

10

Arivaali
MATHEMATICS
Guide

X STANDARD

✻ June-2025 ; April-2026 Questions: Page-197

✻ All Public Exam. Answers: Page-(iv)



KOUSELRAMU PADHIPPAKHAM PVT. LTD.

728, 7th BLOCK, MOGAPPAIR WEST, CHENNAI - 600 037.

Phone : 044-26535245 ; Mobile : 9176629095

email : kouselramu97@gmail .com

Price : ₹ 140

Published by

P. AMUTHA

KOUSEL RAMU PADHIPPAKHAM PVT. LTD.

728, 7th Block, Mogappair West, Chennai - 600 037.

Contact : 044-26535245 ; 9176629095.

© Reserved with the Publishers

Sixth Edition (Reprint): April 2026

PREFACE

The every learning teacher friends and the ever cheerful students ! Welcome you all !

By considering the Govt. Board Examinations, the selected questions of Examples and Exercises from the Text Book and the important created questions which are not available in the Text Book are answered and given in such a way that Easy to Difficult, the Most important to the less important and the Concept based arrangements. Only a few questions which can be easily solved with the help of its previous questions itself are left for students' practice. So, this book will satisfy all the categories of the students such as the Slow learners and the Toppers.

The one mark questions that were asked in the Board Examinations are shown by the round markings of its question numbers such as ①, ②, ... and the other questions (2, 5, 8 marks) that were asked in the Board Examinations are shown by the markings such as **SEP 2020**, **SEP 2021**, **MAY 2022**, **AUG 2022**, **APR 2023**, **JUN 2023**, **APR 2024**, **JUN 2024**, **APR 2025**, **JUN 2025** and **APR 2026**.

This book has been designed in such a way that it can be used by both the student community and the teaching faculty with their coordination. If you find any difficulty in using this book, kindly let us know about it and give the chance to rectify the same in the future editions.

With Best Wishes

Arivaali Team

CONTENTS

UNIT	TOPIC	PAGE
1	Relations and Functions	1
2	Numbers and Sequences	18
3	Algebra	38
	Matrices	55
	Graphs	65
4	Geometry	95
	Practical Geometry	112
5	Coordinate Geometry	134
6	Trigonometry	152
7	Mensuration	167
8	Statistics	178
	Probability	188
	Govt. Board Examination Question Papers	197

(iv)

10th Mathematics All Public Examinations - Arivaali Guide Analysis

Exam		Page Number / Question Number in Arivaali Guide										
Qn.No.		Sep-20	Sep-21	May-22	Aug-22	Apr-23	Jun-23	Apr-24	Jul-24	Apr-25	Jul-25	Apr-26
1 Marks	1	2/3	2/1	2/6	2/4	2/2	2/4	2/1	3/10	2/5	2/2	3/8
	2	3/16	19/4	19/3	2/5	3/17	19/6	3/11	3/8	Created	3/14	3/15
	3	19/2	19/7	20/16	19/4	19/7	Created	19/5	19/6	19/1	20/15	19/3
	4	20/12	41/7	41/3	41/1	20/14	41/5	19/10	41/6	19/9	20/17	20/15
	5	43/21	42/12	42/8	41/2	41/4	42/12	42/8	42/17	41/3	41/2	41/2
	6	42/17	43/22	42/13	41/5	43/23	98/6	42/12	98/9	42/17	42/15	42/14
	7	97/2	98/6	97/3	98/6	97/1	98/12	98/6	98/11	98/11	98/8	98/9
	8	98/15	98/12	98/7	98/12	98/11	135/3	98/12	135/3	Created	135/1	135/5
	9	135/3	135/1	135/4	135/5	136/17	136/8	135/1	136/10	136/7	136/13	135/3
	10	155/16	136/16	136/7	136/8	154/6	153/2	154/7	153/2	154/10	153/1	155/16
	11	169/16	154/10	154/12	154/15	168/3	169/8	Created	154/10	168/1	168/1	169/9
	12	169/12	168/3	168/2	168/4	169/15	168/1	169/5	168/3	169/13	169/15	169/12
	13	180/4	169/8	169/17	169/8	181/16	180/2	Created	180/9	180/9	181/11	181/17
	14	181/14	181/11	181/12	181/11	181/14	181/10	181/12	180/2	181/15	181/18	181/10
2 Marks	15	4/8	4/7	4/5	4/8	5/9	5/10	4/8	5/9	4/5	4/2	5/10
	16	6/18	5/11	5/12	10/1	9/34	8/26	9/30	7/20	8/25	5/12	5/13
	17	20/4	23/17	20/2	21/5	26/33	21/5	20/1	25/29	-	20/1	-
	18	22/11	23/22	23/18	22/13	46/16	25/29	-	-	45/12	25/30	27/39
	19	29/51	46/22	-	46/18	47/32	47/31	-	47/31	59/20	-	-
	20	48/35	47/31	103/17	101/9	103/18	56/9	105/25	Created	103/17	173/18	55/25
	21	56/8	100/6	138/9	144/5	140/25	102/15	-	138/14	-	104/19	56/4
	22	103/16	137/6	138/14	138/14	141/35	137/4	139/20	-	141/34	137/5	100/5
	23	137/5	141/30	139/20	137/4	157/11	156/6	155/2	158/14	160/23	139/19	137/5
	24	155/3	139/17	160/23	160/22	-	170/3	172/16	170/1	172/15	157/9	140/28
	25	171/12	160/22	172/13	171/8	172/15	171/9	170/2	-	173/18	170/3	155/2
	26	172/16	170/2	-	170/4	182/3	182/8	182/2	182/8	182/5	182/6	182/8
	27	182/3	189/6	189/4	193/4	-	189/6	190/8	189/5	-	189/4	189/6
	28	171/7	171/11	Created	47/29	20/3	142/38	Created	23/18	Created	Created	Created
5 Marks	29	10/3	11/8	10/4	13/14	13/12	11/6	12/9	10/3	10/3	12/11	11/8
	30	12/11	32/7	-	-	33/10	35/16	Created	14/18	13/12	16/22	16/22
	31	30/2	-	31/6	23/21	35/17	36/23	37/26	35/16	-	-	30/1
	32	54/23	54/22	51/9	53/17	-	54/21	51/6	51/8	36/22	36/23	35/16
	33	53/18	51/6	-	51/5	59/2	50/1	59/1	36/23	60/3	51/9	59/2
	34	Created	107/3	54/20	47/28	112/15	59/1	106/1	59/2	106/2	59/1	110/11
	35	60/3	110/10	106/1	106/2	106/2	107/3	144/7	107/3	145/10	107/3	145/9
	36	106/2	149/21	109/9	105/25	145/9	144/7	148/20	145/8	151/26	144/7	-
	37	145/10	-	146/14	145/9	Created	148/20	162/4	150/23	159/17	165/11	162/4
	38	166/12	162/4	163/6	164/7	163/5	156/4	173/19	166/13	176/8	176/9	-
	39	-	173/19	-	170/1	170/4	173/1	174/2	173/1	173/1	174/4	-
	40	185/6	176/9	176/8	171/10	-	187/15	187/15	-	187/17	185/8	187/15
	41	193/3	192/2	-	193/3	193/3	194/5	194/5	192/2	193/4	192/2	194/6
	42	149/22	Created	Created	140/26	11/7	162/4	Created	-	Created	Created	Created
8 Marks	43 (a)	115/6	116/7	121/12	114/5	133/24	113/2	116/7	132/23	122/13	114/4	113/2
	43 (b)	132/23	131/22	129/20	131/22	122/13	132/23	131/22	117/8	133/24	129/20	131/22
	44 (a)	83/19	76/12	92/28	77/13	65/1	66/2	87/23	74/10	77/13	76/12	82/18
	44 (b)	87/23	79/15	81/17	92/28	86/22	88/24	70/6	78/14	68/4	73/9	66/2
Marks		100/100	95/100	93/100	100/100	100/100	99/100	91/100	95/100	91/100	91/100	92/100

RELATIONS AND FUNCTIONS



1

POINTS TO REMEMBER

1. Representation of functions:

$$X = \{1, 2, 3, 4\}; Y = \{2, 4, 6, 8, 10\}$$

$$f: X \rightarrow Y \Rightarrow f(x) = 2x$$

$$\Rightarrow f(1) = 2(1) = 2$$

$$f(2) = 2(2) = 4$$

$$f(3) = 2(3) = 6$$

$$f(4) = 2(4) = 8$$

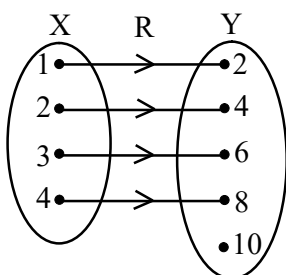
- ◆ Set of ordered pairs

$$f = \{(1, 2), (2, 4), (3, 6), (4, 8)\}$$

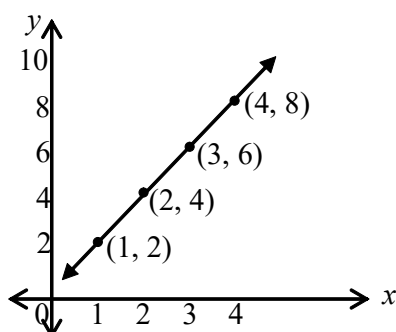
- ◆ Table

x	1	2	3	4
$f(x)$	2	4	6	8

- ◆ Arrow diagram



- ◆ Graph

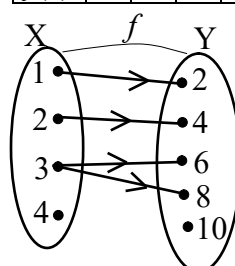


2. Situations of 'not a function':

- ◆ An element in Domain has more than one image in Co-domain.
- ◆ An element in Domain has no images in Co-domain.

$$f = \{(1, 2), (2, 4), (3, 6), (3, 8)\}$$

x	1	2	3	3
$f(x)$	2	4	6	8

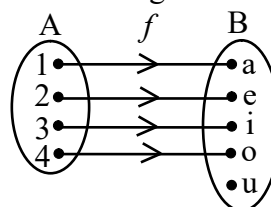


$3 \in X$ has two images $6, 8 \in Y$

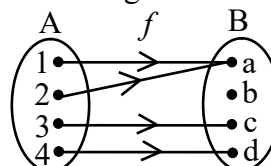
$4 \in X$ has no images in Y

3. Types of Functions:

- ◆ One-One function (Injection):
Distinct elements of domain have distinct images in co-domain.

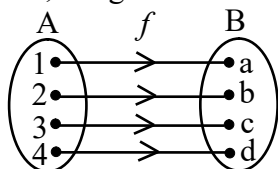


- ◆ Many-one function:
More than one element of domain have same image in codomain.



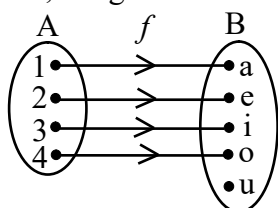
◆ **Onto function (Surjection):**

Every element of co-domain has a pre-image in domain
i.e., $\text{Range} = \text{co-domain}$.



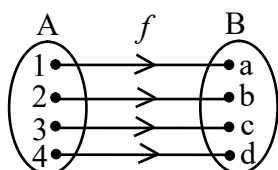
◆ **Into function:**

Atleast one element of co-domain has no pre-image in domain
i.e., $\text{Range} \subset \text{co-domain}$



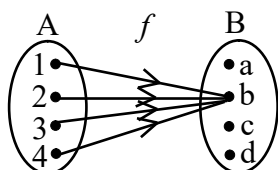
◆ **One-One and Onto (Bijection):**

A function which is both one-one and onto.



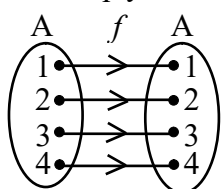
◆ **Constant function:**

Number of elements in the Range is 1.



◆ **Identity function:**

$f(x) = x$ and it is defined within a non-empty set.



1 MARK QUESTIONS

Book Back (Exercise: 1.6) Questions

1. If $n(A \times B) = 6$ and $A = \{1, 3\}$ then $n(B)$ is
(a) 1 (b) 2
(c) 3 (d) 6
2. $A = \{a, b, p\}$, $B = \{2, 3\}$, $C = \{p, q, r, s\}$
then $n[(A \cup C) \times B]$ is
(a) 8 (b) 20
(c) 12 (d) 16
3. If $A = \{1, 2\}$, $B = \{1, 2, 3, 4\}$, $C = \{5, 6\}$
and $D = \{5, 6, 7, 8\}$ then state which of the
following statements is true.
(a) $(A \times C) \subset (B \times D)$ (b) $(B \times D) \subset (A \times C)$
(c) $(A \times B) \subset (A \times D)$ (d) $(D \times A) \subset (B \times A)$
4. If there are 1024 relations from a set
 $A = \{1, 2, 3, 4, 5\}$ to a set B , then the
number of elements in B is
(a) 3 (b) 2
(c) 4 (d) 8
5. The range of the relation $R = \{(x, x^2) | x \text{ is a prime number less than } 13\}$ is
(a) $\{2, 3, 5, 7\}$
(b) $\{2, 3, 5, 7, 11\}$
(c) $\{4, 9, 25, 49, 121\}$
(d) $\{1, 4, 9, 25, 49, 121\}$
6. If the ordered pairs $(a+2, 4)$ and $(5, 2a+b)$
are equal then (a, b) is
(a) $(2, -2)$ (b) $(5, 1)$
(c) $(2, 3)$ (d) $(3, -2)$
7. Let $n(A) = m$ and $n(B) = n$ then the total
number of non-empty relations that can be
defined from A to B is
(a) m^n (b) n^m
(c) $2^{mn} - 1$ (d) 2^{mn}

8. If $\{(a, 8), (6, b)\}$ represents an identity function, then the value of a and b are respectively
 (a) $(8, 6)$ (b) $(8, 8)$
 (c) $(6, 8)$ (d) $(6, 6)$
9. Let $A = \{1, 2, 3, 4\}$ and $B = \{4, 8, 9, 10\}$. A function $f : A \rightarrow B$ given by $f = \{(1, 4), (2, 8), (3, 9), (4, 10)\}$ is a
 (a) Many-one function
 (b) Identity function
 (c) One-to-one function
 (d) Into function
10. If $f(x) = 2x^2$ and $g(x) = \frac{1}{3x}$, then $f \circ g$ is
 (a) $\frac{3}{2x^2}$ (b) $\frac{2}{3x^2}$
 (c) $\frac{2}{9x^2}$ (d) $\frac{1}{6x^2}$
11. If $f : A \rightarrow B$ is a bijective function and if $n(B) = 7$, then $n(A)$ is equal to
 (a) 7 (b) 49
 (c) 1 (d) 14
12. Let f and g be two functions given by
 $f = \{(0, 1), (2, 0), (3, -4), (4, 2), (5, 7)\}$
 $g = \{(0, 2), (1, 0), (2, 4), (-4, 2), (7, 0)\}$
 then the range of $f \circ g$ is
 (a) $\{0, 2, 3, 4, 5\}$ (b) $\{-4, 1, 0, 2, 7\}$
 (c) $\{1, 2, 3, 4, 5\}$ (d) $\{0, 1, 2\}$
13. Let $f(x) = \sqrt{1+x^2}$ then
 (a) $f(xy) = f(x) \cdot f(y)$
 (b) $f(xy) \geq f(x) \cdot f(y)$
 (c) $f(xy) \leq f(x) \cdot f(y)$
 (d) None of these
14. If $g = \{(1, 1), (2, 3), (3, 5), (4, 7)\}$ is a function given by $g(x) = \alpha x + \beta$ then the values of α and β are
 (a) $(-1, 2)$ (b) $(2, -1)$
 (c) $(-1, -2)$ (d) $(1, 2)$
15. $f(x) = (x+1)^3 - (x-1)^3$ represents a function which is
 (a) linear (b) cubic
 (c) reciprocal (d) quadratic

Additional Questions:

16. Let $f(x) = x^2 - x$, then $f(x-1) - f(x+1)$ is
 (a) $4x$ (b) $2 - 2x$
 (c) $2 - 4x$ (d) $4x - 2$
17. If $n(A) = p$, $n(B) = q$, then the total number of relations that exist from A to B is
 (a) 0 (b) 1
 (c) $2^{pq} - 1$ (d) 2^{pq}

Answer Key:

- | | | | | |
|-------|-------|-------|-------|-------|
| 1. c | 2. c | 3. a | 4. b | 5. c |
| 6. d | 7. c | 8. a | 9. c | 10. c |
| 11. a | 12. d | 13. c | 14. b | 15. d |
| 16. c | 17. d | | | |

2 MARK QUESTIONS**1. Example: 1.1 (i)**

If $A = \{1, 3, 5\}$ and $B = \{2, 3\}$ then find $A \times B$ and $B \times A$.

Solution:

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

$$A \times B = \{(1, 2), (1, 3), (3, 2), (3, 3), (5, 2), (5, 3)\}$$

$$B \times A = \{(2, 1), (2, 3), (2, 5), (3, 1), (3, 3), (3, 5)\}$$

2. Exercise: 1.1 / 1 (i)

Find $A \times B$, $A \times A$ and $B \times A$, if $A = \{2, -2, 3\}$ and $B = \{1, -4\}$ **JUN 2025**

Solution:

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

$$A \times B = \{(2, 1), (2, -4), (-2, 1), (-2, -4), (3, 1), (3, -4)\}$$

$$A \times A = \{(2, 2), (2, -2), (2, 3), (-2, 2), (-2, -2), (-2, 3), (3, 2), (3, -2), (3, 3)\}$$

$$B \times A = \{(1, 2), (1, -2), (1, 3), (-4, 2), (-4, -2), (-4, 3)\}$$

3. Exercise: 1.1 / 1 (ii)

Find $A \times B$, $A \times A$ and $B \times A$, if $A = B = \{p, q\}$

Solution:

$$A = \{p, q\}; B = \{p, q\}$$

$$A \times B = \{(p, p), (p, q), (q, p), (q, q)\}$$

$$A \times A = \{(p, p), (p, q), (q, p), (q, q)\}$$

$$B \times A = \{(p, p), (p, q), (q, p), (q, q)\}$$

4. Exercise: 1.1 / 1 (iii)

Find $A \times B$, $A \times A$ and $B \times A$, if $A = \{m, n\}$; $B = \phi$.

Solution:

$$A = \{m, n\}; B = \{\}$$

$$A \times B = \{\}$$

$$A \times A = \{(m, m), (m, n), (n, m), (n, n)\}$$

$$B \times A = \{\}$$

5. Exercise: 1.1 / 2

Let $A = \{1, 2, 3\}$ and $B = \{x | x \text{ is a prime number less than } 10\}$. Find $A \times B$ and $B \times A$. **MAY 2022**

Solution:

APR 2025

$$A = \{1, 2, 3\}$$

$$B = \{2, 3, 5, 7\} \quad [\because \text{prime no.} < 10]$$

$$A \times B = \{(1, 2), (1, 3), (1, 5), (1, 7), (2, 2), (2, 3), (2, 5), (2, 7), (3, 2), (3, 3), (3, 5), (3, 7)\}$$

$$B \times A = \{(2, 1), (2, 2), (2, 3), (3, 1), (3, 2), (3, 3), (5, 1), (5, 2), (5, 3), (7, 1), (7, 2), (7, 3)\}$$

6. Example: 1.1 (ii)

Let $A = \{1, 3, 5\}$ and $B = \{2, 3\}$. Is $A \times B = B \times A$?

If not why?

Solution:

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

$$A \times B = \{(1, 2), (1, 3), (3, 2), (3, 3), (5, 2), (5, 3)\}$$

$$B \times A = \{(2, 1), (2, 3), (2, 5), (3, 1), (3, 3), (3, 5)\}$$

$$A \times B \neq B \times A$$

Reason: $(1, 2) \neq (2, 1)$, $(1, 3) \neq (3, 1)$, ...

7. Example: 1.1 (iii)

If $A = \{1, 3, 5\}$ and $B = \{2, 3\}$ then show that

$$n(A \times B) = n(B \times A) = n(A) \times n(B). \quad \text{SEP 2021}$$

Solution:

$$A = \{1, 3, 5\} \quad ; n(A) = 3$$

$$B = \{2, 3\} \quad ; n(B) = 2$$

$$\Rightarrow n(A) \times n(B) = 3 \times 2 = 6$$

$$A \times B = \{(1, 2), (1, 3), (3, 2), (3, 3), (5, 2), (5, 3)\}$$

$$\Rightarrow n(A \times B) = 6$$

$$B \times A = \{(2, 1), (2, 3), (2, 5), (3, 1), (3, 3), (3, 5)\}$$

$$\Rightarrow n(B \times A) = 6$$

$$\therefore n(A \times B) = n(B \times A) = n(A) \times n(B)$$

8. Example: 1.2

If $A \times B = \{(3, 2), (3, 4), (5, 2), (5, 4)\}$ then find A and B . **SEP 2020 | AUG 2022 | APR 2024**

Solution:

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

$$A = \{3, 5\} \quad [\because \text{First elements} \in A]$$

$$B = \{2, 4\} \quad [\because \text{Second elements} \in B]$$

9. Exercise: 1.1 / 3

If $B \times A = \{(-2, 3), (-2, 4), (0, 3), (0, 4), (3, 3), (3, 4)\}$ find A and B. **APR 2023 | JUN 2024**

Solution:

$$A = \{3, 4\} \quad [\because \text{Second elements} \in A]$$

$$B = \{-2, 0, 3\} \quad [\because \text{First elements} \in B]$$

10. Exercise: 1.2 / 3

A Relation R is given by the set $\{(x, y) | y = x + 3, x \in \{0, 1, 2, 3, 4, 5\}\}$. Determine its domain and range. **JUN 2023 | APR 2026**

Solution:

$$R = \{(x, y) | y = x + 3, x \in \{0, 1, 2, 3, 4, 5\}\}$$

$$\text{Domain} = \{0, 1, 2, 3, 4, 5\}$$

$$\text{Range} = \{3, 4, 5, 6, 7, 8\}$$

Rough

$$\begin{aligned} 0+3 &= 3 \\ 1+3 &= 4 \\ 2+3 &= 5 \\ 3+3 &= 6 \\ 4+3 &= 7 \\ 5+3 &= 8 \end{aligned}$$

11. Exercise: 1.2 / 2

Let $A = \{1, 2, 3, 4, \dots, 45\}$ and R be the relation defined as “is square of a number” on A. Write R as a subset of $A \times A$. Also find domain and range of R. **SEP 2021**

Solution:

$$R \Rightarrow \text{Square of a number}$$

$$R = \{(1, 1), (2, 4), (3, 9), (4, 16), (5, 25), (6, 36)\}$$

$$\text{Domain} = \{1, 2, 3, 4, 5, 6\}$$

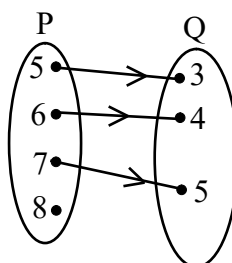
$$\text{Range} = \{1, 4, 9, 16, 25, 36\}$$

Rough

$$\begin{aligned} 1^2 &= 1 \\ 2^2 &= 4 \\ 3^2 &= 9 \\ 4^2 &= 16 \\ 5^2 &= 25 \\ 6^2 &= 36 \end{aligned}$$

12. Example: 1.5

The arrow diagram shows a relationship between the sets P and Q. Write the relation in (i) set builder form (ii) Roster form. **MAY 2022 | JUN 2025**

**Solution:**

$$(i) \{(x, y) / y = x - 2, x \in P, y \in Q\}$$

$$(ii) \{(5, 3), (6, 4), (7, 5)\}$$

13. Example: 1.8

If $X = \{-5, 1, 3, 4\}$ and $Y = \{a, b, c\}$, then which of the following relations are functions from X to Y?

$$(i) R_1 = \{(-5, a), (1, a), (3, b)\} \quad \text{APR 2026}$$

$$(ii) R_2 = \{(-5, b), (1, b), (3, a), (4, c)\}$$

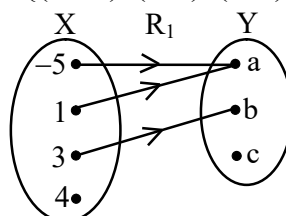
$$(iii) R_3 = \{(-5, a), (1, a), (3, b), (4, c), (1, b)\}$$

Solution:

$$X = \{-5, 1, 3, 4\}$$

$$Y = \{a, b, c\}$$

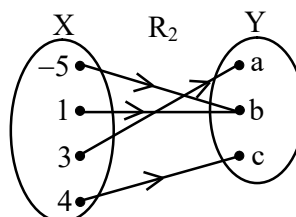
$$(i) R_1 = \{(-5, a), (1, a), (3, b)\}$$



R_1 is not a function.

$[\because 4 \in X \text{ has no image in } Y]$

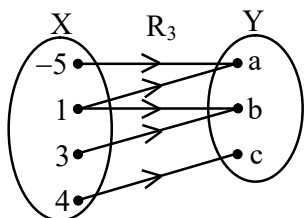
$$(ii) R_2 = \{(-5, b), (1, b), (3, a), (4, c)\}$$



R_2 is a function.

$[\because \text{Each } x \in X \text{ has a unique image in } Y]$

(iii) $R_3 = \{(-5, a), (1, a), (3, b), (4, c), (1, b)\}$



R_1 is not a function.

$[\because 1 \in X \text{ has two images in } Y]$

14. Example: 1.7

A relation $f: X \rightarrow Y$ is defined by $f(x) = x^2 - 2$ where, $X = \{-2, -1, 0, 3\}$ and $Y = \mathbb{R}$ (i) List the elements of f (ii) Is ' f ' a function?

Solution:

$$f(x) = x^2 - 2, X = \{-2, -1, 0, 3\}$$

$$f(-2) = (-2)^2 - 2 = 2$$

$$f(-1) = (-1)^2 - 2 = -1$$

$$f(0) = (0)^2 - 2 = -2$$

$$f(3) = (3)^2 - 2 = 7$$

(i) $f = \{(-2, 2), (-1, -1), (0, -2), (3, 7)\}$

(ii) f is a function.

$[\because \text{Each } x \in X, \text{ has a unique image}]$

15. Example: 1.15 (i)

Let f be a function $f: \mathbb{N} \rightarrow \mathbb{N}$ be defined by $f(x) = 3x + 2, x \in \mathbb{N}$. Find the images of 1, 2, 3.

Solution:

$$f(x) = 3x + 2$$

$$f(1) = 3(1) + 2 = 3 + 2 = 5$$

$$f(2) = 3(2) + 2 = 6 + 2 = 8$$

$$f(3) = 3(3) + 2 = 9 + 2 = 11$$

16. Example: 1.15 (ii)

Let f be a function $f: \mathbb{N} \rightarrow \mathbb{N}$ be defined by $f(x) = 3x + 2, x \in \mathbb{N}$. Find the pre-images of 29, 53.

Solution:

$$f(x) = 3x + 2$$

$$f(x) = 29 \Rightarrow 3x + 2 = 29$$

$$\Rightarrow 3x = 29 - 2 = 27$$

$$\Rightarrow x = \frac{27}{3} = 9$$

$$f(x) = 53 \Rightarrow 3x + 2 = 53$$

$$\Rightarrow 3x = 53 - 2 = 51$$

$$\Rightarrow x = \frac{51}{3} = 17$$

17. Exercise: 1.4 / 6

Let $A = \{1, 2, 3, 4\}$ and $B = \mathbb{N}$. Let $f: A \rightarrow B$ be defined by $f(x) = x^3$ then, (i) find the range of f (ii) identify the type of function.

Solution:

$$f(x) = x^3$$

$$A = \{1, 2, 3, 4\}$$

$$B = \{1, 2, 3, \dots\}$$

$$f(1) = 1^3 = 1$$

$$f(2) = 2^3 = 8$$

$$f(3) = 3^3 = 27$$

$$f(4) = 4^3 = 64$$

(i) Range = $\{1, 8, 27, 64\}$

(ii) f is one-one and into.

$[\because \text{Distinct elements} \Rightarrow \text{distinct images};$
Range $\subset$ co-domain]

18. Exercise: 1.4 / 5

Show that the function $f: \mathbb{N} \rightarrow \mathbb{N}$ defined by $f(m) = m^2 + m + 3$ is one-one function. **SEP 2020**

Solution:

$$f(1) = 1^2 + 1 + 3 = 5$$

$$f(2) = 2^2 + 2 + 3 = 9$$

$$f(3) = 3^2 + 3 + 3 = 15$$

∴
∴

f is one-one function.

[$\because$ Distinct elements $\Rightarrow$ distinct images]

19. Example: 1.15 (iii) for Practice

Let f be a function $f: \mathbb{N} \rightarrow \mathbb{N}$ be defined by $f(x) = 3x + 2$, $x \in \mathbb{N}$. (i) Find the range of f .
(ii) Identify the type of function.

Answer:

(i) Range = $\{5, 8, 11, \dots\}$

(ii) f is one-one and into function.

20. Example: 1.9

Given $f(x) = 2x - x^2$, find (i) $f(1)$ (ii) $f(x+1)$
(iii) $f(x) + f(1)$. **JUN2024**

Solution:

$$f(x) = 2x - x^2$$

$$(i) \quad f(1) = 2(1) - (1)^2 = 2 - 1 = 1$$

$$(ii) \quad f(x+1) = 2(x+1) - (x+1)^2 \\ = 2x + 2 - x^2 - 2x - 1 \\ = -x^2 + 1$$

$$(iii) \quad f(x) + f(1) = 2x - x^2 + 1 \\ = -x^2 + 2x + 1$$

21. Exercise: 1.3 / 5

Let $f(x) = 2x + 5$. If $x \neq 0$ then find $\frac{f(x+2) - f(2)}{x}$.

Solution:

$$\frac{f(x+2) - f(2)}{x} = \frac{[2(x+2) + 5] - [2(2) + 5]}{x} \\ = \frac{2x + 4 + 5 - 4 - 5}{x} \\ = \frac{2x}{x} \\ = 2$$

22. Example: 1.14

If $A = \{-2, -1, 0, 1, 2\}$ and $f: A \rightarrow B$ is an onto function defined by $f(x) = x^2 + x + 1$ then find B .

Solution:

$$A = \{-2, -1, 0, 1, 2\}$$

f is an onto function $\Rightarrow$ Range = Co-domain

$$f(x) = x^2 + x + 1$$

$$f(-2) = (-2)^2 + (-2) + 1 = 4 - 2 + 1 = 3$$

$$f(-1) = (-1)^2 + (-1) + 1 = 1 - 1 + 1 = 1$$

$$f(0) = (0)^2 + (0) + 1 = 0 + 0 + 1 = 1$$

$$f(1) = (1)^2 + (1) + 1 = 1 + 1 + 1 = 3$$

$$f(2) = (2)^2 + (2) + 1 = 4 + 2 + 1 = 7$$

$$\Rightarrow B = \{1, 3, 7\} \quad [\because \text{Range} = \text{co-domain}]$$

23. Exercise: 1.5 / 1 (iv)

Using the functions f and g given below, find $f \circ g$ and $g \circ f$. Check whether $f \circ g = g \circ f$.

$$f(x) = 3 + x, \quad g(x) = x - 4$$

Solution:

$$f(x) = 3 + x$$

$$g(x) = x - 4$$

$$f \circ g(x) = f(g(x))$$

$$= f(x - 4)$$

$$= 3 + x - 4$$

$$= x - 1$$

$$g \circ f(x) = g(f(x))$$

$$= g(3 + x)$$

$$= 3 + x - 4$$

$$= x - 1$$

$$\therefore f \circ g = g \circ f$$

24. Exercise: 1.5 / 1 (v)

Using the functions f and g given below, find $f \circ g$ and $g \circ f$. Check whether $f \circ g = g \circ f$.

$$f(x) = 4x^2 - 1, \quad g(x) = 1 + x$$

Solution:

$$f(x) = 4x^2 - 1$$

$$g(x) = 1 + x$$

$$\begin{aligned}
 f \circ g(x) &= f(g(x)) \\
 &= f(1+x) \\
 &= 4(1+x)^2 - 1 \\
 &= 4(1+2x+x^2) - 1 \\
 &= 4+8x+4x^2-1 \\
 &= 4x^2+8x+3
 \end{aligned}$$

$$\begin{aligned}
 g \circ f(x) &= g(f(x)) \\
 &= g(4x^2-1) \\
 &= 1+4x^2-1 \\
 &= 4x^2
 \end{aligned}$$

$$\therefore f \circ g \neq g \circ f$$

25. Example: 1.19 for Practice

Find $f \circ g$ and $g \circ f$ when $f(x) = 2x + 1$ and $g(x) = x^2 - 2$. **[APR 2025]**

Answer: $f \circ g = 2x^2 - 3$; $g \circ f = 4x^2 + 4x - 1$

26. Exercise: 1.5 / 1 (i) for Practice

Using the functions f and g given below, find $f \circ g$ and $g \circ f$. Check whether $f \circ g = g \circ f$.

$$f(x) = x - 6, g(x) = x^2 \quad \text{[JUN 2023]}$$

Answer: $f \circ g = x^2 - 6$; $g \circ f = x^2 - 12x + 36$

27. Exercise: 1.5 / 1 (iii)

Using the functions f and g given below, find $f \circ g$ and $g \circ f$. Check whether $f \circ g = g \circ f$.

$$f(x) = \frac{x+6}{3}, g(x) = 3-x$$

Solution:

$$f(x) = \frac{x+6}{3}$$

$$g(x) = 3-x$$

$$\begin{aligned}
 f \circ g(x) &= f(g(x)) \\
 &= f(3-x) \\
 &= \frac{3-x+6}{3} \\
 &= \frac{9-x}{3}
 \end{aligned}$$

$$\begin{aligned}
 g \circ f(x) &= g(f(x)) \\
 &= g\left(\frac{x+6}{3}\right) \\
 &= 3 - \frac{x+6}{3} \\
 &= \frac{9-x-6}{3} \\
 &= \frac{3-x}{3}
 \end{aligned}$$

$$\therefore f \circ g \neq g \circ f$$

28. Exercise: 1.5 / 1 (ii)

Using the functions f and g given below, find $f \circ g$ and $g \circ f$. Check whether $f \circ g = g \circ f$.

$$f(x) = \frac{2}{x}, g(x) = 2x^2 - 1$$

Solution:

$$f(x) = \frac{2}{x}$$

$$g(x) = 2x^2 - 1$$

$$f \circ g(x) = f(g(x)) = f(2x^2 - 1)$$

$$= \frac{2}{2x^2 - 1}$$

$$g \circ f(x) = g(f(x))$$

$$= g\left(\frac{2}{x}\right)$$

$$= 2\left(\frac{2}{x}\right)^2 - 1$$

$$= 2\left(\frac{4}{x^2}\right) - 1$$

$$= \frac{8}{x^2} - 1$$

$$\therefore f \circ g \neq g \circ f$$

29. Exercise: 1.5 / 2 (ii)

Find the value of k , such that $f \circ g = g \circ f$

$$f(x) = 2x - k, g(x) = 4x + 5$$

Solution:

$$f(x) = 2x - k$$

$$g(x) = 4x + 5$$

$$\begin{aligned}
 f \circ g(x) &= f(g(x)) \\
 &= f(4x + 5) \\
 &= 2(4x + 5) - k \\
 &= 8x + 10 - k
 \end{aligned}$$

$$\begin{aligned}
 g \circ f(x) &= g(f(x)) \\
 &= g(2x - k) \\
 &= 4(2x - k) + 5 \\
 &= 8x - 4k + 5
 \end{aligned}$$

$$\begin{aligned}
 f \circ g = g \circ f &\Rightarrow 8x + 10 - k = 8x - 4k + 5 \\
 &\Rightarrow 10 - k = -4k + 5 \\
 &\Rightarrow -k + 4k = 5 - 10 \\
 &\Rightarrow 3k = -5 \\
 &\Rightarrow k = \frac{-5}{3}
 \end{aligned}$$

30. Example: 1.21 for Practice

If $f(x) = 3x - 2$, $g(x) = 2x + k$ and if $f \circ g = g \circ f$, then find the value of k . **[APR 2024]**

Answer: $k = -1$

31. Exercise: 1.5 / 2 (i) for Practice

Find the value of k , such that $f \circ g = g \circ f$
 $f(x) = 3x + 2$, $g(x) = 6x - k$

Answer: $k = -5$

32. Exercise: 1.5 / 3

If $f(x) = 2x - 1$, $g(x) = \frac{x+1}{2}$, show that $f \circ g = g \circ f = x$

Solution:

$$f(x) = 2x - 1$$

$$g(x) = \frac{x+1}{2}$$

$$\begin{aligned}
 f \circ g(x) &= f(g(x)) \\
 &= f\left(\frac{x+1}{2}\right) \\
 &= 2\left(\frac{x+1}{2}\right) - 1 \\
 &= x + 1 - 1 \\
 &= x
 \end{aligned}$$

$$\begin{aligned}
 g \circ f(x) &= g(f(x)) \\
 &= g(2x - 1) \\
 &= \frac{2x - 1 + 1}{2} \\
 &= \frac{2x}{2} \\
 &= x
 \end{aligned}$$

$$\therefore f \circ g = g \circ f = x$$

33. Exercise: 1.5 / 6

Let $f(x) = x^2 - 1$. Find (i) $f \circ f$ (ii) $f \circ f \circ f$

Solution:

$$f(x) = x^2 - 1$$

$$\begin{aligned}
 \text{(i) } f \circ f(x) &= f(f(x)) \\
 &= f(x^2 - 1) \\
 &= (x^2 - 1)^2 - 1 \\
 &= x^4 - 2x^2 + 1 - 1 \\
 &= x^4 - 2x^2
 \end{aligned}$$

$$\begin{aligned}
 \text{(ii) } f \circ f \circ f(x) &= f[f \circ f(x)] \\
 &= f(x^4 - 2x^2) \\
 &= (x^4 - 2x^2)^2 - 1 \\
 &= x^8 - 4x^6 + 4x^4 - 1
 \end{aligned}$$

34. Example: 1.22

Find k if $f \circ f(k) = 5$ where $f(k) = 2k - 1$. **[APR 2023]**

Solution:

$$\begin{aligned}
 f(k) &= 2k - 1 \\
 f \circ f(k) &= f(f(k)) \\
 &= f(2k - 1) \\
 &= 2(2k - 1) - 1 \\
 &= 4k - 2 - 1 \\
 &= 4k - 3 \\
 f \circ f(k) = 5 &\Rightarrow 4k - 3 = 5 \\
 &\Rightarrow 4k = 5 + 3 = 8 \\
 &\Rightarrow k = \frac{8}{4} = 2 \\
 &\Rightarrow k = 2
 \end{aligned}$$

5 MARK QUESTIONS

1. Exercise: 1.1 / 4

If $A = \{5, 6\}$, $B = \{4, 5, 6\}$, $C = \{5, 6, 7\}$,
Show that $A \times A = (B \times B) \cap (C \times C)$. **AUG 2022**

Solution:

$$A = \{5, 6\}$$

$$B = \{4, 5, 6\}$$

$$C = \{5, 6, 7\}$$

$$A \times A = \{(5, 5), (5, 6), (6, 5), (6, 6)\}$$

$$B \times B = \{(4, 4), (4, 5), (4, 6), (5, 4), (5, 5), (5, 6), (6, 4), (6, 5), (6, 6)\}$$

$$C \times C = \{(5, 5), (5, 6), (5, 7), (6, 5), (6, 6), (6, 7), (7, 5), (7, 6), (7, 7)\}$$

$$(B \times B) \cap (C \times C) = \{(5, 5), (5, 6), (6, 5), (6, 6)\}$$

$$\therefore A \times A = (B \times B) \cap (C \times C)$$

2. Exercise: 1.1 / 5

Given $A = \{1, 2, 3\}$, $B = \{2, 3, 5\}$, $C = \{3, 4\}$
and $D = \{1, 3, 5\}$, check if $(A \cap C) \times (B \cap D) = (A \times B) \cap (C \times D)$ is true?

Solution:

$$A = \{1, 2, 3\}$$

$$B = \{2, 3, 5\}$$

$$C = \{3, 4\}$$

$$D = \{1, 3, 5\}$$

$$A \cap C = \{3\}$$

$$B \cap D = \{3, 5\}$$

$$(A \cap C) \times (B \cap D) = \{(3, 3), (3, 5)\}$$

$$A \times B = \{(1, 2), (1, 3), (1, 5), (2, 2), (2, 3), (2, 5), (3, 2), (3, 3), (3, 5)\}$$

$$C \times D = \{(3, 1), (3, 3), (3, 5), (4, 1), (4, 3), (4, 5)\}$$

$$(A \times B) \cap (C \times D) = \{(3, 3), (3, 5)\}$$

$$\therefore (A \cap C) \times (B \cap D) = (A \times B) \cap (C \times D) \text{ is true}$$

3. Exercise: 1.1 / 7 (i)

Let A = The set of all natural numbers less than 8,
 B = The set of all prime numbers less than 8,
 C = The set of even prime numbers. Verify that
 $(A \cap B) \times C = (A \times C) \cap (B \times C)$ **SEP 2020**

JUN 2024 | APR 2025

Solution:

$$A = \{1, 2, 3, 4, 5, 6, 7\} \quad [\because x < 8, x \in \mathbb{N}]$$

$$B = \{2, 3, 5, 7\} \quad [\because x < 8, x \in \text{Prime numbers}]$$

$$C = \{2\} \quad [\because x \in \text{Even prime numbers}]$$

$$A \cap B = \{2, 3, 5, 7\}$$

$$(A \cap B) \times C = \{(2, 2), (3, 2), (5, 2), (7, 2)\}$$

$$A \times C = \{(1, 2), (2, 2), (3, 2), (4, 2), (5, 2), (6, 2), (7, 2)\}$$

$$B \times C = \{(2, 2), (3, 2), (5, 2), (7, 2)\}$$

$$(A \times C) \cap (B \times C) = \{(2, 2), (3, 2), (5, 2), (7, 2)\}$$

$$\therefore (A \cap B) \times C = (A \times C) \cap (B \times C)$$

4. Exercise: 1.1 / 7 (ii)

Let A = The set of all natural numbers less than 8,
 B = The set of all prime numbers less than 8,
 C = The set of even prime numbers. Verify that
 $A \times (B - C) = (A \times B) - (A \times C)$ **MAY 2022**

Solution:

$$A = \{1, 2, 3, 4, 5, 6, 7\} \quad [\because x < 8, x \in \mathbb{N}]$$

$$B = \{2, 3, 5, 7\} \quad [\because x < 8, x \in \text{Prime numbers}]$$

$$C = \{2\} \quad [\because x \in \text{Even prime numbers}]$$

$$B - C = \{3, 5, 7\}$$

$$\begin{aligned} A \times (B - C) &= \{(1, 3), (1, 5), (1, 7), (2, 3), (2, 5), (2, 7), (3, 3), (3, 5), (3, 7), (4, 3), (4, 5), (4, 7), (5, 3), (5, 5), (5, 7), (6, 3), (6, 5), (6, 7), (7, 3), (7, 5), (7, 7)\} \end{aligned}$$

$$\begin{aligned}
 A \times B &= \{(1, 2), (1, 3), (1, 5), (1, 7), \\
 &\quad (2, 2), (2, 3), (2, 5), (2, 7), \\
 &\quad (3, 2), (3, 3), (3, 5), (3, 7), \\
 &\quad (4, 2), (4, 3), (4, 5), (4, 7), \\
 &\quad (5, 2), (5, 3), (5, 5), (5, 7), \\
 &\quad (6, 2), (6, 3), (6, 5), (6, 7), \\
 &\quad (7, 2), (7, 3), (7, 5), (7, 7)\} \\
 A \times C &= \{(1, 2), (2, 2), (3, 2), (4, 2), (5, 2), \\
 &\quad (6, 2), (7, 2)\} \\
 (A \times B) - (A \times C) \\
 &= \{(1, 3), (1, 5), (1, 7), \\
 &\quad (2, 3), (2, 5), (2, 7), \\
 &\quad (3, 3), (3, 5), (3, 7), \\
 &\quad (4, 3), (4, 5), (4, 7), \\
 &\quad (5, 3), (5, 5), (5, 7), \\
 &\quad (6, 3), (6, 5), (6, 7), \\
 &\quad (7, 3), (7, 5), (7, 7)\} \\
 \therefore A \times (B - C) &= (A \times B) - (A \times C)
 \end{aligned}$$

5. Exercise: 1.1 / 6 (iii)

Let $A = \{x \in W \mid x < 2\}$, $B = \{x \in N \mid 1 < x \leq 4\}$
and $C = \{3, 5\}$. Verify that
 $(A \cup B) \times C = (A \times C) \cup (B \times C)$

Solution:

$$\begin{aligned}
 A &= \{0, 1\} & [\because x < 2, x \in N] \\
 B &= \{2, 3, 4\} & [\because 1 < x \leq 4, x \in N] \\
 C &= \{3, 5\}
 \end{aligned}$$

$$\begin{aligned}
 A \cup B &= \{0, 1, 2, 3, 4\} \\
 (A \cup B) \times C \\
 &= \{(0, 3), (0, 5), (1, 3), (1, 5), \\
 &\quad (2, 3), (2, 5), (3, 3), (3, 5), \\
 &\quad (4, 3), (4, 5)\}
 \end{aligned}$$

$$A \times C = \{(0, 3), (0, 5), (1, 3), (1, 5)\}$$

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

$$\begin{aligned}
 (A \times C) \cup (B \times C) \\
 &= \{(0, 3), (0, 5), (1, 3), (1, 5), \\
 &\quad (2, 3), (2, 5), (3, 3), (3, 5), \\
 &\quad (4, 3), (4, 5)\}
 \end{aligned}$$

$$\therefore (A \cup B) \times C = (A \times C) \cup (B \times C)$$

6. Exercise: 1.1 / 6 (i)

Let $A = \{x \in W \mid x < 2\}$, $B = \{x \in N \mid 1 < x \leq 4\}$
and $C = \{3, 5\}$. Verify that

$$A \times (B \cup C) = (A \times B) \cup (A \times C) \quad \text{JUN 2023}$$

Solution:

$$A = \{0, 1\} \quad [\because x < 2, x \in N]$$

$$B = \{2, 3, 4\} \quad [\because 1 < x \leq 4, x \in N]$$

$$C = \{3, 5\}$$

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

$$\begin{aligned}
 A \times (B \cup C) \\
 &= \{(0, 2), (0, 3), (0, 4), (0, 5), \\
 &\quad (1, 2), (1, 3), (1, 4), (1, 5)\}
 \end{aligned}$$

$$A \times B = \{(0, 2), (0, 3), (0, 4), \\ (1, 2), (1, 3), (1, 4)\}$$

$$A \times C = \{(0, 3), (0, 5), (1, 3), (1, 5)\}$$

$$\begin{aligned}
 (A \times B) \cup (A \times C) \\
 &= \{(0, 2), (0, 3), (0, 4), (0, 5), \\
 &\quad (1, 2), (1, 3), (1, 4), (1, 5)\}
 \end{aligned}$$

$$\therefore A \times (B \cup C) = (A \times B) \cup (A \times C)$$

7. Created Question (for Practice)

Let $A = \{x \in W \mid x < 3\}$, $B = \{x \in N \mid 1 < x \leq 5\}$
and $C = \{3, 5, 7\}$ verify that $A \times (B \cup C) =$
 $(A \times B) \cup (A \times C)$. APR 2023

8. Exercise: 1.1 / 6 (ii)

Let $A = \{x \in W \mid x < 2\}$, $B = \{x \in N \mid 1 < x \leq 4\}$
and $C = \{3, 5\}$. Verify that

$$A \times (B \cap C) = (A \times B) \cap (A \times C) \quad \begin{matrix} \text{SEP 2021} \\ \text{APR 2026} \end{matrix}$$

Solution:

$$A = \{0, 1\} \quad [\because x < 2, x \in N]$$

$$B = \{2, 3, 4\} \quad [\because 1 < x \leq 4, x \in N]$$

$$C = \{3, 5\}$$

$$B \cap C = \{3\}$$

$$A \times (B \cap C) = \{(0, 3), (1, 3)\}$$

$$\begin{aligned}
 A \times B &= \{(0, 2), (0, 3), (0, 4), \\
 &\quad (1, 2), (1, 3), (1, 4)\} \\
 A \times C &= \{(0, 3), (0, 5), (1, 3), (1, 5)\} \\
 (A \times B) \cap (A \times C) &= \{(0, 3), (1, 3)\} \\
 \therefore A \times (B \cap C) &= (A \times B) \cap (A \times C)
 \end{aligned}$$

9. Example: 1.3 for Practice

Let $A = \{x \in \mathbb{N} \mid 1 < x < 4\}$, $B = \{x \in \mathbb{W} \mid 0 \leq x < 2\}$ and $C = \{x \in \mathbb{N} \mid x < 3\}$. Then verify that
 (i) $A \times (B \cup C) = (A \times B) \cup (A \times C)$
 (ii) $A \times (B \cap C) = (A \times B) \cap (A \times C)$. **APR 2024**

Answer: $A = \{2, 3\}$; $B = \{0, 1\}$; $C = \{1, 2\}$

10. Example: 1.6

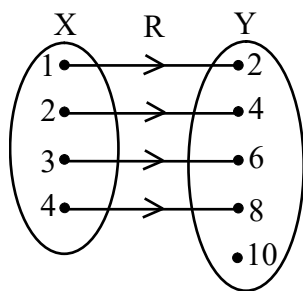
Let $X = \{1, 2, 3, 4\}$ and $Y = \{2, 4, 6, 8, 10\}$ and $R = \{(1, 2), (2, 4), (3, 6), (4, 8)\}$. Show that R is a function and find its domain, co-domain and range?

Solution:

$$X = \{1, 2, 3, 4\}$$

$$Y = \{2, 4, 6, 8, 10\}$$

$$R = \{(1, 2), (2, 4), (3, 6), (4, 8)\}$$



R is a function.

[$\because$ Each $x \in X$, has unique image $y \in Y$]

$$\text{Domain } X = \{1, 2, 3, 4\}$$

$$\text{Co-domain } Y = \{2, 4, 6, 8, 10\}$$

$$\text{Range of } f = \{2, 4, 6, 8\}$$

11. Example: 1.11

Let $A = \{1, 2, 3, 4\}$ and $B = \{2, 5, 8, 11, 14\}$ be two sets. Let $f: A \rightarrow B$ be a function given by $f(x) = 3x - 1$. Represent this function (i) by arrow diagram (ii) in a table form (iii) as a set of ordered pairs (iv) in a graphical form. **SEP 2020 JUN 2025**

Solution:

$$A = \{1, 2, 3, 4\}$$

$$B = \{2, 5, 8, 11, 14\}$$

$$f(x) = 3x - 1$$

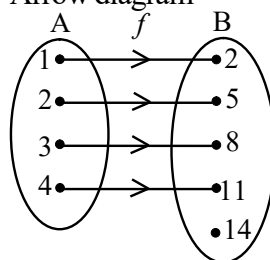
$$f(1) = 3(1) - 1 = 3 - 1 = 2$$

$$f(2) = 3(2) - 1 = 6 - 1 = 5$$

$$f(3) = 3(3) - 1 = 9 - 1 = 8$$

$$f(4) = 3(4) - 1 = 12 - 1 = 11$$

(i) Arrow diagram



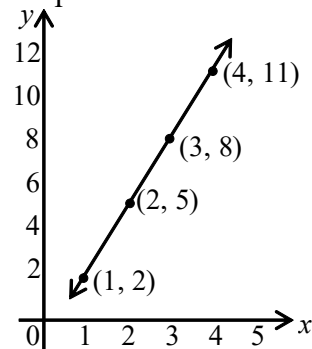
(ii) Table

x	1	2	3	4
$f(x)$	2	5	8	11

(iii) Set of ordered pairs

$$f = \{(1, 2), (2, 5), (3, 8), (4, 11)\}$$

(iv) Graph



12. Exercise: 1.4 / 2

Let $f: A \rightarrow B$ be a function defined by $f(x) = \frac{x}{2} - 1$ where $A = \{2, 4, 6, 10, 12\}$, $B = \{0, 1, 2, 4, 5, 9\}$. Represent f by (i) set of ordered pairs (ii) a table (iii) an arrow diagram (iv) a graph.

APR 2023 | APR 2025**Solution:**

$$f: A \rightarrow B$$

$$A = \{2, 4, 6, 10, 12\}$$

$$B = \{0, 1, 2, 4, 5, 9\}$$

$$f(x) = \frac{x}{2} - 1$$

$$f(2) = \frac{2}{2} - 1 = 1 - 1 = 0$$

$$f(4) = \frac{4}{2} - 1 = 2 - 1 = 1$$

$$f(6) = \frac{6}{2} - 1 = 3 - 1 = 2$$

$$f(10) = \frac{10}{2} - 1 = 5 - 1 = 4$$

$$f(12) = \frac{12}{2} - 1 = 6 - 1 = 5$$

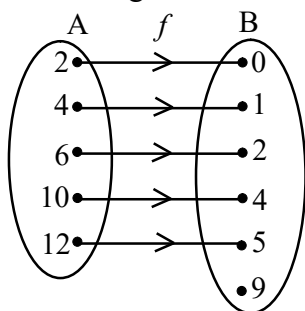
(i) Set of ordered pairs

$$f = \{(2, 0), (4, 1), (6, 2), (10, 4), (12, 5)\}$$

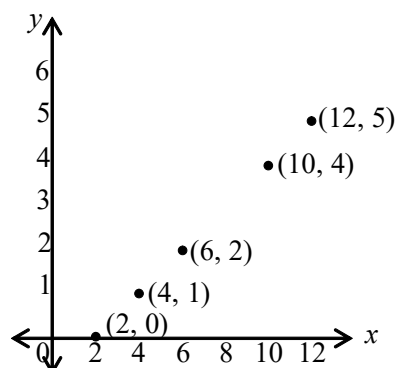
(ii) Table

x	2	4	6	10	12
$f(x)$	0	1	2	4	5

(iii) Arrow diagram



(iv) Graph

**13. Exercise: 1.4 / 3 for Practice**

Represent the function $f = \{(1, 2), (2, 2), (3, 2), (4, 3), (5, 4)\}$ through (i) an arrow diagram (ii) a table form (iii) a graph.

14. Exercise: 1.2 / 4 (ii) (for Practice)

Represent the given relation by (i) an arrow diagram (ii) a graph and (iii) a set in roster form, wherever possible $\{(x, y)/y = x + 3, x, y \text{ are natural number } < 10\}$

AUG 2022**15. Exercise: 1.3 / 3**

Given the function $f: x \rightarrow x^2 - 5x + 6$, evaluate (i) $f(-1)$ (ii) $f(2a)$ (iii) $f(2)$ (iv) $f(x-1)$.

Solution:

$$f: x \rightarrow x^2 - 5x + 6$$

$$\begin{aligned} \text{(i)} \quad f(-1) &= (-1)^2 - 5(-1) + 6 \\ &= 1 + 5 + 6 \\ &= 12 \end{aligned}$$

$$\begin{aligned} \text{(ii)} \quad f(2a) &= (2a)^2 - 5(2a) + 6 \\ &= 4a^2 - 10a + 6 \end{aligned}$$

$$\begin{aligned} \text{(iii)} \quad f(2) &= (2)^2 - 5(2) + 6 \\ &= 4 - 10 + 6 \\ &= 0 \end{aligned}$$

$$\begin{aligned}
 \text{(iv)} \quad f(x-1) &= (x-1)^2 - 5(x-1) + 6 \\
 &= x^2 - 2x + 1 - 5x + 5 + 6 \\
 &= x^2 - 7x + 12
 \end{aligned}$$

16. Exercise: 1.3 / 6

A function f is defined by $f(x) = 2x - 3$.

- (i) find $\frac{f(0)+f(1)}{2}$.
 (ii) find x such that $f(x) = 0$.
 (iii) find x such that $f(x) = x$.
 (iv) find x such that $f(x) = f(1-x)$

Solution:

$$f(x) = 2x - 3$$

$$\begin{aligned}
 \text{(i)} \quad \frac{f(0)+f(1)}{2} &= \frac{[2(0)-3]+[2(1)-3]}{2} \\
 &= \frac{-3+2-3}{2} \\
 &= -2
 \end{aligned}$$

$$\begin{aligned}
 \text{(ii)} \quad f(x) = 0 &\Rightarrow 2x - 3 = 0 \\
 &\Rightarrow 2x = 3 \\
 &\Rightarrow x = \frac{3}{2}
 \end{aligned}$$

$$\begin{aligned}
 \text{(iii)} \quad f(x) = x &\Rightarrow 2x - 3 = x \\
 &\Rightarrow 2x - x = 3 \\
 &\Rightarrow x = 3
 \end{aligned}$$

$$\begin{aligned}
 \text{(iv)} \quad f(x) = f(1-x) &\Rightarrow 2x - 3 = 2(1-x) - 3 \\
 &\Rightarrow 2x - 3 = 2 - 2x - 3 \\
 &\Rightarrow 2x + 2x = 2 - 3 + 3 \\
 &\Rightarrow 4x = 2 \\
 &\Rightarrow x = \frac{2}{4} = \frac{1}{2}
 \end{aligned}$$

17. Exercise: 1.4 / 9

If the function f is defined by

$$f(x) = \begin{cases} x+2 & \text{if } x > 1 \\ 2 & \text{if } -1 \leq x \leq 1 \\ x-1 & \text{if } -3 < x < -1 \end{cases}; \text{ find the values of}$$

$$\text{(i)} f(3) \quad \text{(ii)} f(0) \quad \text{(iii)} f(-1.5) \quad \text{(iv)} f(2) + f(-2)$$

Solution:

$$f(x) = \begin{cases} x+2 & \text{if } x > 1 \\ 2 & \text{if } -1 \leq x \leq 1 \\ x-1 & \text{if } -3 < x < -1 \end{cases}$$

$$\begin{aligned}
 \text{(i)} \quad f(3) &= [x+2]_{x=3} \\
 &= 3+2 \\
 &= 5
 \end{aligned}$$

$$\begin{aligned}
 \text{(ii)} \quad f(0) &= [2]_{x=0} \\
 &= 2
 \end{aligned}$$

$$\begin{aligned}
 \text{(iii)} \quad f(-1.5) &= [x-1]_{x=-1.5} \\
 &= -1.5-1 \\
 &= -2.5
 \end{aligned}$$

$$\begin{aligned}
 \text{(iv)} \quad f(2)+f(-2) &= [x+2]_{x=2} + [x-1]_{x=-2} \\
 &= [2+2] + [-2-1] \\
 &= 4-3 \\
 &= 1
 \end{aligned}$$

18. Exercise: 1.4 / 10

A function $f: [-5, 9] \rightarrow \mathbb{R}$ is defined as follows:

$$f(x) = \begin{cases} 6x+1 & \text{if } -5 \leq x < 2 \\ 5x^2-1 & \text{if } 2 \leq x < 6 \\ 3x-4 & \text{if } 6 \leq x \leq 9 \end{cases} \quad \text{Find}$$

$$\text{(i)} f(-3) + f(2) \quad \text{(ii)} f(7) - f(1) \quad \text{(iii)} 2f(4) + f(8)$$

$$\text{(iv)} \frac{2f(-2) - f(6)}{f(4) + f(-2)}$$

JUN2024

Solution:

$$f: [-5, 9] \rightarrow \mathbb{R}$$

$$f(x) = \begin{cases} 6x+1 & \text{if } -5 \leq x < 2 \\ 5x^2-1 & \text{if } 2 \leq x < 6 \\ 3x-4 & \text{if } 6 \leq x \leq 9 \end{cases}$$

$$\begin{aligned}
 \text{(i)} \quad f(-3) + f(2) &= [6x+1]_{x=-3} + [5x^2-1]_{x=2} \\
 &= [6(-3)+1] + [5(2)^2-1] \\
 &= [-18+1] + [5(4)-1] \\
 &= -17+19 \\
 &= 2
 \end{aligned}$$

$$(ii) f(7) - f(1)$$

$$\begin{aligned} &= [3x - 4]_{x=7} - [6x + 1]_{x=1} \\ &= [3(7) - 4] - [6(1) + 1] \\ &= [21 - 4] - [6 + 1] \\ &= 17 - 7 \\ &= 10 \end{aligned}$$

$$(iii) 2f(4) + f(8)$$

$$\begin{aligned} &= 2[5x^2 - 1]_{x=4} + [3x - 4]_{x=8} \\ &= 2[5(4)^2 - 1] + [3(8) - 4] \\ &= 2[80 - 1] + [24 - 4] \\ &= 2[79] + [20] \\ &= 158 + 20 \\ &= 178 \end{aligned}$$

$$(iv) \frac{2f(-2) - f(6)}{f(4) + f(-2)}$$

$$\begin{aligned} &= \frac{2[6x + 1]_{x=-2} - [3x - 4]_{x=6}}{[5x^2 - 1]_{x=4} + [6x + 1]_{x=-2}} \\ &= \frac{2[6(-2) + 1] - [3(6) - 4]}{[5(4)^2 - 1] + [6(-2) + 1]} \\ &= \frac{2[-12 + 1] - [18 - 4]}{[80 - 1] + [-12 + 1]} \\ &= \frac{2[-11] - [14]}{[79] + [-11]} \\ &= \frac{-22 - 14}{79 - 11} \\ &= \frac{-36}{68} \\ &= \frac{-9}{17} \end{aligned}$$

19. Example: 1.18 for Practice

If the function $f : \mathbb{R} \rightarrow \mathbb{R}$ defined by

$$f(x) = \begin{cases} 2x + 7; & x < -2 \\ x^2 - 2; & -2 \leq x < 3 \\ 3x - 2; & x \geq 3 \end{cases}, \text{ then find the values}$$

of (i) $f(4)$ (ii) $f(-2)$ (iii) $f(4) + 2f(1)$

$$(iv) \frac{f(1) - 3f(4)}{f(-3)}.$$

Answer:

$$(i) f(4) = 10; (ii) f(-2) = 2$$

$$(iii) f(4) + 2f(1) = 8; (iv) \frac{f(1) - 3f(4)}{f(-3)} = -31$$

20. Example: 1.23

If $f(x) = 2x + 3$, $g(x) = 1 - 2x$ and $h(x) = 3x$.

Prove that $f \circ (g \circ h) = (f \circ g) \circ h$.

Solution:

$$f(x) = 2x + 3$$

$$g(x) = 1 - 2x$$

$$h(x) = 3x$$

$$\begin{aligned} f \circ g(x) &= f(g(x)) \\ &= f(1 - 2x) \\ &= 2(1 - 2x) + 3 \\ &= 2 - 4x + 3 \\ &= 5 - 4x \end{aligned}$$

$$\begin{aligned} (f \circ g) \circ h(x) &= f \circ g(h(x)) \\ &= f \circ g(3x) \\ &= 5 - 4(3x) \\ &= 5 - 12x \quad \text{--- ①} \end{aligned}$$

$$\begin{aligned} g \circ h(x) &= g(h(x)) \\ &= g(3x) \\ &= 1 - 2(3x) \\ &= 1 - 6x \end{aligned}$$

$$\begin{aligned}
 f \circ (g \circ h)(x) &= f(g \circ h(x)) \\
 &= f(1 - 6x) \\
 &= 2(1 - 6x) + 3 \\
 &= 2 - 12x + 3 \\
 &= 5 - 12x \quad \text{--- ②}
 \end{aligned}$$

$$\text{① \& ②} \Rightarrow (f \circ g) \circ h = f \circ (g \circ h)$$

21. Exercise: 1.5 / 8 (ii)

Consider the functions $f(x)$, $g(x)$, $h(x)$ as given below. Show that $(f \circ g) \circ h = f \circ (g \circ h)$.

$$f(x) = x^2, g(x) = 2x \text{ and } h(x) = x + 4$$

Solution:

$$\begin{aligned}
 f(x) &= x^2 \\
 g(x) &= 2x \\
 h(x) &= x + 4 \\
 f \circ g(x) &= f(g(x)) \\
 &= f(2x) \\
 &= (2x)^2 \\
 &= 4x^2 \\
 (f \circ g) \circ h(x) &= f \circ g(h(x)) \\
 &= f \circ g(x + 4) \\
 &= 4(x + 4)^2 \quad \text{--- ①}
 \end{aligned}$$

$$\begin{aligned}
 g \circ h(x) &= g(h(x)) \\
 &= g(x + 4) \\
 &= 2(x + 4)
 \end{aligned}$$

$$\begin{aligned}
 f \circ (g \circ h)(x) &= f(g \circ h)(x) \\
 &= f(2(x + 4)) \\
 &= [2(x + 4)]^2 \\
 &= 4(x + 4)^2 \quad \text{--- ②}
 \end{aligned}$$

$$\text{① \& ②} \Rightarrow (f \circ g) \circ h = f \circ (g \circ h)$$

22. Exercise: 1.5 / 8 (i) for Practice

Consider the functions $f(x)$, $g(x)$, $h(x)$ as given below. Show that $(f \circ g) \circ h = f \circ (g \circ h)$.

$$f(x) = x - 1, g(x) = 3x + 1 \text{ and } h(x) = x^2$$

JUN 2025 | APR 2026

Solution:

$$\begin{aligned}
 f \circ g &= 3x; g \circ h = 3x^2 + 1 \\
 (f \circ g) \circ h &= f \circ (g \circ h) = 3x^2
 \end{aligned}$$

23. Exercise: 1.5 / 8 (iii)

Consider the functions $f(x)$, $g(x)$, $h(x)$ as given below. Show that $(f \circ g) \circ h = f \circ (g \circ h)$.

$$f(x) = x - 4, g(x) = x^2 \text{ and } h(x) = 3x - 5$$

Solution:

$$\begin{aligned}
 f(x) &= x - 4 \\
 g(x) &= x^2 \\
 h(x) &= 3x - 5 \\
 f \circ g(x) &= f(g(x)) \\
 &= f(x^2) \\
 &= x^2 - 4 \\
 (f \circ g) \circ h(x) &= f \circ g(h(x)) \\
 &= f \circ g(3x - 5) \\
 &= (3x - 5)^2 - 4 \quad \text{--- ①}
 \end{aligned}$$

$$\begin{aligned}
 g \circ h(x) &= g(h(x)) \\
 &= g(3x - 5) \\
 &= (3x - 5)^2
 \end{aligned}$$

$$\begin{aligned}
 f \circ (g \circ h)(x) &= f(g \circ h)(x) \\
 &= f[(3x - 5)^2] \\
 &= (3x - 5)^2 - 4 \quad \text{--- ②}
 \end{aligned}$$

$$\text{① \& ②} \Rightarrow (f \circ g) \circ h = f \circ (g \circ h)$$

24. Unit Exercise: 1 / 6

If $f(x) = x^2$, $g(x) = 3x$ and $h(x) = x - 2$, Prove that $(f \circ g) \circ h = f \circ (g \circ h)$.

Solution:

$$f(x) = x^2$$

$$g(x) = 3x$$

$$h(x) = x - 2$$

$$f \circ g(x) = f(g(x))$$

$$= f(3x)$$

$$= (3x)^2$$

$$= 9x^2$$

$$(f \circ g) \circ h(x) = f \circ g(h(x))$$

$$= f \circ g(x - 2)$$

$$= 9(x - 2)^2 \quad \text{———— ①}$$

$$g \circ h(x) = g(h(x))$$

$$= g(x - 2)$$

$$= 3(x - 2)$$

$$f \circ (g \circ h)(x) = f(g \circ h(x))$$

$$= f[3(x - 2)]$$

$$= [3(x - 2)]^2$$

$$= 9(x - 2)^2 \quad \text{———— ②}$$

$$\text{① \& ②} \Rightarrow (f \circ g) \circ h = f \circ (g \circ h)$$

25. Example: 1.24

Find x if $gff(x) = fgg(x)$, given $f(x) = 3x + 1$ and $g(x) = x + 3$.

Solution:

$$f(x) = 3x + 1$$

$$g(x) = x + 3$$

$$gff(x) = g[ff(x)]$$

$$= g[f(f(x))]$$

$$= g[f(3x + 1)]$$

$$= g[3(3x + 1) + 1]$$

$$= g[9x + 3 + 1]$$

$$= g[9x + 4]$$

$$= 9x + 4 + 3$$

$$= 9x + 7$$

$$fgg(x) = f[gg(x)]$$

$$= f[g(g(x))]$$

$$= f[g(x + 3)]$$

$$= f[x + 3 + 3]$$

$$= f[x + 6]$$

$$= 3(x + 6) + 1$$

$$= 3x + 18 + 1$$

$$= 3x + 19$$

$$gff(x) = fgg(x) \Rightarrow 9x + 7 = 3x + 19$$

$$\Rightarrow 9x - 3x = 19 - 7$$

$$\Rightarrow 6x = 12$$

$$\Rightarrow x = 2$$



Exercise: 3.15 / 4

10. The following table shows the data about the number of pipes and the time taken to fill the same tank.

No. of pipes (x)	2	3	6	9
Time taken (y) in min.	45	30	15	10

Draw the graph for the above data and hence

- (i) find the time taken to fill the tank when five pipes are used
 (ii) find the number of pipes when the time is 9 minutes.

JUN2024

Solution:

Pipes (x)	2	3	6	9
Time (y) min.	45	30	15	10

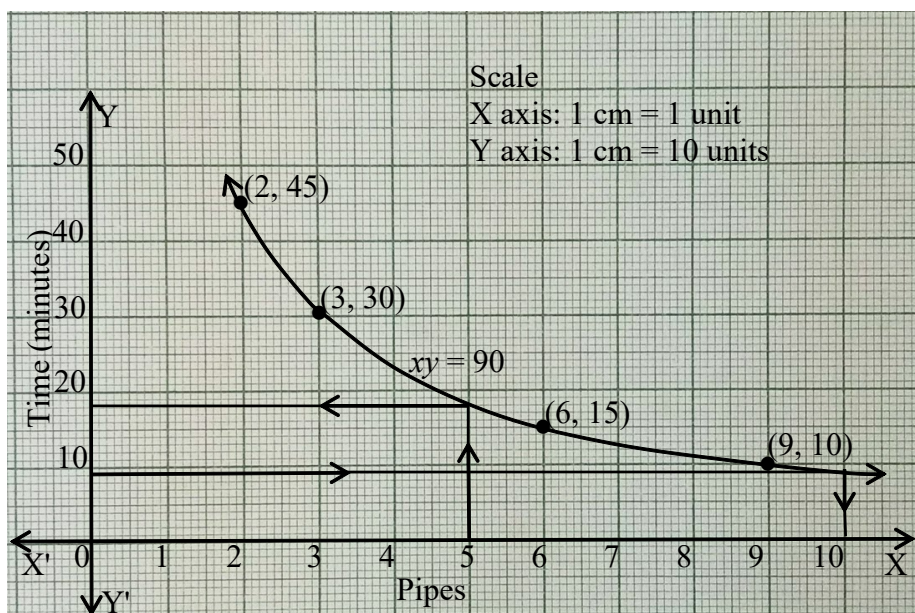
Variation : $2 \rightarrow 3$ (increases); $45 \rightarrow 30$ (decreases) $\Rightarrow$ Indirect variation

Constant : $k = xy = 2(45) = 90$

Equation : $xy = k \Rightarrow xy = 90$

Points : $(2, 45), (3, 30), (6, 15), (9, 10)$

Graph :



- Solution : (i) $x = 5$ pipes $\Rightarrow y = 18$ minutes
 (ii) $y = 9$ minutes $\Rightarrow x = 10$ pipes

Exercise: 3.16 / 1 (iv)

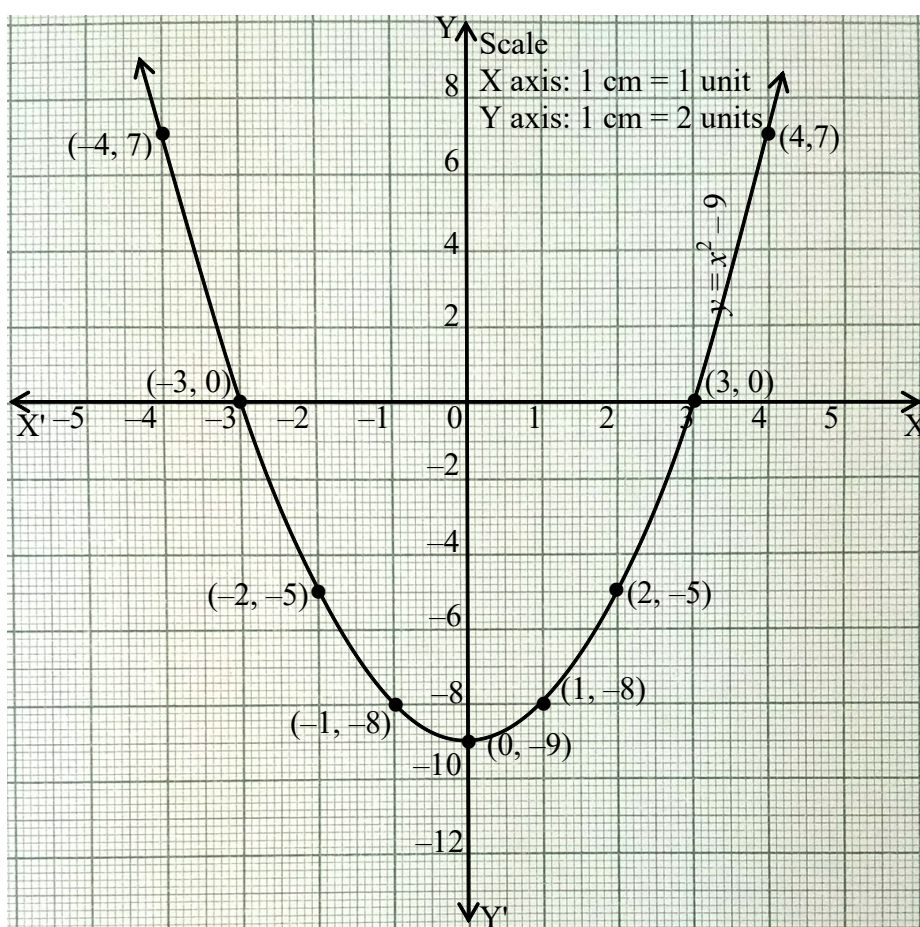
11. Graph the following quadratic equation and state its nature of solutions. $x^2 - 9 = 0$

Solution:

Step 1: $y = x^2 - 9$

x	-4	-3	-2	-1	0	1	2	3	4
x^2	16	9	4	1	0	1	4	9	16
-9	-9	-9	-9	-9	-9	-9	-9	-9	-9
y	7	0	-5	-8	-9	-8	-5	0	7

Step 2:



Step 3: Two intersecting points : $(-3, 0)$, $(3, 0)$

Step 4: Real and unequal roots : $-3, 3$

In $\triangle LMN$, $\angle L = 90^\circ$

$$\Rightarrow MN^2 = ML^2 + LN^2$$

$$= 8^2 + 6^2$$

$$= 64 + 36$$

$$= 100$$

$$\Rightarrow MN = 10$$

$$LQ = LR = x \quad (\text{say})$$

[Tangents from an external point]

$$MQ = MP = y \quad (\text{say})$$

[Tangents from an external point]

$$NP = NR = z \quad (\text{say})$$

[Tangents from an external point]

$$\Rightarrow x + y = 8 \quad \text{--- (1)}$$

$$y + z = 10 \quad \text{--- (2)}$$

$$z + x = 6 \quad \text{--- (3)}$$

$$\textcircled{1} + \textcircled{2} + \textcircled{3} \Rightarrow 2x + 2y + 2z = 24 \quad (\div 2)$$

$$\Rightarrow x + y + z = 12 \quad \text{--- (4)}$$

$$\textcircled{4} - \textcircled{2} \Rightarrow (x + y + z) - (y + z) = 12 - 10$$

$$\Rightarrow x = 2$$

OQLR is a square.

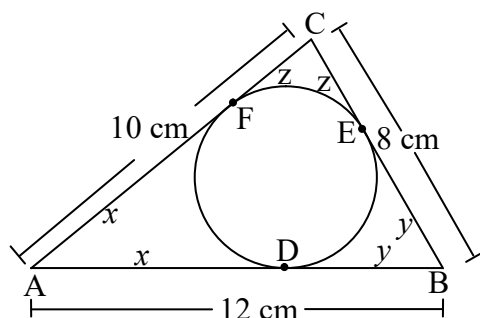
$$[\because \angle RLQ = \angle LQO = \angle LRO = 90^\circ \text{ \& } LR = LQ]$$

$$\Rightarrow OR = OQ = LR = LQ = x = 2$$

$\therefore$ Radius = 2 cm

13. Exercise: 4.4 / 3

A circle is inscribed in $\triangle ABC$ having sides 8 cm, 10 cm and 12 cm as shown in the figure, Find AD, BE and CF.



Solution:

In $\triangle ABC$, $AB = 12$ cm

$$BC = 8$$
 cm

$$CA = 10$$
 cm

$$\left. \begin{array}{l} AF = AD = x \text{ (say)} \\ BD = BE = y \text{ (say)} \\ CE = CF = z \text{ (say)} \end{array} \right\} \begin{array}{l} \text{Tangents from} \\ \text{an external} \\ \text{point} \end{array}$$

$$\Rightarrow x + y = 12 \quad \text{--- (1)}$$

$$y + z = 8 \quad \text{--- (2)}$$

$$z + x = 10 \quad \text{--- (3)}$$

$$\textcircled{1} + \textcircled{2} + \textcircled{3} \Rightarrow 2x + 2y + 2z = 30 \quad (\div 2)$$

$$\Rightarrow x + y + z = 15 \quad \text{--- (4)}$$

$$\textcircled{4} - \textcircled{2} \Rightarrow (x + y + z) - (y + z) = 15 - 8$$

$$\Rightarrow x = 7$$

$$\textcircled{4} - \textcircled{3} \Rightarrow (x + y + z) - (z + x) = 15 - 10$$

$$\Rightarrow y = 5$$

$$\textcircled{4} - \textcircled{1} \Rightarrow (x + y + z) - (x + y) = 15 - 12$$

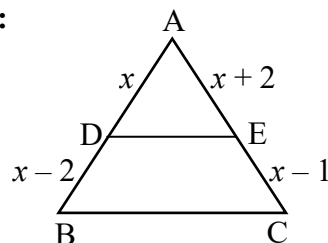
$$\Rightarrow z = 3$$

$\therefore AD = 7$ cm, $BE = 5$ cm, $CF = 3$ cm.

14. Example: 4.12

In $\triangle ABC$, if $DE \parallel BC$, $AD = x$, $DB = x - 2$, $AE = x + 2$ and $EC = x - 1$ then find the lengths of the sides AB and AC.

Solution:



In $\triangle ABC$, $DE \parallel BC$

$$\Rightarrow \frac{AD}{DB} = \frac{AE}{EC} \quad (\text{by BPT})$$

$$\Rightarrow \frac{x}{x-2} = \frac{x+2}{x-1}$$

$$\Rightarrow x^2 - x = x^2 - 4$$

$$\Rightarrow x = 4$$

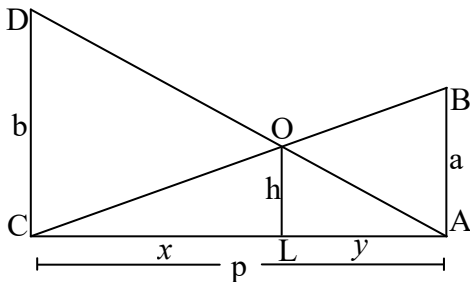
$$AB = AD + DB = x + x - 2 = 4 + 4 - 2 = 6$$

$$AC = AE + EC = x + 2 + x - 1 = 4 + 2 + 4 - 1 = 9$$

$\therefore AB = 6$, $AC = 9$

15. Example: 4.9

Two poles of height 'a' metres and 'b' metres are 'P' metres apart. Prove that the height of the point of intersection of the lines joining the top of each pole to the foot of the opposite pole is given by $\frac{ab}{a+b}$ metres. **APR 2023**

Solution:In $\triangle ABC$ & $\triangle LOC$

$$\angle CAB = \angle CLO \quad (90^\circ)$$

$$\angle C = \angle C \quad (\text{Common angle})$$

$$\Rightarrow \triangle ABC \sim \triangle LOC \quad (\text{by AA Similarity})$$

$$\Rightarrow \frac{AB}{LO} = \frac{AC}{LC}$$

$$\Rightarrow \frac{a}{h} = \frac{p}{x}$$

$$\Rightarrow x = \frac{ph}{a}$$

In $\triangle ACD$ & $\triangle ALO$

$$\angle ACD = \angle ALO \quad (90^\circ)$$

$$\angle A = \angle A \quad (\text{Common angle})$$

$$\Rightarrow \triangle ACD \sim \triangle ALO \quad (\text{by AA Similarity})$$

$$\Rightarrow \frac{AC}{AL} = \frac{CD}{LO}$$

$$\Rightarrow \frac{p}{y} = \frac{b}{h}$$

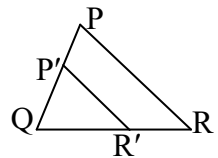
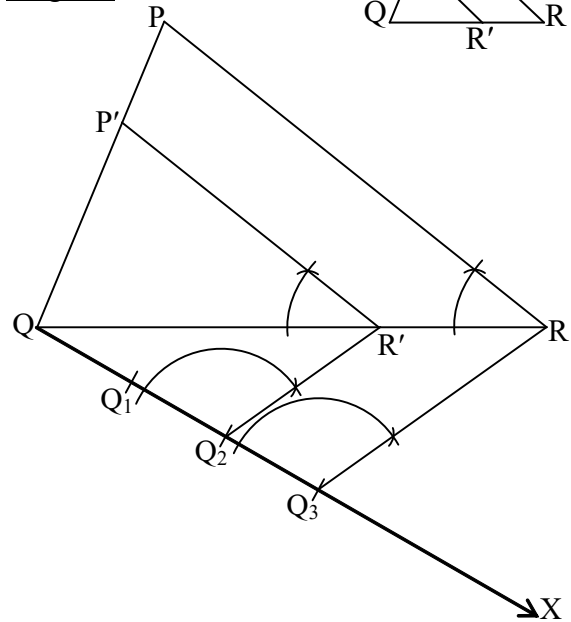
$$\Rightarrow y = \frac{ph}{b}$$

$$p = x + y = \frac{ph}{a} + \frac{ph}{b} = ph \left(\frac{1}{a} + \frac{1}{b} \right) = ph \left(\frac{a+b}{ab} \right)$$

$$\Rightarrow h = \frac{pab}{p(a+b)} = \frac{ab}{a+b} \text{ m}$$

PRACTICAL GEOMETRY**8 MARK QUESTIONS****Exercise: 4.1 / 10**

1. Construct a triangle similar to a given triangle PQR with its sides equal to $\frac{2}{3}$ of the corresponding sides of the triangle PQR (scale factor $\frac{2}{3} < 1$).

Solution:Rough diagram:Diagram:Construction:

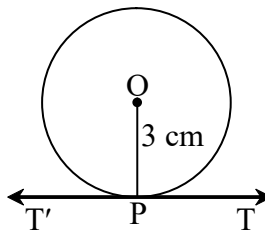
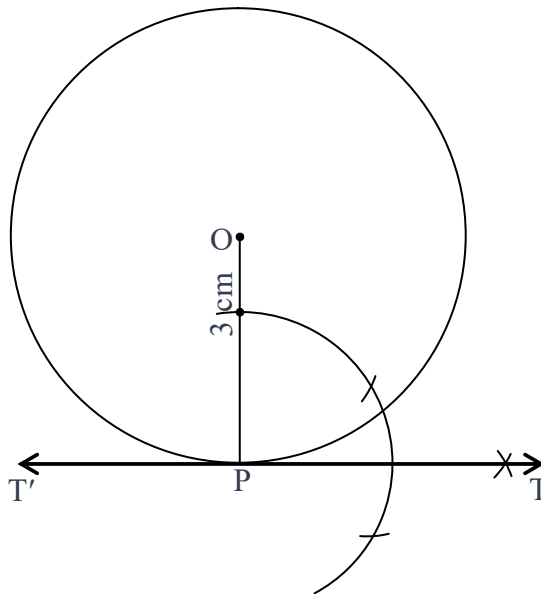
1. Construct a $\triangle PQR$ with any measurement.
2. Draw a ray QX opposite to vertex P making an acute angle.
3. Mark 3 points on QX at equal distances from Q.
4. Join Q_3R . Draw $Q_2R' \parallel Q_3R$.
5. Draw $R'P' \parallel RP$. $\triangle P'Q'R'$ is the required triangle.

Construction:

1. Draw $BC = 5.6$ cm.
2. Draw $\angle CBE = 40^\circ$
3. Draw $\angle EBF = 90^\circ$
4. Draw $\perp r$ bisector of BC to meet BF at O and BC at G .
5. Draw a circle with centre O and radius OB to meet $\perp r$ bisector at I .
6. From C mark an arc of radius 4 cm on BC at D .
7. Join ID and produce it to meet the circle at A .
8. Join AB and AC . $\triangle ABC$ is the required $\triangle$.

Example: 4.29

16. Draw a circle of radius 3 cm. Take a point P on this circle and draw a tangent at P .

Solution:Rough diagram:Diagram:Construction:

1. Draw a circle of radius 3 cm with centre O .
2. Mark a point P on the circle. Join OP .
3. Draw $\perp r$ TT' to OP through P .
4. TT' is the required tangent.

Exercise: 4.4 / 11

17. Draw a tangent at any point R on the circle of radius 3.4 cm and centre at P.

Solution:

Rough diagram:

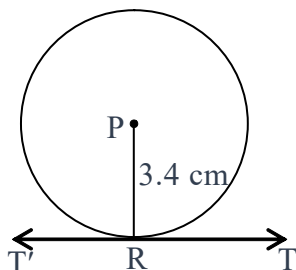
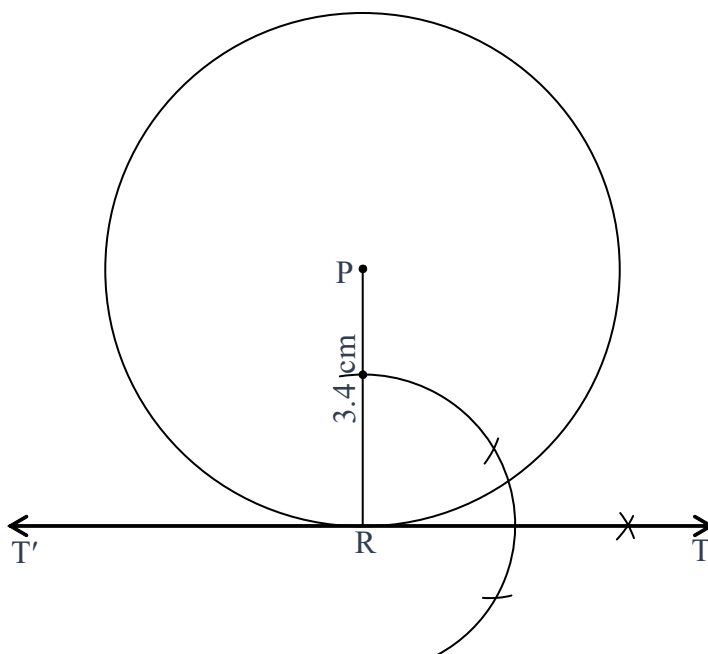


Diagram:



Construction:

1. Draw a circle of radius 3.4 cm with centre P.
 2. Mark a point R on the circle. Join PR.
 3. Draw $TT' \perp PR$ through R.
 4. TT' is the required tangent.
-

GOVT. BOARD EXAM QUESTION PAPER : X - STD : MARCH-2026**Time Allowed : 3.00 Hours]****MATHEMATICS****[Maximum Marks: 100****PART - I****Note:** (i) Answer **all** the questions.

$14 \times 1 = 14$

(ii) Choose the most appropriate answer from the given **four** alternatives and write the option code and the corresponding answer.

1. If $\{(a, 8), (6, b)\}$ represents an identity function, then the value of a and b are respectively
(a) $(8, 6)$ (b) $(8, 8)$ (c) $(6, 8)$ (d) $(6, 6)$
 2. $f(x) = (x + 1)^3 - (x - 1)^3$ represents a function which is
(a) linear (b) cubic (c) reciprocal (d) quadratic
 3. If the H.C.F of 65 and 117 is expressible in the form of $65m - 117$, then the value of m is
(a) 4 (b) 2 (c) 1 (d) 3
 4. The value of $(1^3 + 2^3 + 3^3 + \dots + 15^3) - (1 + 2 + 3 + \dots + 15)$ is
(a) 14400 (b) 14200 (c) 14280 (d) 14520
 5. The solution of the system $x + y - 3z = -6$, $-7y + 7z = 7$, $3z = 9$ is
(a) $x = 1, y = 2, z = 3$ (b) $x = -1, y = 2, z = 3$
(c) $x = -1, y = -2, z = 3$ (d) $x = 1, y = -2, z = 3$
 6. If the given matrix $A = \begin{pmatrix} 1 & 3 & 5 & 7 \\ 2 & 4 & 6 & 8 \\ 9 & 11 & 13 & 15 \end{pmatrix}$ the order of the matrix A^T is
(a) 2×3 (b) 3×2 (c) 3×4 (d) 4×3
 7. The poles of heights 6 m and 11 m stand vertically on a plane ground. If the distance between their feet is 12 m, what is the distance between their tops ?
(a) 13 m (b) 14 m (c) 15 m (d) 12.8 m
 8. The point of intersection of the straight lines $3x - y = 4$ and $x + y = 8$ is
(a) $(5, 3)$ (b) $(2, 4)$ (c) $(3, 5)$ (d) $(4, 4)$
 9. The straight line given by the equation $x = 11$ is
(a) Parallel to X axis (b) Parallel to Y axis
(c) Passing through the origin (d) Passing through the point $(0, 11)$
 10. If $\tan \theta + \cot \theta = 2$, then $\tan^2 \theta + \cot^2 \theta$ is equal to
(a) 2 (b) 4 (c) $\sqrt{2}$ (d) 0
-

11. A solid sphere of radius x cm is melted and cast into a shape of a solid cone of same radius. The height of the cone is
 (a) $3x$ cm (b) x cm (c) $4x$ cm (d) $2x$ cm
12. A spherical ball of radius r_1 units is melted to make 8 new identical balls each of radius r_2 units. Then $r_1 : r_2$ is
 (a) $2 : 1$ (b) $1 : 2$ (c) $4 : 1$ (d) $1 : 4$
13. For a collection of data, $\Sigma x^2 = 140$, $\Sigma x = 28$ and $n = 7$, the standard deviation is
 (a) 4 (b) 2 (c) 16 (d) 8
14. The probability of a red marble selected at random from a jar containing p red, q blue and r green marbles is
 (a) $\frac{q}{p+q+r}$ (b) $\frac{p}{p+q+r}$ (c) $\frac{p+q}{p+q+r}$ (d) $\frac{p+r}{p+q+r}$

PART - II

Note: Answer **any 10** questions. Question No. **28** is **compulsory**.

$10 \times 2 = 20$

15. A relation R is given by the set $\{(x, y/y = x + 3, x \in \{0, 1, 2, 3, 4, 5\})\}$. Determine its domain and range.
16. Let $X = \{-5, 1, 3, 4\}$ and $Y = \{a, b, c\}$. Determine whether the relation $R = \{(-5, a) (1, a) (3, b)\}$ is a function from X to Y .
17. Find the least positive value of x such that $71 \equiv x \pmod{8}$.
18. Find the sum to infinity of $9 + 3 + 1 + \dots$.
19. Reduce the rational expression $\frac{x^2 - 16}{x^2 + 8x + 16}$ to its lowest form.
20. If the difference between a number and its reciprocal is $\frac{24}{5}$, find the number.
21. Construct a 3×3 matrix whose elements are given by $a_{ij} = |i - 2j|$
22. D and E are respectively the points on the sides AB and AC of a ΔABC such that $AB = 5.6$ cm, $AD = 1.4$ cm, $AC = 7.2$ cm and $AE = 1.8$ cm, show that $DE \parallel BC$.
23. Find the slope of a line joining the points $(14, 10)$ and $(14, -6)$.
24. Find the equation of a straight line whose intercepts on the x and y axes are 4 and -6 respectively.
25. Prove that $\frac{1 + \cos \theta}{1 - \cos \theta} = \operatorname{cosec} \theta + \cot \theta$.

26. Find the Standard Deviation of first 21 natural numbers.
27. A die is rolled and a coin is tossed simultaneously. Find the Probability that the die shows an odd number and the coin shows a head.
28. Find the ratio of the volume of a cube to that of a largest sphere which exactly fits into the cube.

PART - III

Note: Answer **any 10** questions. Question No. 42 is **compulsory**.

$$10 \times 5 = 50$$

29. Let $A = \{x \in W/x < 2\}$, $B = \{x \in N/1 < x \leq 4\}$ and $C = \{3, 5\}$. Verify that $A \times (B \cap C) - (A \times B) \cap (A \times C)$
30. If $f(x) = x - 1$, $g(x) = 3x + 1$ and $h(x) = x^2$, then show that $(f \circ g) \circ h = f \circ (g \circ h)$.
31. Find the sum of all natural numbers between 300 and 600 which are divisible by 7.
32. Find the sum to n terms of the series. $3 + 33 + 333 + \dots$
33. If $A = \begin{pmatrix} 5 & 2 & 9 \\ 1 & 2 & 8 \end{pmatrix}$, $B = \begin{pmatrix} 1 & 7 \\ 1 & 2 \\ 5 & -1 \end{pmatrix}$ verify that $(AB)^T = B^T A^T$.
34. Show that the angle bisectors of a triangle are concurrent.
35. Find the area of the quadrilateral formed by the points (8, 6), (5, 11), (-5, 12) and (-4, 3).
36. A(-3, 0), B(10, -2) and C(12, 3) are the vertices of $\triangle ABC$. Find the equation of the altitude through A.
37. Two ships are sailing in the sea on either sides of a lighthouse. The angle of elevation of the top of the lighthouse as observed from the ships are 30° and 45° respectively. If the lighthouse is 200 m high, find the distance between two ships. ($\sqrt{3} = 1.732$)
38. A garden roller whose length is 3 m long and whose diameter is 2.8 m is rolled to level a garden. How much area will it cover in 8 revolutions?
39. A solid right circular cone of diameter 14 cm and height 8 cm is melted to form a hollow sphere. If the external diameter of the sphere is 10 cm, find the internal diameter.
40. Find the coefficient of variation of 24, 26, 33, 37, 29, 31.
41. Two dice are rolled together. Find the Probability of getting a doublet or sum of faces as 4.
42. If α and β are the roots of the equation $2x^2 - 3x + 1 = 0$, then form a quadratic equation whose roots are $\frac{1}{\alpha^2}$ and $\frac{1}{\beta^2}$.
-

PART - IV

Note: Answer **all** the questions.

$$2 \times 8 = 16$$

43. (a) Construct a triangle similar to a given triangle PQR with its sides equal to $\frac{3}{5}$ of the corresponding sides of the triangle PQR. (Scale factor $\frac{3}{5} < 1$).

OR

- (b) Draw a circle of diameter 6 cm from a point P, which is 8 cm away from its centre. Draw two tangents PA and PB to the circle and measure their lengths.
44. (a) Graph the quadratic equation $x^2 - 6x + 9 = 0$ and state its nature of solutions.

OR

- (b) Graph the following linear function $y = \frac{1}{2}x$. Identify the constant of variation and verify it with the graph. Also (i) find y when $x = 9$ (ii) find x when $y = 7.5$.

-oOo-
