨ ¬q
b) q∧ (¬p ∨ q)
c) p ∧ (q ∨ r)
d) (p∧ q) ∨ r

Answer:

P	q	¬p	v	¬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:

¬ ((p ∨ ¬q) ∨ (r ∧ (p ∨ ¬q))) ≡ ¬p ∧ 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 ∧ w) ∨ (¬z w) ∨ (z ∧ ¬w) ≡ z ∨ w

State carefully which law you are using at each stage.

Answer:

(z ∧ *w*) ∨ (¬z ∧ *w*) ∨ (z ∧ ¬*w*)	= (z ∧ *w*) ∨ (z ∧ ¬*w*) ∨ (¬z *w*)	*Commutative Law*
	= (z ∧ (w ∨ ¬*w*)) ∨ (¬z *w*)	*Distributive Law*
	= (z ∧T) ∨ (¬z ∧ *w*)	*Complement Law*
	= z ∨ (¬z ∧ *w*)	*Identity Law*
	= (z ∨ ¬z) ∧ (z ∨ *w*)	*Distributive Law*

$= \mathrm{T} \wedge (z \vee w)$ *Complement Law*

$= (z \vee w) \quad \mathrm{T}$ *Commutative Law*

$= z \vee w$ *Identity Law*