More IB Logic Questions

**1.** Three propositions *p*, *q* and *r* are defined as follows:

 *p*: the water is cold. *q*: the water is boiling. *r*: the water is warm.

(a) Write one sentence, in words, for the following logic statement:

 ( *p*   *q*)  *r*

(b) Write the following sentence as a logic statement using symbols only.

*"The water is cold if and only if it is neither boiling nor warm"*

|  |  |
| --- | --- |
| *Working:* |  |
|  | *Answers*:(a) …………………………………………..(b) ………………………………………….. |

(Total 4 marks)

**2.** *B* and *C* are subsets of a universal set *U* such that

*U* = {*x* : *x*  , 0  *x*  10}, *B* = {prime numbers 10}, *C* = {*x* : *x*  , 1  *x*  6}.

(a) List the members of sets

(i) *B*

(ii) *C* ** *B*

(iii) *B* ** *C′*

Consider the propositions:

 *p*: *x* is a prime number less than 10.

 *q*: *x* is a positive integer between 1 and 7.

(b) Write down, in words, the contrapositive of the statement, “If *x* is a prime number less than 10, then *x* is a positive integer between 1 and 7.”

(Total 6 marks)

**3.** Consider the following logic statements:

*p*: *x* is a factor of 6

*q*: *x* is a factor of 24

(a) Write *p*  *q* in words.

(1)

(b) Write the converse of *p*  *q.*

(1)

(c) State if the converse is true or false and give an example to justify your answer.

(2)

(Total 4 marks)

**4.** Complete the Truth Table for the compound proposition *(p* * * *q)*  *(p*  *q)*.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| *p* | *q* | *q* | (*p* **  *q*) | (*p*  *q*) | *(p* **  *q)*  *(p*  *q)* |
| T | T | F | F |  |  |
| T | F | T | T |  |  |
| F | T | F |  | T |  |
| F | F |  | F | F |  |

(Total 8 marks)

**5.** (a) Solve 2*x* + 3 = 5.

(b) Consider the logic statements.

 *p*: 2*x* + 3 = 5 *q*: *x*2 = *x*

 The compound proposition 2*x* + 3 = 5  *x*2 = *x* is given.
Is this compound proposition true?

(c) Write down the converse of this compound proposition.

(d) Give an example to show that the converse is false.

(Total 8 marks)

**6.** Consider two propositions *p* and *q*. Complete the truth table below for the compound proposition.

 (*p*   *q*)  ( *p*  *q*)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| *p* | *q* |  *p* |  *q* | *p*   *q* |  *p*  *q* | (*p*   *q*)  ( *p*  *q*) |
| T | T | F | F | F | **(d)** | T |
| T | F | F | T | **(b)** | F | **(f)** |
| F | T | **(a)** | F | **(c)** | T | **(g)** |
| F | F | T | T | F | **(e)** | **(h)** |

More IB Logic Questions – Answers

**1.** (a) *“If the water is not cold and not boiling then it is warm”*
(or equivalent statement) (A2)

(b) *p*  ¬(*q*  *r*) ***or*** *p*  ¬*q*  ¬ *r* (A2)

**Note:** Award (A1) for p  and (A1) for ¬(q  r).

[4]

**2.** (a) (i) B = 2,3,5,7 (A1)

**Note:** Brackets not required

(ii) C  B = 2,3,5 (A1)(ft)

**Note:** Follow through only from incorrect B

(iii) C = 0,1,7,8,9 (A1)(ft)

B  C = 0,1,2,3,5,7,8,9 (A1)(ft) (C4)

**Note:** Award (A1) for correct C seen. The first (A1)(ft) in (iii) can be awarded only if C was listed incorrectly **and** a mark was lost as a result in (a)(ii). If C was not listed and C is wrong, the first mark is lost. The second mark can (ft) within part (iii) as well as from (i).

(b) “If *x* is not a positive integer between 1 and 7, then *x* is not a prime number
less than 10.” (A1)(A1) (C2)

**Note:** Award (A1) for **both** (not) statements, (A1) for correct order.

[6]

**3.** (a) If *x* is a factor of 6 then *x* is a factor of 24 (A1)1

(b) If *x* is a factor of 24 then *x* is a factor of 6 (or *q*  *p*) (A1) 1

(c) False (R1)

 4, 8, 12 are all factors of 24 but not of 6
(any one of the three factors will do) (A1) 2

[4]

**4.**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| *p* | *q* | *q* | *(p*  *q)* | *(p*  *q)* | *(p*  *q)  (p*  *q)* |
| T | T | F | F | **T** | **T** |
| T | F | T | T | **T** | **T** |
| F | T | F | **F** | T | **T** |
| F | F | **T** | F | F | **T** |

 (A1) (A1) (A2) (A4) (C8)

[8]

**5.** (a) 2*x* = 2 (M1)
*x* = 1 (A1) (C2)

(b) Yes (A1) (C1)

(c) *x*2 = *x*  2*x* + 3 = 5 (A1)(A1)(A1) (C3)

**Note:** Award (A1) for x2 = x, (A1) for , (A1) for 2x + 3 = 5.
Accept also: If x2 = x (A1) then (A1) 2x + 3 = 5 (A1).

(d) *x* = 0 (A2) (C2)

[8]

**6.**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| *p* | *q* | ¬*p* | ¬*q* | *p*  ¬*q* | ¬*p*  *q* | (*p*  ¬*q*)  (¬*p*  *q*) |  |
| T | T | F | F | F | **(d) T** | T |  |
| T | F | F | T | **(b) T** | F | **(f) F** |  |
| F | T | **(a) T** | F | **(c) F** | T | **(g) T** |  |
| F | F | T | T | F | **(e) T** | **(h) T** | (A8) |

**Note:** Award (A1) for each correct answer.

[8]