Midterm CM1020 coursework assignment - [dp261@london.ac.uk](mailto:dp261@london.ac.uk)

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## Question 1

## (a)

1. 10 is in all three so X ∩ Y ∩ Z = { 10 }

( X \ Z) is the { 4, 6, 8 }

X ∪ (X \ Z) = { 2, 4, 6, 8, 10 }

1. X = { 2, 4, 6, 8, 10 }

The values of all X must be in the other two sets, however this is False. So X cannot be a subset

1. P ( X union ( Y and Z)) , therefore:

P(X ∪ (Y ∩ Z)) = { 2, 4, 6, 8, 10, 12 } = = 64

## (b)

Powerset (A) subset { , All empty sets , we test this

{ , {}} will be an empty set of the set and the general empty set = A could be a subset of these

{{ }} is a nested subset, however this set would be an empty set and a single set like { , {}}

Therefore both would be equal, the powerset of these two would then True

## (c)

A ⊆ B ( if and only if) A ∩ C ⊆ B ∩ C for all sets of C

I will try disapprove this statement:

A ⊄ B, however A ∩ C subset B ∩ C for all C

A = {1}, B = {∅}, ∴ A ⊄ C, hence true

A ∩ C = {1} but B ∩ C = ∅

And {1} cannot be a subset of {∅}, so fail and the statement is True

## (d)

If A ⊆ B and C ⊆ B`, then A ∩ C = ∅ B` = complement of B

Universal Set U.

So if A is a subset of B , and C is a subset of B`

A ∩ B ⊆ C ∩ `B , A and C = empty set

Therefore: A is in B, C are not in B , they can not share elements

## 

## Question 2

## (a)

I. so then the equation will be undefined. However the real number can be negative, zero or positive. **Is Not a function**

II. This is an exponential function, As a set of integers can be positive, zero or negative. **Is a function**

III. This is a square root function, the number can be positive,negative or zero. This also does not pass the function test. **So it Not a function**

## b)

Left side:

Right side:

(

If I divide by x, I will not get a final value. ∴ There is no real value for b

## c)

= 0

We Will tackle the brackets:

∴

## d)

I. ∴ is increasing, **SO yes is one-to-one**

II. The range is cut at 0, so x cannot equal 0, SO 0 is exclusive to the domain. **No, not onto**

## e)

Let , then we can say is injective. Because

Therefore is one-to-one

# Question 3

## a)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| t | t | t | f | t | t | t | t |
| t | t | f | f | t | t | f | f |
| t | f | t | t | t | t | t | t |
| t | f | f | t | f | t | f | f |
| f | t | t | t | t | t | f | f |
| f | t | f | t | f | t | f | f |
| f | f | t | f | t | f | f | t |
| f | f | f | f | t | f | f | t |

1. r is false when

So that means row 4 and 6. **NO tautology**

## b)

**Right side:**

**True**

**Left side**

And

**True**

**∴ True**

## c)

I.

II.

III.

## d)

**Contrapositive**

**Converse**

**Inverse**

## e)

**Left side**

And

**LHS = T**

**Right side**

And

**RHS = F**

**∴ LHS RHS -> NOt a Tautology**

# Question 4

## a)

I. Doctor

Wears Mask

II. is watered

grows healthy

III. ℝ numbers

∴

IV. wings

fly

∴

## b)

I. Every Integer, find a nonzero xy < 1

Hence, try: for all x, y and xy for values [0, 1)

∴ **True**

II. Every Non-zero, every Integer xy > 1

Hence try:x, y, and xy for values (-1, 1) but values cannot equal 0

∴ **False**

III. So xy = 2, we could as x cannot equal 0. Therefore exists

∴ **True**

## c)

## d)

We are given the equation

1. ( assuming F )
2. ( assuming T )
3. ( assuming T )

This argument is **not valid , there's just not enough guarantee**

# Question 5

## a)

(de morgan's law)

First term

Second term

=

**Simplify**

()

II. First

Second

Third

**Simplified**

and

∴ ii is equal to zero

## b)

I.

II. De morgan's law

=

Q = )

## c)

To do Duality we will need to modify the existing equation to work

LHS:

RHS:

Therefore

## d)

I.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 0 | 1 | 0 | 1 | 1 |
| 1 | 0 | 1 | 0 | 1 |
| 1 | 0 | 1 | 1 | 1 |
| 1 | 1 | 0 | 0 | 1 |
| 1 | 1 | 0 | 1 | 1 |

II. Karnaugh map

|  | CD |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  | 00 | 01 | 11 | 10 |
| AB |  |  |  |  |  |
| 00 |  | 0 | 0 | 0 | 0 |
| 01 |  | 0 | 1 | 0 | 0 |
| 11 |  | 1 | 1 | 0 | 0 |
| 10 |  | 0 | 1 | 1 | 1 |

III.

End of assignment

## 

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