Sets and Relations

Question1

Let S be a non-empty subset of $\mathbb{R}$. Consider the following statement:

p : There is a rational number $x \in$ S such that $x > 0$.

Which of the following statements is the negation of the statement p?

MHT CET 2024 (16 May Shift 1)

Options:

A. There is a rational number $x \in$ S such that $x \leq 0$.

B. There is no rational number $x \in$ S such that $x \leq 0$.

C. Every rational number $x \in$ S satisfies $x \leq 0$.

D. $x \in$ S and $x \leq 0 \Rightarrow x$ is not a rational number.

Answer: C

Solution:

Given statement is

$$\exists x \in \text{S, such that } x > 0$$
$$\therefore \quad \sim (\exists x \in \text{S, such that } x > 0)$$
$$\equiv \forall x \in \text{S}, x \leq 0$$

i.e., Every rational number $x \in S$ satisfies $x \leq 0$.

Question2

If $n(A) = 4, n(B) = 2$. Then the number of subsets of the set A $\times$ B each having at least 3 elements are MHT CET 2024 (15 May Shift 1)

Options:

A. 275

B. 510

C. 219

D. 256

Answer: C

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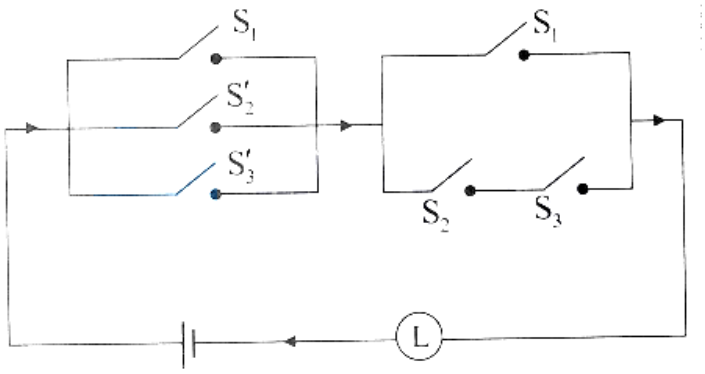
Solution:

$$
\begin{aligned}
&\mathrm{n(A)} = 4, \mathrm{n(B)} = 2 \\
&\therefore \quad \mathrm{n(A \times B)} = 4 \times 2 = 8 \\
&\text{Required numbers } = {}^{8}\mathrm{C}_3 + {}^{8}\mathrm{C}_4 + \ldots + {}^{8}\mathrm{C}_8 \\
&= 2^8 - \left({}^{8}\mathrm{C}_0 + {}^{8}\mathrm{C}_1 + {}^{8}\mathrm{C}_2\right) \\
&= 256 - 37 \\
&= 219
\end{aligned}
$$

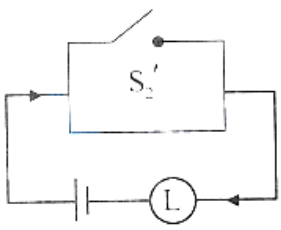
Question3

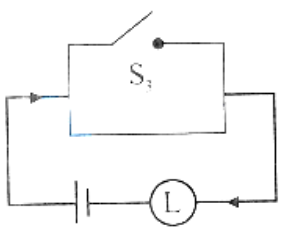
The given circuit is equivalent to

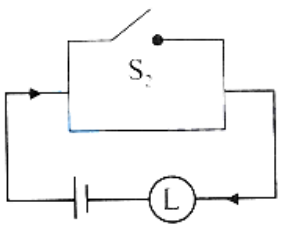


MHT CET 2023 (10 May Shift 1)

Options:

A.


B.


C.


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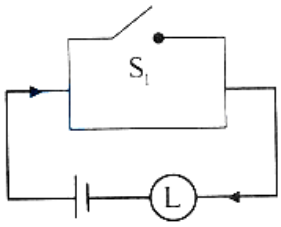
D. 

Answer: D

Solution:

The symbolic form of the given circuit is

$$(p \vee \sim q \vee \sim r) \wedge (p \vee (q \wedge r))$$
$$\equiv p \vee [(\sim q \vee \sim r) \wedge (q \wedge r)]$$

...[Distributive law]

$$\equiv p \vee [\sim (q \wedge r) \wedge (q \wedge r)]$$

...[De Morgan's law]

$$\equiv p \vee F$$

...[Complement law]

$$\equiv p$$

[Identity law]

Question4

Let $A = [a, b, c, d], B = [1, 2, 3]$. Relation R_1, R_2, R_4 are as follows:

$$R_1 = [(a, 1), (b, 2), (c, 1), (d, 2)]$$
$$R_2 = [(a, 1), (b, 1), (c, 1), (d, 1)]$$
$$R_3 = [(a, 2), (b, 3), (c, 2), (d, 2)]$$
$$R_4 = [(a, 1), (b, 2), (a, 2), (d, 3)], \text{ then}$$

MHT CET 2021 (20 Sep Shift 2)

Options:

A. only R_3 and R_4 are not functions

B. only R_1 and R_2 are not functions

C. only R_3 is not a function

D. only R_4 is not a function

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Answer: D

Solution:

We find that in R_4, $f(a) = 1$ and $f(a) = 2$. Hence R_4 is not a function.

Question5

If A and B are subsets of universal set X such that $\mathrm{n(X)} = 200, \mathrm{n(A)} = 90, \mathrm{n(B)} = 80$, $n\left(A' \cap B'\right) = 40,$ then $n\left(A \cap B'\right) =$

MHT CET 2020 (20 Oct Shift 2)

Options:

A. 70

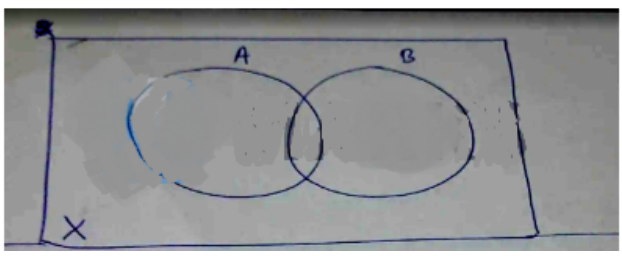
B. 80

C. 20

D. 10

Answer: B

Solution:



$$\begin{aligned} n\left(A \cap B'\right) &= n(A) - n(A \cap B) \\ n(x) &= 200 \\ &\sim (A \cap B) = n(A) + n(B) + 2\left(A' \cap B'\right) \\ &\quad - n(X) \\ n\left(A \cap B'\right) &= 90 - 10 \\ &= 80 \end{aligned}$$

Question6

If $\mathrm{A} = \{x, y, z\}, \mathrm{B} = \{1, 2\}$, then the total number of relations from set A to set B are

MHT CET 2020 (16 Oct Shift 1)

Options:

A. 64

B. 16

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C. 32

D. 8

Answer: A

Solution:

It is given that $A = \{x, y, z\}$ and $B = \{1, 2\}$.

$\therefore A \times B = \{(x, 1), (x, 2), (y, 1), (y, 2), (z, 1), (z, 2)\}$

Since $n(A \times B) = 6$, the number of subsets of $A \times B$ is 2^6.

Therefore, the number of relations from A to B is 2^6.

Question7

Given $\mathrm{A} = \{1, 2, 3, 4, 5\}, \mathrm{B} = \{1, 4, 5\}$. If R is a relation from A to B such that $(x, y) \in \mathrm{R}$ with $x > y$, then range of R is MHT CET 2020 (14 Oct Shift 2)

Options:

A. {1,4}

B. {4,5}

C. {1,4,5}

D. {2,4}

Answer: A

Solution:

$A = \{1, 2, 3, 4, 5\}; B = \{1, 4, 5\}$

$R: \quad A \to B(x > y)$

Domain

$$\begin{pmatrix} 2 \\ 3 \\ 4 \\ 5 \end{pmatrix}$$

Range

$$\begin{pmatrix} 1 \\ 4 \end{pmatrix}$$

Range $R = \{1, 4\}$

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Question8

If $A=\{x / x$ is a prime number, $0 \leq x \leq 9]$, then the number of elements of powerset of A is MHT CET 2020 (13 Oct Shift 2)

Options:

A. 12

B. 4

C. 16

D. 8

Answer: C

Solution:

$$
\begin{aligned}
& A=\{2,3,5,7\} \\
& \text{Power set of } A=2^4 \\
& \qquad\qquad\quad =16.
\end{aligned}
$$

Question9

If $A=\{2,4\}, \quad B=\{3,4,5\}$, then $(\mathrm{A} \cap \mathrm{B}) \times(\mathrm{AUB})=$ MHT CET 2020 (12 Oct Shift 1)

Options:

A. $\{(3,2),(3,4),(4,4),(5,4)\}$

B. $\{(2,3),(2,4),(2,5)\}$

C. $\{(4,2),(4,3),(4,4),(4,5)\}$

D. $\{(4,3),(4,4),(4,5)\}$

Answer: C

Solution:

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$A \cap B = \{4\}$

$A \cup B = \{2,3,4,5\}$

Hence

$(A \cap B) \times (A \cup B)$

$= \{(4,2),(4,3),(4,4),(4,5)\}$

Question10

If $A = \{x \in R : x^2 - 5|x| + 6 = 0\}$, then $n(A) =$ _____ MHT CET 2019 (02 May Shift 1)

Options:

A. 2

B. 0

C. 1

D. 4

Answer: D

Solution:

Given: $A = \{x \in R : x^2 - 5|x| + 6 = 0\}$
$x^2 - 5|x| + 6 = 0 \Rightarrow |x|^2 - 5|x| + 6 = 0$
$|x| = 2, 3 \Rightarrow x = \pm 2, \pm 3$
Hence, $n(A) = 4$

Question11

If $A = \{x | x \in N, x$ is a prime number less than 12} and B = {x | $x \in N$, x is factor of 10}, then $A \cap B$ =... MHT CET 2019 (Shift 2)

Options:

A. $\{2\}$

B. $\{2,5\}$

C. $\{2,5,10\}$

D. $\{1,2,5,10\}$

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Answer: B

Solution:

We have, $\{x|x \in N, x|, isaprimenumberlessthan12\}$
$=\{2, 3, 5,7, 11\}$
And B $=\{x|x \in N, xisafactorof10\} = \{1, 2, 5, 10\}$
$A \cap B =\{2,5\}$

Question12

If $X =(4^n - 3n - 1 : n \in N)$ and $Y =\{9(n - 1): n \in N\}$, then $X \cap Y =$ MHT CET 2018

Options:

A. X

B. Y

C. ϕ

D. $\{0\}$

Answer: A

Solution:

$X = \{4^n - 3n - 1 : n \in N\}$
$X = \left\{(1 + 3)^n - 3n - 1 : n \in N\right\}$
$X = \left\{1 + 3n + \frac{3^2n(n-1)}{2!} + \frac{3^3n(n-1)(2n-1)}{6} ....3n - 1\right\}$
$X = \left\{3^2\,(n - 1)\,n\left(\frac{1}{2!} + \frac{3(2n-1)}{6} + ...\right)\right\}$
$X = \left\{9\,(n - 1)\,n\left(\frac{1}{2!} + ...\right)\right\}$
$Y = \{9\,(n - 1) : n \in N\}$
$\therefore X \subseteq Y$
$\therefore X \cap Y = X$
(or)
Put $n = 1, 2, 3, 4, 5, 6, ...$ in X and Y
$X = \{0, 9, 54, ...\}$
$Y = \{0, 9, 18, 27, 36, 45, 54, 63.....\}$
$X \subset Y$
$\therefore X \cap Y = X$

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Question13

The chances to fail in Physics are 20% and the chances to fail in Mathematics are 10%. What are the chances to fail in at least one subject? MHT CET 2008

Options:

A. 28%

B. 38%

C. 72%

D. 82%

Answer: A

Solution:

Let $P(A) = \frac{20}{100} = \frac{1}{5}, P(B) = \frac{10}{100} = \frac{1}{10}$ Since, event are independent and we have to

$$\text{find} \quad \begin{aligned} P(A \cup B) &= P(A) + P(B) - P(A) \cdot P(B) \\ &= \frac{1}{5} + \frac{1}{10} - \frac{1}{5} \cdot \frac{1}{10} \\ &= \frac{3}{10} - \frac{1}{50} = \frac{14}{50} = \frac{14}{50} \times 100 = 28\% \end{aligned}$$

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