



MATHS

BOOKS - SURA MATHS (TAMIL ENGLISH)

DISCRETE MATHEMATICS

Exercise 12 1

1. Determine whether * is a binary operation

on the sets given below.

(i) a * b = a. |b| on R.

(ii) *a* * *b*= min (a,b) on A={1,2,3,4,5}

(iii) $(a * b) = a\sqrt{b}$ is binary on R.



3. Let
$$*$$
 be defined on R by
 $(a * b) = a + b + ab - 7$. Is $*$ binary on R? If
so, find $3 * \left(-\frac{7}{15}\right)$.

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4. Let $A=ig\{a+\sqrt{5}b\!:\!a,b\in Zig\}$. Check

whether the usual multiplication is a binary

operation on A.



5. Fill in the following table so that the binary

operation * on A={a,b,c} is commutative.





matrices of the same type. Find (i) $A \lor B$, (ii)

 $A \wedge B$, (iii) $(A \lor A) \wedge C$, (iv) $(A \land B) \lor C$.

7. (i) Let $M = \left\{ \begin{pmatrix} x & x \\ x & x \end{pmatrix} : x \in R - \{0\} \right\}$ and let * be the matrix multiplication. Determine whether M is closed under *. If so, examinie the existence of identity, existence of inverse properties for the operation * on M.

8. Let A be $Q/\{1\}$. Define * on A by x * y=x+y-xy. Is

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* binary on A? If so, examine the commutative

and association properties satisfied by * on A.



Exercise 12 2

1. Let p: Jupiter is a planet and q: India is an island be any two simple statements. Give verbal sentence describing each of the following statements:

(i) ~*p*

(ii) $p \wedge {\scriptstyle{\sim}} q$

(iii) ~ $p \lor q$



 Write each of the following sentences in symbolic form using statement variables p and q.

(i) 19 is not a prime number and all the angles

of a triangle are equal.

(ii) 19 is a prime number or all the angles of a

triangle are not equal.

(iii) 19 is a prime number and all the angles of

a triangle are equal.

(iv) 19 is not a prime number.

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3. Determine the truth value of each of the following statements.

(i) If 6+2=5, then the milk is white.

(ii) China is an Europe or $\sqrt{3}$ is an integer.

(iii) It is not true that 5+5=9 or Earth is a planet.

(iv) 11 is a prime number and all the sides of a

rectangle are equal.



4. Which one of the following sentences is a

proposition?

(i) 4+7=12

(ii) What are you doing?

(iii) $3^n \leq 81, n \in N$

(iv) Peacock is our national bird

(v) How tall this mountain is?



5. Write the converse, inverse, and contrapositive of each of the following implication.

(i) If x and y are numbers such that x=y, then $x^2 = y^2$.

(ii) If a quadrilateral is a square then it is a rectangle.

6. Show that (i) ~ $(p \wedge q) \equiv$ ~ $p \lor$ ~q

(ii)
$${}^{\hspace*{-0.5mm}}{}(p
ightarrow q) \equiv p \wedge {}^{\hspace*{-0.5mm}}{} q.$$

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7. Prove that $q
ightarrow p \equiv \ extsf{--} p
ightarrow \ extsf{--} extsf{--} q$

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8. Show that p
ightarrow q and q
ightarrow p are not equivalent.



10. Check whether the statement p
ightarrow (q
ightarrow p) is a tautology or a contradiction

without using the truth table.



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12. Prove $p
ightarrow (q
ightarrow r) \equiv (p \wedge q)
ightarrow r$

without using truth table.

13. Prove that
$$p \rightarrow (\neg q \lor r) \equiv \neg p \lor (\neg q \lor r)$$
 using truth table.
(varphi) Watch Video Solution

1. A binary operation on a set S is a function

from

A. S ightarrow S

 $\texttt{B.}\,(S \times S) \to S$

 $\mathsf{C}.\,S o (S imes S)$

 $\mathsf{D}.\,(S\times S)\to(S\times S)$

Answer: B

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2. Subtraction is not binary operation in

A. R

C. N

D. Q

Answer: C



3. Which one of the following is a binary

operation on N?

A. Subtraction

B. Multiplication

C. Division

D. All the above

Answer: B



4. In the set R of real number * is defined as follows. Which one of the following is not a binary operation on R?

A. $a * b = \min(a, b)$

 $\mathsf{B}.\,a*b=\max(a,b)$

$$\mathsf{C}. a * b = a$$

D.
$$a * b = a^b$$

Answer: D



5. The operation * defined by $a * b = \frac{ab}{7}$ is

not a binary operation on

A.
$$Q^+$$

B.Z

C. R

D. C

Answer: C

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6. In the set Q define $a \odot b = a + b + ab$. For what value of $y, 3 \odot (y \odot 5) = 7$?

A.
$$y=rac{2}{3}$$

B.
$$y=~-~rac{2}{3}$$

C. $y=~-~rac{3}{2}$

D. y=4

Answer: B

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7. If
$$a * b = \sqrt{a^2 + b^2}$$
 on the real numbers then $*$ is

A. commutative but not associative

B. associative but not commutative

C. both commutative and associative

D. neither commutative nor associative

Answer: C

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8. Which one of the following statements has

the truth value T?

A. six x is an even function



9. Which one of the following statements has

truth value F?

- A. Chennai is in India or $\sqrt{2}$ is an integer. B. Chennai is in India or $\sqrt{2}$ is an irrational number
- C. Chennai is in China or $\sqrt{2}$ is an integer
- D. Chennai is in China or $\sqrt{2}$ is an irrational

number

Answer: C

10. If a compound statement involves 3 simple statements, then the number of rows in the truth table is

A. 9

B. 8

C. 6

D. 5

Answer: B



11. Which one is the inverse of the statement $(p \lor q)
ightarrow (p \land q)$? A. $(p \land q)
ightarrow (p \lor q)$ $\mathsf{B.}\,\mathsf{\text{-}}(p \lor q) \to (p \land q)$ $\mathsf{C}.\,(\,{\scriptstyle{\scriptstyle{\sim}}} p \lor {\scriptstyle{\scriptstyle{\sim}}} q) \to (\,{\scriptstyle{\scriptstyle{\sim}}} p \land {\scriptstyle{\scriptstyle{\sim}}} q)$ $\mathsf{D}.\,(\,{\scriptstyle{\scriptstyle{\sim}}} p \wedge {\scriptstyle{\scriptstyle{\sim}}} q) \to (\,{\scriptstyle{\scriptstyle{\sim}}} p \vee {\scriptstyle{\scriptstyle{\sim}}} q)$

Answer: D

12. Which one is the contrapositive of the statement $(p \lor q) \rightarrow r$? A. ~ $r
ightarrow (~ p \land ~q)$ B. ~ $r
ightarrow (p \lor q)$ $\mathsf{C}.\, r \to (p \wedge q)$ $\mathsf{D}.\,p
ightarrow (qee r)$

Answer: A



13. In the last column of the truth table for $\sim (p \lor \sim q)$ the number of final outcomes of the truth value 'F' are

A. 1

B. 2

C. 3

D. 4

Answer: C



14. Which one of the following is incorrect?For any two propostitions p and q, we have

A.
$$\sim (p \lor q) \equiv \sim p \land \sim q$$

B. $\sim (p \land q) \equiv \sim p \lor \sim q$
C. $\sim (p \lor q) \equiv \sim p \lor \sim q$
D. $\sim (\sim p) \equiv p$

Answer: C

15. The dual of ~ $(p \lor q) \lor [p \lor (p \land ~r)]$ is

Answer: D



16. The proposition
$$p \land (\ensuremath{\,^{\sim}} p \lor q)$$
 is

A. a tautology

B. a contradiction

C. logically equivalent to $p \wedge q$

D. logically equivalent to $p \lor q$

Answer: C

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17. Determine the truth value of each of the

following statements:

(a) 4+2=5 and 6+3=9

(b) 3+2=5 and 6+1=7

(c) 4+5 =9 and 1+2=4

(d) 3+2=5 and 4+7=11

A. (a)-F, (b)-T, (c)-F, (d)-T

B. (a)-T, (b)-F, (c)-T, (d)-F

C. (a)-T, (b)-T, (c)-F, (d)-F

Answer: A

18. Which one of the following is not true?

A. Negation of a negation of a statement is the statement itself. B. If the last column of the truth table contains only T then it is a tautology. C. If the last column of its truth table contains only F then it is a contradiction D. If p and q are any two statements then $p < \Rightarrow q$ is a tautology.





Government Exam Questions

1. Let * be a binary operation on set Q of rational numbers defined as $a * b = \frac{ab}{8}$.

Write the identity for *, If any.

2. A fair coin is tossed a fixed number of times. If the probability of getting seven heads is equal to that of getting nine heads, find the probability of getting exactly two heads.



Additional Questions

1. The binary operation * defined on a set s is

said to be commutative if

A.
$$a st b \in S \, orall a, b \in S$$

$$\texttt{B.}~a*b=b*a~\forall a,b\in S$$

$$\mathsf{C}.\,(a\ast b)\ast c=a\ast (b\ast c)\,\forall a,b\in S$$

D.
$$a * b = e \, orall a, b \in S$$

Answer: B

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2. If * is defined by $a*b=a^2+b^2+ab+1$,

then (2 * 3) * 2 is
A. 20

B.40

C. 400

D. 445

Answer: D

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3. The number of binary operations that can

be defined on a set of 3 elements is

A. 3^2

 $\mathsf{B.}\,3^3$

C. 3^{9}

 $D.3^1$

Answer: C

Watch Video Solution 4. The identify element of $\left\{ \begin{pmatrix} x & x \\ x & x \end{pmatrix} \right\} x \in R, x \neq 0$ under matrix

multiplication is



Answer: C



5. Which one of the following is not a statement?

A. 2+3=5

B. How beautiful is this flower?

C. Delhi is the capital of Tamil Nadu

D. A triangle has found angles

Answer: B

6. Which of the following is a tautology?

A. $p \lor q$

- $\mathsf{B.}\,p\wedge q$
- $\mathsf{C}.\,q \lor \, {\scriptstyle{\sim}} q$
- D. $q \wedge {\scriptstyle{\sim}} q$

Answer: C



7. Which of the following is a contradiction?

A. $p \lor q$

- $\mathsf{B.}\,p\wedge q$
- $\mathsf{C}.\,q \lor \, {\scriptstyle{\sim}} q$
- D. $q \wedge {\mathsf{~}} q$

Answer: D

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8. The identify element in the group $\{R-\{1\},x\}$ where a*b=a+b-ab is

A. 0

B.1

C.
$$\frac{1}{a-1}$$

D. $\frac{a}{a-1}$

Answer: A

Watch Video Solution Define * 9. by

 $a * b = a + b + 1 \, orall a, b \in Z$. Then the

on Z

identity element of z is

A. 1

B. 0

C. 2

 $\mathsf{D}.-1$

Answer: D

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10. A binary operation * is defined on the set

of positive rational number Q^+ by

$$a * b = rac{ab}{4}$$
. Then $3 * \left(rac{1}{5} * rac{1}{2}
ight)$ is

A.
$$\frac{3}{160}$$

B. $\frac{5}{160}$
C. $\frac{3}{10}$
D. $\frac{3}{40}$

Answer: A



Fill In The Blanks

1. If $a st b = a^2 b^2 - ab$ then 3 st (1 st 1) _____

A. 0

B. 1

C. 2

D. 4

Answer: A



2. The number whose multiplication inverse does not exist in C.

A. 0

B. 1

C. 0

D. 1

Answer: B

3. Let p: Kamala is going to school

q: There are 20 students in the class. Then

Kamala is not going to school or there are 20

students in the class is represented by

A. $p \lor q$

 $\mathsf{B.}\,p\wedge q$

C. ~p

D. ~ $p \lor q$

Answer: D



4. If p is true and q is unknown, then _____

A. $\sim p$ is true

- B. $p \lor (\ensuremath{\,^{\sim}} q)$ is false
- C. $p \land (\ensuremath{\,^{\sim}} p)$ is true
- D. $p \lor q$ is true

Answer: D

5. + is not a binary operation on

A. ~

B.z

C. Chennai is in China or $\sqrt{2}$ is an integer

D. Q-{0}

Answer: D

6. - is a binary operation on

A. ∼

B. Q-{0}

C. R-{0}

D. Z

Answer: D

7. Which of the following is a statement?

A. 7+2 < 10

B. Wish you all success

C. All the best

D. How old are you?

Answer: A

8. In $(N, \ st$), x st y= max(x,y), $x, y \in N$, then 7 st (-7)

A. 7

 $\mathsf{B.}-7$

C. 0

D.-49

Answer: A

9. In $(S, \ st$), is defined by x st y = x where x, $y \in S$, then

A. associative

B. Commutative

C. associative and commutative

D. neither associative nor commutative

Answer: A

10. The number of commutative binary operations which can be defined on a set containing n elements is

A.
$$nrac{n(n+1)}{2}$$

 $\mathsf{B.}\,n^{n^2}$

$$\mathsf{C}.\,n^{rac{n}{2}}$$

D. n^2

Answer: D



1. Which of the following are not statements?

(i) 3+4=8

(ii) Then sun is a planet

(iii) Switch on the light

(iv) Where are you going?

A. (i), (ii)

B. (ii), (iii)

C. (iii), (iv)

D. (iv) only

Answer: C



2. If p is true and q is false, then which of the following is not true?

A. p
ightarrow q is F

B. $p \lor q$ is T

C. $p \wedge q$ is F

 $\mathsf{D}.\, p < \ \Rightarrow q \text{ is } \mathsf{T}$

Answer: D



3. $p \lor q$ is false when

A. p is T, q is F

B. p is F, q is T

C. p is T, q is T

D. p is F, q is F

Answer: D



4. Which of the following is not a binary operation on R?

A.
$$a * b = ab$$

$$\mathsf{B.}\,a*b=a-b$$

$$\mathsf{C}.\,a*b=\sqrt{ab}$$

D.
$$a*b=\sqrt{a^2+b^2}$$

Answer: C





5. Which of the following is a contradiction?

- A. $p \lor q$
- $\mathsf{B.}\,p\wedge q$
- $\mathsf{C}.\, p \lor \, {\scriptstyle{\sim}} q$
- D. $p \wedge {\ensuremath{\sc -}} p$

Answer: D



Match The Following

	List - I		List - II
i.	$p \lor p \equiv p, p \land p \equiv p$	a)	Identity law
ii.	$p \lor (q \lor r) = (p \lor p) \lor r$	b)	Idempotent law
iii,	$p \lor (q \lor r) = (p \land p) \lor (p \land r)$	c)	Associative law
iv.	$p \vee \Pi = \Pi$	d)	Distributive law

The correct match is

A. (i)-b, (ii)-c, (iii)-d, (iv)-a

B. (i)-c, (ii)-d, (iii)-b, (iv)-a

C. (i)-c, (ii)-d, (iii)-a, (iv)-b

D. (i)-b, (ii)-c, (iii)-d, (iv)-a

Answer: D





The correct match is

A. (i)-a, (ii)-b, (iii)-c, (iv)-d

B. (i)-b, (ii)-c, (iii)-d, (iv)-a

C. (i)-c, (ii)-b, (iii)-d, (iv)-a

D. (i)-d, (ii)-c, (iii) -a, (iv)-b

Answer: D

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3. Let p:2 is the only even prime q: sin x is an even function be simple statements.

List - I		List - II		
i.	$p \lor p$	a)	2 is not the only even prime	
ii.	~p	b)	~q	
iii.	$\sin x$ is an odd function	c)	2 is the only even prime or $\sin x$ is an even function	
iv.	$p \leftrightarrow q$	d)	2 is the only even prime if and only if sin x is an even function.	

The Correct match is

A. (i)-c, (ii)-a, (iii)-d, (iv)-b

B. (i)-b, (ii)-a, (iii)-b, (iv)-d

C. (i)-b, (ii)-d, (iii)-c, (iv)-a

D. (i)-c, (ii)-a, (iii)-b, (iv)-d

Answer: B



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4. Let
$$G\left\{ egin{pmatrix} a & 0 \\ 0 & 0 \end{pmatrix}
ight\} / a \in R - \{0\}
ight\}$$
 and $*$

is the matrix multiplication.

1.4	List - I		List - II
i.	$ \begin{pmatrix} ab & 0 \\ 0 & 0 \end{pmatrix} \in \mathbf{G} \ \forall \ a, \\ b \in \mathbb{R} - \{0\} $	a)	Inverse element
ii.	$\begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix} \in G$	b)	(G, *) is closed
iii.	$\begin{pmatrix} abc & 0 \\ 0 & 0 \end{pmatrix} \in \mathbf{G}$	c)	Identity element
iv.	$\begin{pmatrix} 1 & 0 \\ a & 0 \\ 0 & 0 \end{pmatrix} \in \mathbf{G} \ \forall \ a \in \mathbf{G}$	d)	(G, *) is associative

The Correct match is

A. (i)-b, (ii)-c, (iii)-d, (iv)-a

B. (i)-a, (ii)-b, (iii)-c, (iv)-d

C. (i)-b, (ii)-c, (iii)-d, (iv)-a

D. (i)-d, (ii)-c, (iii)-b, (iv)-a

Answer: A

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2 Marks

1. Let * be a binary operation on set Q of rational numbers defined as $a * b = \frac{ab}{8}$. Write the identity for *, If any.



2. Show that $p \lor (\ensuremath{{\scriptstyle\sim}} p)$ is a tautology.



3. Show that $p ee (q \wedge r)$ is a contingency.



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4. In the set of integers under the operation * defined by a * b = a + b - 1. Find the identify element.

5. Let S be the set of positive rational numbers and is defined by $a * b = \frac{ab}{2}$. Then find the identity element and the inverse of 2.



6. Let $G=\{1, w, w^2\}$ where w is a complex cube root of unity. Then find the inverse of w^2 . Under usual multiplication.

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 Write the truth value for each of the following statements. (1) 3+5=8 and $\sqrt{2}$ is an irrational number.

(2) 5 is a positive integer or a square is a rectangle.

(3) Chennai is not a Tamilnadu.

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2. In (z, *) where * is defined by $a * b = a^b$,

prove that * is not a binary operation on z.

3. Let G={1,i,-1,-i} under the binary operation multiplication. Find the inverse of all the elements.



4. In (z, *) where * is defined as

a * b = a + b + 2. Verify the commutative and

associative axiom.



5. Construct the truth table for $(extsf{-}p) ee (q \wedge r)$


2. In (N, *) where * is defined by $x * y = \max(x,y)$ check the closure axion and identify anion.

