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# 21.1 maths paper (Answers).

## question 01

01) a) rational b) irrational c) rational
d) rational e) irrational

02) a) $p^8$ b) $p^{-15} \rightarrow 1/p^{15}$ c) $p^{-20} \rightarrow 1/p^{20}$

d) $y^3 \times y^{-15} \rightarrow y^{-12} \rightarrow 1/y^{12}$ e) $256m^4$

03) a) $4^x = 64$
$x = 3$

b) $3^{2x} = 9^4$
$3^{2x} = (3^2)^4$
$3^{2x} = 3^8$
$2x = 8 \quad x = 4$

c) $2^x = 1/32 \rightarrow 2^5$
$2^x = 2^{-5}$
$x = -5$

04) a) $y^1 = y$ b) $\frac{1}{d^6}$ c) $\frac{z^7}{y^6}$

05) a) $9 \times 9 \times 3$
$81 \times 3$

b) $\frac{(4+1)^5 \times 1}{(4+1)^5} = 1$

c) $b^{15} b^2$
$b^{17}$

## question 02

01) (a) $\notin$ (not element) (b) $\in$ (element) (c) (sub set) $\subseteq$ (d) $\in$ (e) $=$ (equal)

How to get the answer for question e)

$2x^2 + 3x - 2 = 0$

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$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

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$a = 2$
$b = 3$
$c = -2$

$$x = \frac{-3 \pm \sqrt{3^2 - (4 \times 2 \times (-2))}}{2 \times 2}$$

$$= \frac{-3 \pm \sqrt{9 - (-16)}}{4}$$

$$= \frac{-3 \pm \sqrt{25}}{4}$$

$$x = \frac{-3 \pm 5}{4} \rightarrow x = \frac{-3+5}{4} = \frac{2}{4} = \frac{1}{2} \qquad x = \frac{-3-5}{4} = \frac{-8}{4} = -2$$

Answers = $-2$ or $1/2$

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Question 02

02) all - 238 | Foss - 103 | Robot - 82 | Innov - 95

Foss | Robot - 15 , Inno | Robot - 19 , Foss | Inno - 22

6 - nothing *( 238 - 6 = 232 ( A ∪ B ∪ C ) )

$(A \cup B \cup C) = (A) + (B) + (C) - (A \cap B) - (A \cap C) - (B \cap C) + (A \cap B \cap C)$

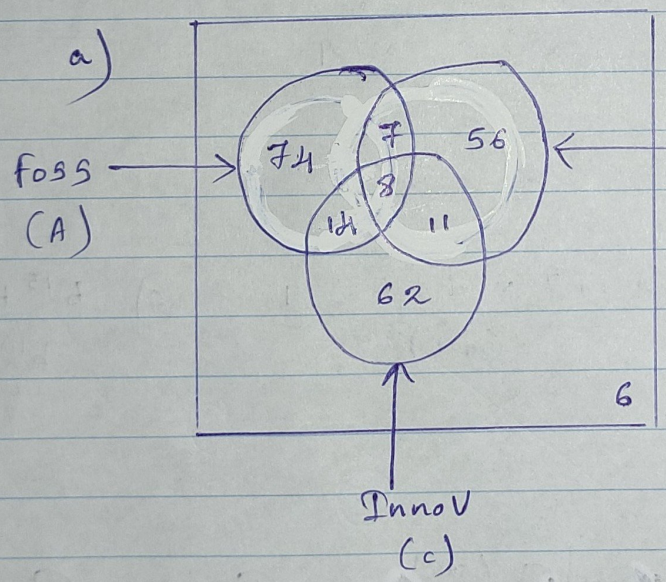
$232 = 103 + 82 + 95 - 15 - 22 - 19 + (A \cap B \cap C)$

$232 = (280 - 56) + (A \cap B \cap C)$

$232 - 224 = (A \cap B \cap C)$

$8 = (A \cap B \cap C)$

a)




ℰ = 238

b) 143

c) 8

03) a) {a, b} × {2, 3, 5}

{(a, 2), (a, 3), (a, 5), (b, 2), (b, 3), (b, 5)}

b) (A × B) → {(a, 3), (a, 5), (b, 3), (b, 5)}

(A × C) → {(a, 2), (a, 3), (b, 2), (b, 3)}

(A × B) ∪ (A × C) → {(a, 3), (a, 5), (b, 3), (b, 5), (a, 2), (a, 3), (b, 2), (b, 3)}

c) (B ∩ C) → {3} × {a, b}

ans = {(a, 3), (b, 3)}

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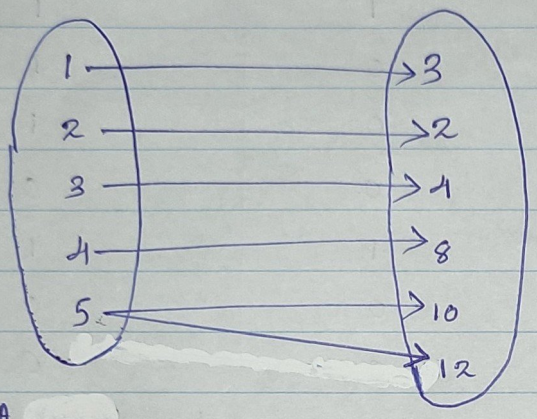
## question 02

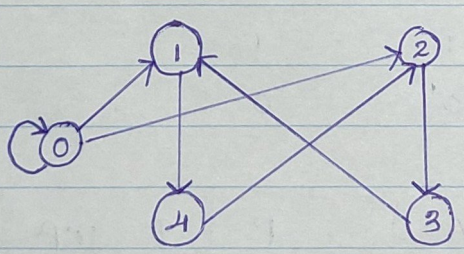
03) d) ans → { (a, 3), (b, 3) }

04) a)




b) no, it is not a function. because, element of the domain is not paried with exactly one element of the range.

05) {(0,0), (0,1), (0,2), (1,4), (2,3), (3,1), (4,2)}




## question 03 (propositional logic)

a) A proposition is a statement which is either true of false but not both.

ex: colombo is in Sri Lanka.

17 is a prime number.

normal proposition only have one statement.
and in a composite proposition they are composed of sub statements

eg:- 17 is a prime number and 10 is an even number.

No: 0 - false / 1 - True. Date: __/__/____

02) a)

| p | q | r | ~p | ~q | (~q)∧r | (~p)∨(~q)∧r |
|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 1 | 1 | 0 | 1 |
| 0 | 0 | 1 | 1 | 1 | 1 | 1 |
| 0 | 1 | 0 | 1 | 0 | 0 | 1 |
| 0 | 1 | 1 | 1 | 0 | 0 | 1 |
| 1 | 0 | 0 | 0 | 1 | 0 | 0 |
| 1 | 0 | 1 | 0 | 1 | 1 | 1 |
| 1 | 1 | 0 | 0 | 0 | 0 | 0 |
| 1 | 1 | 1 | 0 | 0 | 0 | 0 |

b)

| p | q | r | ~p | ~r | (q)∧(~r) | (~p)∨(q)∧(~r) |
|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 1 | 1 | 0 | 1 |
| 0 | 0 | 1 | 1 | 0 | 0 | 1 |
| 0 | 1 | 0 | 0 | 1 | 1 | 1 |
| 0 | 1 | 1 | 0 | 0 | 0 | 0 |
| 1 | 0 | 0 | 1 | 1 | 0 | 1 |
| 1 | 0 | 1 | 1 | 0 | 0 | 1 |
| 1 | 1 | 0 | 0 | 1 | 1 | 1 |
| 1 | 1 | 1 | 0 | 0 | 0 | 0 |

03) a)

| p | q | (p∧q) | ~(p∧q) | = | p | q | ~p | ~q | (~p)∨(~q) |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 1 | | 0 | 0 | 1 | 1 | 1 |
| 0 | 1 | 0 | 1 | = | 0 | 1 | 1 | 0 | 1 |
| 1 | 0 | 0 | 1 | | 1 | 0 | 0 | 1 | 1 |
| 1 | 1 | 1 | 0 | | 1 | 1 | 0 | 0 | 0 |

Truth tables are equal.

b)

| p | q | (p∨q) | ~(p∨q) | = | p | q | ~p | ~q | (~p)∧(~q) |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 1 | | 0 | 0 | 1 | 1 | 1 |
| 0 | 1 | 1 | 0 | = | 0 | 1 | 1 | 0 | 0 |
| 1 | 0 | 1 | 0 | | 1 | 0 | 0 | 1 | 0 |
| 1 | 1 | 1 | 0 | | 1 | 1 | 0 | 0 | 0 |

Truth tables are equal

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03) c)

| p | q | r | $(p \vee q)$ | $(p \vee q) \wedge r$ | $\sim(p \vee q) \wedge r$ |
|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 | 1 |
| 0 | 0 | 1 | 0 | 0 | 1 |
| 0 | 1 | 0 | 1 | 0 | 1 |
| 0 | 1 | 1 | 1 | 1 | 0 |
| 1 | 0 | 0 | 1 | 0 | 1 |
| 1 | 0 | 1 | 1 | 1 | 0 |
| 1 | 1 | 0 | 1 | 0 | 1 |
| 1 | 1 | 1 | 1 | 1 | 0 |

| p | q | r | $\sim p$ | $\sim q$ | $\sim r$ | $(\sim p \wedge \sim q)$ | $(\sim p \wedge \sim q) \vee \sim r$ |
|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 |
| 0 | 0 | 1 | 1 | 1 | 0 | 1 | 1 |
| 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 |
| 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 |
| 1 | 0 | 0 | 0 | 1 | 1 | 0 | 1 |
| 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 |
| 1 | 1 | 0 | 0 | 0 | 1 | 0 | 1 |
| 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 |

The tables are equal.

04) a)

| p | q | $p \Rightarrow q$ | $q \Rightarrow p$ | $(p \Rightarrow q) \wedge (q \Rightarrow p)$ |
|---|---|---|---|---|
| 0 | 0 | 1 | 1 | 1 |
| 0 | 1 | 1 | 0 | 0 |
| 1 | 0 | 0 | 1 | 0 |
| 1 | 1 | 1 | 1 | 1 |

b)

| p | q | $p \wedge q$ | $\sim(p \wedge q)$ | $(q \Leftrightarrow p)$ | $\sim(q \Leftrightarrow p)$ | $\sim(p \wedge q) \vee \sim(q \Leftrightarrow p)$ |
|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 1 | 1 | 0 | 1 |
| 0 | 1 | 0 | 1 | 0 | 1 | 1 |
| 1 | 0 | 0 | 1 | 0 | 1 | 1 |
| 1 | 1 | 1 | 0 | 1 | 0 | 0 |

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05) a)

| p | q | r | $(p \Rightarrow q)$ | $(q \Rightarrow r)$ | $(p \Rightarrow r)$ | $[(p \Rightarrow q) \wedge (q \Rightarrow r)]$ | $[(p \Rightarrow r) \wedge (q \Rightarrow r) \Rightarrow (p \Rightarrow r)$ |
|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 |
| 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 |
| 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 |
| 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1 | 0 | 0 | 0 | 1 | 0 | 0 | 1 |
| 1 | 0 | 1 | 0 | 1 | 1 | 0 | 1 |
| 1 | 1 | 0 | 1 | 0 | 0 | 0 | 1 |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

This table is a tautalogy

b)

| p | q | r | $\neg p$ | $\neg r$ | $(\neg p \Rightarrow \neg r)$ | $(\neg p \Rightarrow \neg r) \vee q$ |
|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 1 | 1 | 1 | 1 |
| 0 | 0 | 1 | 1 | 0 | 0 | 0 |
| 0 | 1 | 0 | 1 | 1 | 1 | 1 |
| 0 | 1 | 1 | 1 | 0 | 0 | 1 |
| 1 | 0 | 0 | 0 | 1 | 1 | 1 |
| 1 | 0 | 1 | 0 | 0 | 1 | 1 |
| 1 | 1 | 0 | 0 | 1 | 1 | 1 |
| 1 | 1 | 1 | 0 | 0 | 1 | 1 |

This table is a contigent proposition

c)

| p | q | r | $(p \Rightarrow r)$ | $q \Rightarrow (p \Rightarrow r)$ |
|---|---|---|---|---|
| 0 | 0 | 0 | 1 | 1 |
| 0 | 0 | 1 | 1 | 1 |
| 0 | 1 | 0 | 0 | 0 |
| 0 | 1 | 1 | 1 | 1 |
| 1 | 0 | 0 | 1 | 1 |
| 1 | 0 | 1 | 1 | 1 |
| 1 | 1 | 0 | 0 | 0 |
| 1 | 1 | 1 | 1 | 1 |

This table is a contigent proposition.

d)

| p | q | $(p \Rightarrow q)$ | $(q \Rightarrow p)$ | $(p \Rightarrow q) \vee (q \Rightarrow p)$ |
|---|---|---|---|---|
| 0 | 0 | 1 | 1 | 1 |
| 0 | 1 | 1 | 0 | 1 |
| 1 | 0 | 0 | 1 | 1 |
| 1 | 1 | 1 | 1 | 1 |

This table is a tautology.