

IB Style Solutions – Logic, Sets and Probability

Logic

Question 1 - Answers/Solutions

- a. (i) It is snowing if and only if I do not wear a hat. [1 mark]
- (ii) It is not snowing, and the boys will walk to school. [1 mark]
- b. (i) He does not see or he does not run. [1 mark]
- (ii) Converse: If I visit the Louvre, then I go to Paris [3 marks]
- Inverse: If I do not go to Paris, then I do not visit the Louvre.
- Contrapositive: If I do not visit the Louvre, then I do not go to Paris.

c. $\neg q \Rightarrow p$

Question 2 - Answers/Solutions

- a. (i) Converse: If $x^2 = 25$, then $x = 5$. [1 mark]
- (ii) No [1 mark]
- (iii) Contrapositive: If $x^2 \neq 25$, then $x \neq 5$. [1 mark]
- (iv) Yes [1 mark]
- b. (i) ~~True~~ [1 mark]
- (ii) False [1 mark]

Question 3 - Answers/Solutions

- a. (i) $T \vee T \equiv F$ [1 mark]
- (ii) $F \Rightarrow T \equiv T$ [1 mark]
- (iii) $F \Leftrightarrow F \equiv T$ [1 mark]
- b. continued on next page . . .



b.

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

[3 marks, 1 mark per column]

Question 4 - Answers/Solutions

a. (i) Conclusion: The team did not win.

[2 marks]

(ii) Conclusion: Carlos studies for his exam.

[2 marks]

b. (i) $\neg p \wedge \neg q$

[1 mark]

(ii) $p \vee q$ (This is the negation of part (b) (i) above).

[1 mark]

Question 5 - Answers/Solutions

a. If he plays the game and he hates to lose, then we cannot party after the game.

[2 marks]

b.

p	q	r	$\neg r$	$p \wedge q$	$(p \wedge q) \Rightarrow \neg r$
T	T	T	F	T	F
T	T	F	T	T	T
T	F	T	F	F	T
T	F	F	T	F	T
F	T	T	F	F	T
F	T	F	T	F	T
F	F	T	F	F	T
F	F	F	T	F	T

[3 marks, 1 mark per column]



Question 6 - Answers/Solutions

a. If it is not Tuesday, then Marie does not play the violin.

[1 mark]

b. (i)

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

[3 marks, 1 mark per column]

(ii) Yes, the statement is a tautology because it is true for all possible cases of p and q .

[2 marks]

Question 7 - Answers/Solutions

a.

p	q	$\neg p$	$\neg q$	$p \wedge \neg q$	$\neg q \Rightarrow \neg p$
T	T	F	F	F	T
T	F	F	T	T	F
F	T	T	F	F	T
F	F	T	T	F	T

[4 marks, 1 mark per column]

b. The two statements are not logically equivalent because corresponding (i.e. each row) truth values are not identical. In fact one is the negation of the other.

[2 marks]



Question 8 - Answers/Solutions

a. (i) $\neg p \Leftrightarrow r$

[2 marks]

(ii) $\neg q \Rightarrow (\neg p \wedge \neg r)$

[3 marks]

b. (i)

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

[2 marks, 1 mark per column]

(ii)

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

[2 marks, 1 mark per column]

(iii) No, the statements are not equivalent as the corresponding truth values are not identical (see last column of parts (i) and (ii) shown above.

[3 marks]

