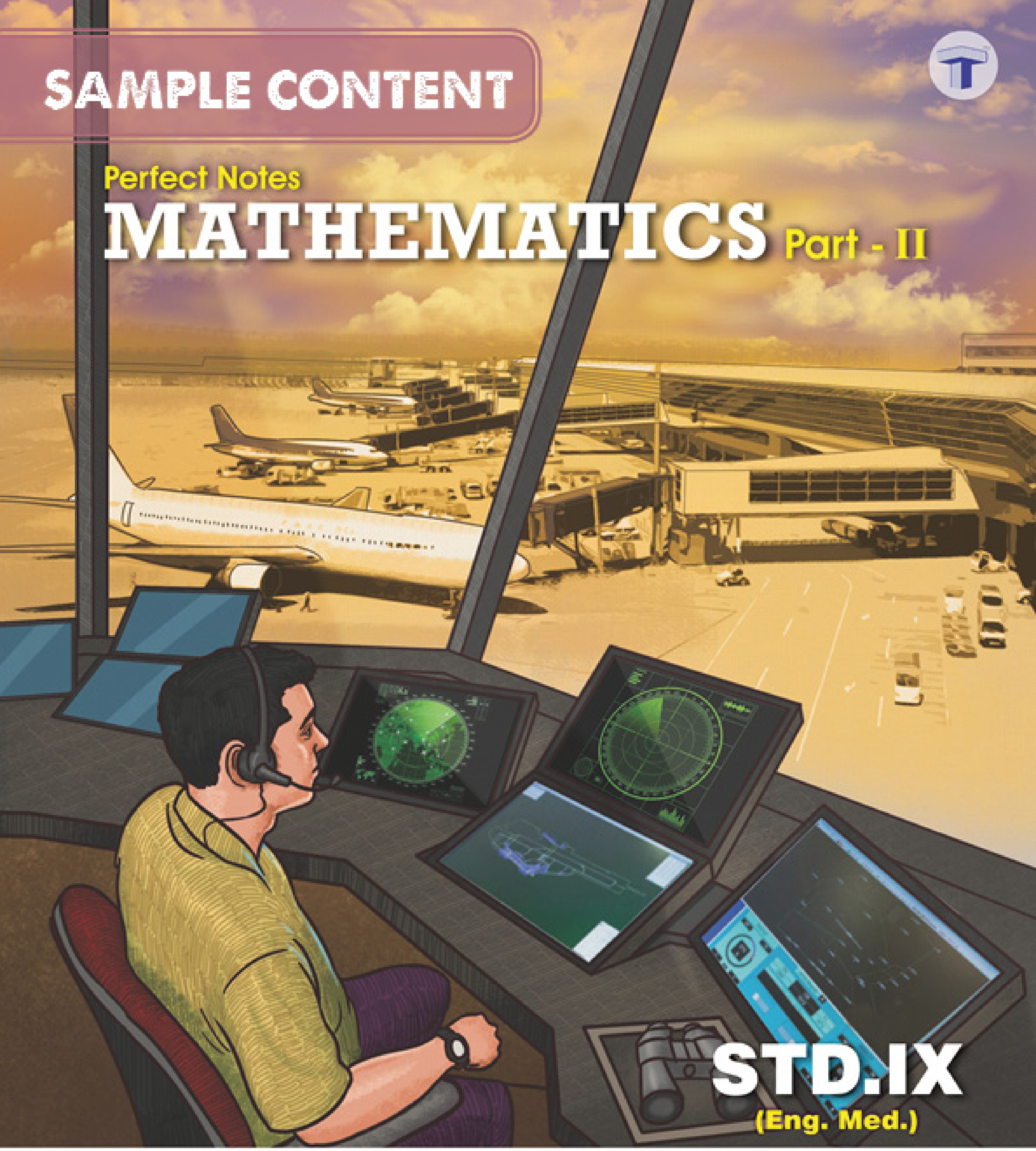

SAMPLE CONTENT

Perfect Notes

MATHEMATICS Part - II

STD.IX
(Eng. Med.)

Target Publications Pvt. Ltd.

Written as per the latest syllabus prescribed by the Maharashtra State Bureau of Textbook Production and Curriculum Research, Pune.

Mathematics Part – II

STD. IX

Salient Features

- Written as per the new textbook.
- Exhaustive coverage of entire syllabus.
- Topic-wise distribution of textual questions and practice problems at the beginning of every chapter.
- Covers solutions to all practice sets and problem sets.
- Includes additional problems for practice.
- MCQs for preparation of competitive examinations.
- Includes practice test for each chapter.
- Constructions drawn with accurate measurements.

SAMPLE CONTENT

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PREFACE

Preparing this **'Mathematics Part - II'** book was a rollercoaster ride. We had a plethora of ideas, suggestions and decisions to ponder over. However, our basic premise was to keep this book in line with the new, improved syllabus and to provide students with an absolutely fresh material.

Mathematics Part - II covers several topics including basic concepts in geometry, logical proofs, trigonometry, co-ordinate geometry and surface area and volume. The study of these topics requires a deep and intrinsic understanding of concepts, terms and formulae. Hence, to ease this task, we present **'Std. IX: Mathematics Part - II'** – a complete and thorough guide, extensively drafted to boost the confidence of students.

For better understanding of different types of questions, topic-wise distribution of textual questions and practice problems has been provided at the beginning of every chapter. Before each practice set, short and easy explanation of different concepts with illustrations for better understanding is given. Solutions and proofs to textual questions and examples are provided in a lucid manner.

'Multiple Choice Questions' based on each chapter facilitate students to prepare for competitive examinations.

'Additional problems for practice' includes additional unsolved problems for practice to help the students sharpen their problem solving skills. 'Solved examples' from textbook are included in this section.

'Apply your knowledge' covers all the textual activities and projects along with their answers.

Every chapter ends with a 'Practice Test'. This test stands as a testimony to the fact that the child has understood the chapter thoroughly.

All the diagrams are neat and have proper labelling. The book has a unique feature that all the constructions are as per the scale.

The journey to create a complete book is strewn with triumphs, failures and near misses. If you think we've nearly missed something or want to applaud us for our triumphs, we'd love to hear from you.

Please write to us on : mail@targetpublications.org

A book affects eternity; one can never tell where its influence stops.

Best of luck to all the aspirants!

From,
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Edition: First

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Solved examples from textbook are indicated by "+".

SAMPLE CONTENT

2 Parallel Lines

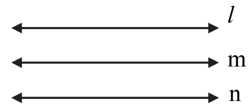
Type of Problems	Practice Set	Q. Nos.
Parallel lines, interior angle theorem, corresponding angle theorem, alternate angle theorem	2.1	Q.1, 2, 3, 4, 5
	Practice Problems (Based on Practice Set 2.1)	Q.1, 2, 3, 4, 5, 6
	Problem Set- 2	Q.3, 5, 6, 7
Test for parallel lines (Interior angles test, alternate angles test, corresponding angles test)	2.2	Q.1, 2, 3, 4, 5, 6
	Practice Problems (Based on Practice Set 2.2)	Q.1, 2, 3
	Problem Set- 2	Q.4, 8
Complementary angles, Supplementary angles	Problem Set- 2	Q.2

SAMPLE CONTENT

Let's Recall

1. Parallel lines:

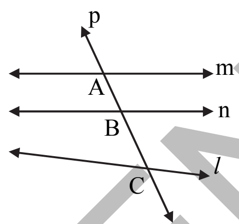
Non intersecting coplanar lines are called parallel lines.
In the adjacent figure, line *l* || line m || line n



2. Transversal:

A line intersecting two or more coplanar lines in distinct points is called transversal.

Line p is a transversal intersecting line m, line n and line *l* at points A, B and C respectively.



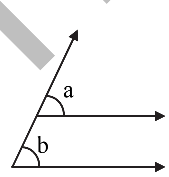
Let's Study

Angles formed by two lines and their transversal

1. Corresponding angles:

Angles whose intersection is a ray and have distinct vertices are called corresponding angles.

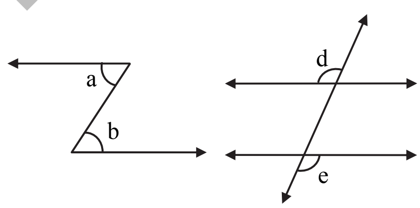
In the adjacent figure, ∠a and ∠b is a pair of corresponding angles.



2. Alternate angles:

Angles whose intersection is a segment, interiors are separate and have distinct vertices are called alternate angles.

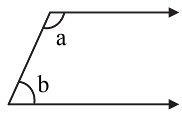
In the adjacent figure, ∠a and ∠b is a pair of alternate interior angles, and ∠d and ∠e is pair of alternate exterior angles.



3. Interior angles:

Angles whose intersection is a segment, have the same interior and distinct vertices are called interior angles.

In the adjacent figure, ∠a and ∠b is a pair of interior angles on the same sides of the transversal.



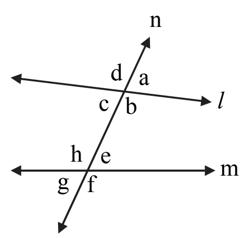
Some important properties:

1. When two lines intersect, the pairs of vertically opposite angles formed are congruent.
2. The angles in a linear pair are supplementary.
3. When one pair of corresponding angles is congruent, then all the remaining pairs of corresponding angles are congruent.
4. When one pair of alternate angles is congruent, then all the remaining pairs of alternate angles are congruent.
5. When one pair of interior angles on one side of the transversal is supplementary, then the other pair of interior angles is also supplementary.

Try This

1. Angles formed by two lines and their transversal. (Textbook pg. no. 13)

Pairs of corresponding angles	Pairs of alternate interior angles	Pairs of interior angles on the same side of the transversal
i. ∠d, ∠h	i. ∠c, ∠e	i. ∠c, ∠h
ii. ∠a, **∠e**	ii. ∠b, ∠h	ii. ∠b, ∠e
iii. ∠c, **∠g**	Pairs of alternate exterior angles	
iv. ∠b, **∠f**	i. ∠d, ∠f	
	ii. ∠a, ∠g	



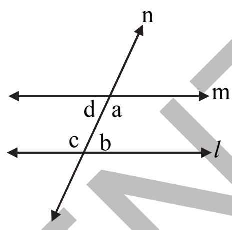
SAMPLE CONTENT

Interior angle theorem

Theorem: If two parallel lines are intersected by a transversal, the interior angles on either side of the transversal are supplementary.

Given: line $l \parallel$ line m, and line n is their transversal.

$\angle a$, $\angle b$ are interior angles formed on one side and $\angle c$, $\angle d$ are interior angles formed on the other side of the transversal.



To prove: $\angle a + \angle b = 180°$

$\angle c + \angle d = 180°$

***Proof*:**

Indirect proof

There are three possibilities.

i. $\angle a + \angle b < 180°$ ii. $\angle a + \angle b > 180°$ iii. $\angle a + \angle b = 180°$

Case I:	Let us assume that $\angle a + \angle b < 180°$ is true.		
	Since $\angle a + \angle b < 180°$,		
$\therefore$	If the lines l and m are produced, they will intersect each other on the side of transversal where $\angle a$ and $\angle b$ are formed.		[Euclid's postulate]
	But, line $l \parallel$ line m		[Given]
$\therefore$	*$\angle a + \angle b < 180°$ is not possible.*	(i)	
Case II:	Let us assume $\angle a + \angle b > 180°$ is true.		
	$\angle a + \angle b > 180°$		
	Here, $\angle a + \angle d = 180°$ and $\angle c + \angle b = 180°$		[Angles in a linear pair]
$\therefore$	$\angle a + \angle d + \angle c + \angle b = 180° + 180° = 360°$		
$\therefore$	$\angle c + \angle d = 360° - (\angle a + \angle b)$		
	But, $\angle a + \angle b > 180°$		
$\therefore$	$[360° - (\angle a + \angle b)] < 180°$		
$\therefore$	$\angle c + \angle d < 180°$		
$\therefore$	If the lines l and m are produced, they will intersect each other on the side of transversal where $\angle c$ and $\angle d$ are formed.		[Euclid's postulate]
	But, line $l \parallel$ line m		[Given]
$\therefore$	$\angle c + \angle d < 180°$ is not posssible.		
	i.e. $\angle a + \angle b > 180°$ is not possible	(ii)	
$\therefore$	$\angle a + \angle b = 180°$ is the only possibility.		[From (i) and (ii)]
$\therefore$	$\angle a + \angle b = 180°$ and $\angle c + \angle d = 180°$		

SAMPLE CONTENT

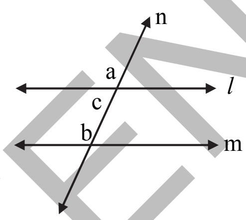
Corresponding angles and Alternate angles theorems

Theorem: The corresponding angles formed by a transversal of two parallel lines are of equal measure.

Given: line l || line m, and line n is the transversal.

To prove: $\angle a = \angle b$

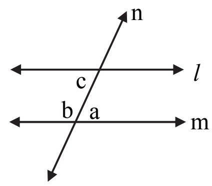
***Proof*:**



	$\angle a + \angle c = 180°$	(i)	[Angles in a linear pair]
	line l || line m, and line n is their transversal		[Given]
∴	$\angle b + \angle c = 180°$	(ii)	[Interior angle theorem]
	$\angle a + \angle c = \angle b + \angle c$		[From (i) and (ii)]
∴	$\angle a = \angle b$		

Theorem: The alternate angles formed by a transversal of two parallel lines are of equal measures.

Given: line l || line m, and
line n is the transversal.

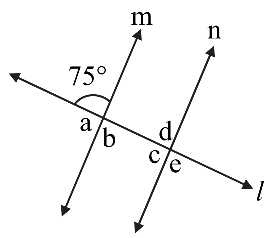


To prove: $\angle a = \angle c$

***Proof*:**

	$\angle a + \angle b = 180°$	(i)	[Angles in a linear pair]
	line l || line m, and line n is their transversal		[Given]
∴	$\angle b + \angle c = 180°$	(ii)	[Interior angle theorem]
	$\angle a + \angle b = \angle b + \angle c$		[From (i) and (ii)]
∴	$\angle a = \angle c$		

Example: In the adjoining figure, line m || line n. Find the measures of $\angle a$, $\angle b$, $\angle c$, $\angle d$ and $\angle e$ from the given measure of angle.



***Solution*:**

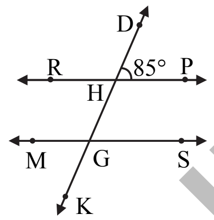
i.	$m\angle a + 75° = 180°$	[Angles in a linear pair]
∴	$m\angle a = 180° - 75°$	
	$m\angle a = 105°$	
ii.	**$m\angle b = 75°$**	[Vertically opposite angles]
iii.	line m || line n and line l is their transversal.	
∴	$m\angle d = m\angle b$	[Alternate angles]
	$m\angle d = 75°$	
iv.	$m\angle b + m\angle c = 180°$	[Interior angles]
∴	$75° + m\angle c = 180°$	
∴	$m\angle c = 180° - 75°$	
	$m\angle c = 105°$	
v.	$m\angle e = m\angle b$	[Corresponding angles]
	$m\angle e = 75°$	

SAMPLE CONTENT

Practice Set 2.1

1. In the adjoining figure, line RP || line MS and line DK is their transversal. ∠DHP = 85°. Find the measures of following angles.

i. ∠RHD
ii. ∠PHG
iii. ∠HGS
iv. ∠MGK



***Solution*:**

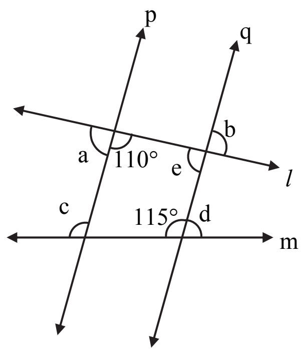
i. m∠DHP + m∠RHD = 180° [Angles in a linear pair]
∴ 85° + m∠RHD = 180°
∴ **m∠RHD = 95°**

ii. m∠PHG = m∠RHD [Vertically opposite angles]
∴ **m∠PHG = 95°**

iii. line RP || line MS and line DK is their transversal.
∴ m∠HGS = m∠DHP [Corresponding angles]
∴ **m∠HGS = 85°**

iv. m∠MGK = m∠HGS [Vertically opposite angles]
∴ **m∠MGK = 85°**

2. In the adjoining figure, line p || line q and line *l* and line m are transversals.
Measures of some angles are shown. Hence find the measures of ∠a, ∠b, ∠c, ∠d.



***Solution*:**

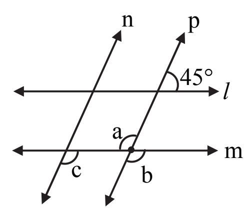
i. 110° + m∠a = 180° [Angles in a linear pair]
∴ **m∠a = 70°**

ii. line p || line q, and line *l* is their transversal.
m∠e + 110° = 180° [Interior angles]
∴ m∠e = 70°
But, m∠b = m∠e [Vertically opposite angles]
∴ **m∠b = 70°**

iii. line p || line q, and line m is their transversal.
∴ **m∠c = 115°** [Corresponding angles]

iv. 115° + m∠d = 180° [Angles in a linear pair]
∴ **m∠d = 65°**

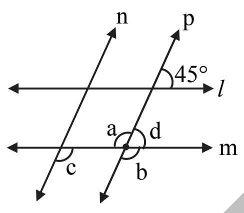
3. In the adjoining figure, line *l* || line m and line n || line p.
Find ∠a, ∠b, ∠c from the given measure of an angle.



***Solution*:**

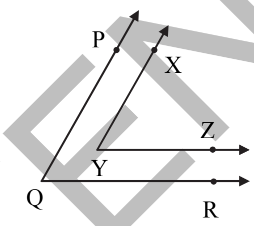
i. line *l* || line m, and line p is their transversal.
∴ m∠d = 45° [Corresponding angles]
But, m∠d + m∠b = 180° [Angles in a linear pair]
∴ 45° + m∠b = 180°
∴ **m∠b = 135°**

SAMPLE CONTENT



ii.	m∠a = m∠b		[Vertically opposite angles]
∴	**m∠a = 135°**		
iii.	line n ‖ line p, and line m is their transversal.		
∴	m∠c = m∠b		[Corresponding angles]
∴	**m∠c = 135°**		

4. In the adjoining figure, sides of ∠PQR and ∠XYZ are parallel to each other. Prove that, ∠PQR ≅ ∠XYZ.

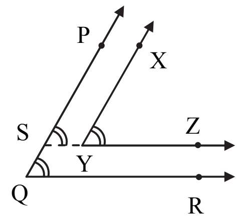


Given: Ray YZ ‖ ray QR and ray YX ‖ ray QP

To prove: ∠PQR ≅ ∠XYZ

Construction: Extend ray YZ in the opposite direction. It intersects ray QP at point S.

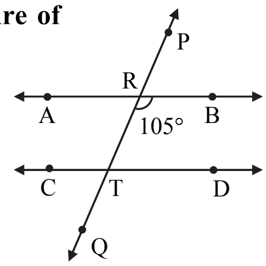
***Proof*:**



	Ray YX ‖ ray QP		[Given]
∴	Ray YX ‖ ray SP and seg SY is their transversal		[P–S–Q]
∴	*∠XYZ ≅ ∠PSY*	(i)	[Corresponding angles]
	ray YZ ‖ ray QR		[Given]
	ray SZ ‖ ray QR and seg PQ is their transversal.		[S–Y–Z]
∴	∠PSY ≅ ∠SQR		[Corresponding angles]
∴	*∠PSY ≅ ∠PQR*	(ii)	[P–S–Q]
∴	**∠PQR ≅ ∠XYZ**		[From (i) and (ii)]

5. In the adjoining figure, line AB ‖ line CD and line PQ is transversal. Measure of one of the angles is given. Hence find the measures of the following angles.

i. ∠ART
ii. ∠CTQ
iii. ∠DTQ
iv. ∠PRB



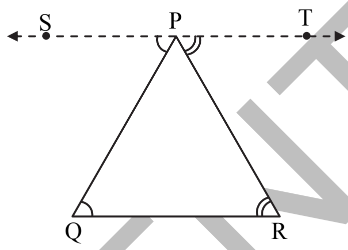
***Solution*:**

i.	m∠ART + m∠BRT = 180°	[Angles in a linear pair]
∴	m∠ART + 105° = 180°	
∴	**m∠ART = 75°**	
ii.	line AB ‖ line CD and line PQ is their transversal.	
∴	m∠CTQ = m∠ART	[Corresponding angles]
∴	**m∠CTQ = 75°**	
iii.	line AB ‖ line CD and line PQ is their transversal.	
∴	m∠DTQ = m∠BRT	[Corresponding angles]
∴	**m∠DTQ = 105°**	
iv	m∠PRB = m∠ART	[Vertically opposite angles]
∴	**m∠PRB = 75°**	

SAMPLE CONTENT

Let's Study

Use of properties of parallel lines



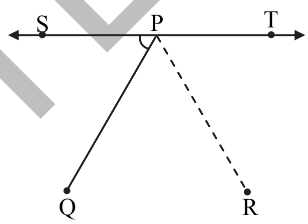
Theorem: The sum of the measures of all the angles of a triangle is 180°.

Given: ΔPQR is any triangle.

To prove: ∠QPR + ∠PQR+ ∠PRQ = 180°.

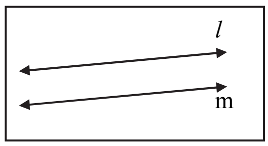
Construction: Draw line ST through point P such that line ST || side QR.

***Proof*:**



	line ST || side QR and seg PQ is their transversal.		[Construction]
∴	*∠PQR = ∠SPQ*	(i)	[Alternate angles]
	line ST || side QR and seg PR is their transversal.		[Construction]
∴	*∠PRQ = ∠TPR*	(ii)	[Alternate angles]
	Adding (i) and (ii), we get ∠PQR + ∠PRQ = ∠SPQ + ∠TPR		
∴	∠PQR + ∠PRQ + ∠QPR = ∠SPQ + ∠TPR + ∠QPR		[Adding ∠QPR to both sides]
	= ∠SPQ + ∠QPT		[∵ ∠TPR + ∠QPR = ∠QPT]
	= 180°		[Angles in a linear pair]
∴	∠QPR + ∠PQR + ∠PRQ = 180°		
∴	The sum of measures of all angles of a triangle is 180°.		

Try This



1. **In the adjoining figure, how will you decide whether line *l* and line m are parallel or not?** (Textbook pg. no. 19)

Ans: In the figure, we observe that line *l* and line m are coplanar and do not intersect each other.

∴ **Line *l* and line m are parallel lines.**

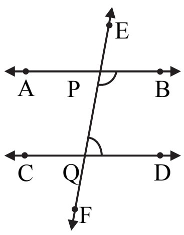
Tests for parallel lines

Whether given two lines are parallel or not can be decided by examining the angles formed by a transversal of the lines.

i. If the interior angles on the same side of a transversal are supplementary, then the lines are parallel.
ii. If one of the pairs of alternate angles is congruent, then the lines are parallel.
iii. If one of the pairs of corresponding angles is congruent, then the lines are parallel.

Interior angles test

Theorem: If the interior angles formed by a transversal of two distinct lines are supplementary, then the two line are parallel.



Given: line EF is the transversal of line AB and line CD.
∠BPQ + ∠PQD = 180°

To prove: line AB || line CD

SAMPLE CONTENT

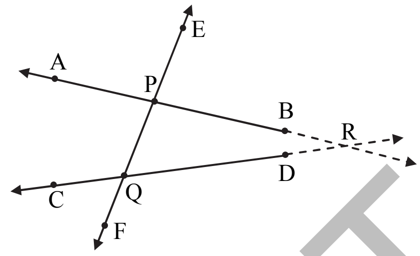
***Proof*:**

Indirect proof

Suppose line AB is not parallel to line CD.

∴ They intersect at point R (say).

Since, points P, Q, R are not collinear, they form a triangle.



In ΔPQR,

∠RPQ + ∠PQR + ∠PRQ = 180° [Sum of the measures of the angles of a triangle is 180°]

∴ ∠BPQ + ∠PQD + ∠PRQ = 180° [P – B – R and Q – D – R]

∴ 180° + ∠PRQ = 180° [Given]

∴ ∠PRQ = 0°

∴ Lines PR and QR are the same i.e. they are not distinct.

This contradicts the given, that line AB and CD are two distinct lines.

So, our assumption is wrong.

∴ line AB || line CD

Alternate angles test

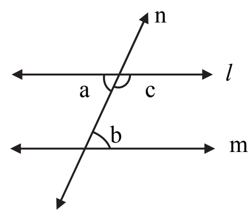
Theorem: If a pair of alternate angles formed by a transversal of two lines is congruent, then the two lines are parallel.

Given: Line n is the transversal of line *l* and line m.

∠a and ∠b is a congruent pair of alternate angles.

i.e., ∠a = ∠b

To prove: line *l* || line m



***Proof*:**

∠a + ∠c = 180° ...(i) [Angles in a linear pair]

∠a = ∠b ...(ii) [Given]

∴ ∠b + ∠c = 180° [From (i) and (ii)]

But ∠b and ∠c are interior angles on lines *l* and m when line n is the transversal.

∴ line *l* || line m [Interior angles test]

Corresponding angles test

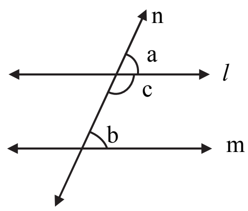
Theorem: If a pair of corresponding angles formed by a transversal of two lines is congruent, then the two lines are parallel.

Given: Line n is the transversal of line *l* and line m.

∠a and ∠b is a congruent pair of corresponding angles.

i.e., ∠a = ∠b

To prove: line *l* || line m



***Proof*:**

∠a + ∠c = 180° ...(i) [Angles in a linear pair]

∠a = ∠b ...(ii) [Given]

∴ ∠b + ∠c = 180° [From (i) and (ii)]

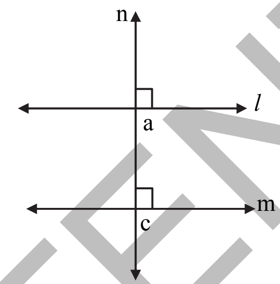
SAMPLE CONTENT

	But ∠b and ∠c are interior angles on lines *l* and m when line n is the transversal.		
∴	line *l* ∥ line m		[Interior angles test]

Corollary I: If a line is perpendicular to two lines in a plane, then the two lines are parallel to each other.

Given: Line n ⊥ line *l*, and line n ⊥ line m

To prove: line *l* ∥ line m



Proof:

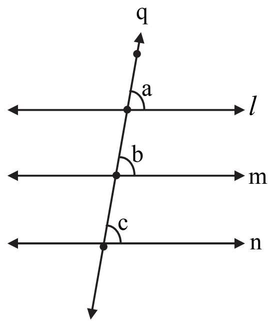
	line n ⊥ line *l*		[Given]
∴	$\angle a = 90^\circ$	(i)	
	line n ⊥ line m		[Given]
∴	$\angle c = 90^\circ$	(ii)	
	∠a = ∠c		[From (i) and (ii)]
	But ∠a and ∠c are corresponding angles on lines *l* and m when line n is the transversal.		
∴	line *l* ∥ line m		[Corresponding angles test]

Corollary II: If two lines in a plane are parallel to a third line in the plane, then those two lines are parallel to each other.

Given: Line *l*, line m and line n are coplanar lines.
line *l* ∥ line m, and line *l* ∥ line n

To prove: line m ∥ line n

Construction: Draw a transversal q intersecting lines *l*, m and n

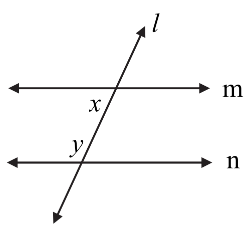


Proof:

	line *l* ∥ line m and line q is their transversal.		
	$\angle a = \angle b$	(i)	[Corresponding angles]
	line *l* ∥ line n and line q is their transversal.		
	$\angle a = \angle c$	(ii)	[Corresponding angles]
∴	∠b = ∠c		[From (i) and (ii)]
	But ∠b and ∠c are corresponding angles on lines m and n when line q is their transversal.		
∴	line m ∥ line n		[Corresponding angles test]

Practice Set 2.2

1. In the adjoining figure, y = 108° and x = 71°. Are the lines m and n parallel? Justify?



Solution:

$x + y = 71^\circ + 108^\circ$

$= 179^\circ$

∴ $x + y \neq 180^\circ$

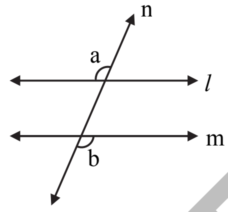
∴ The angles x and y are not supplementary.

∴ x and y do not form a pair of interior angles.

∴ **line m and line n are not parallel lines.**

SAMPLE CONTENT

2. In the adjoining figure, if ∠a ≅ ∠b then prove that line *l* || line m.

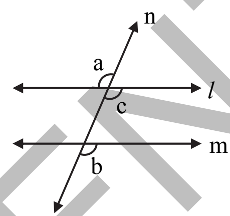


Given: ∠a ≅ ∠b

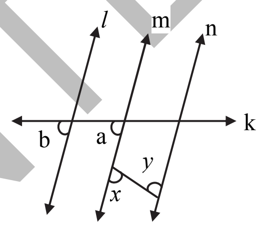
To prove: line *l* || line m

***Proof*:**

	∠a ≅ ∠c	(i)	[Vertically opposite angles]
	But, ∠a ≅ ∠b	(ii)	[Given]
∴	∠b ≅ ∠c		[From (i) and (ii)]
	But, ∠b and ∠c are corresponding angles on lines *l* and m when line n is the transversal.		
∴	**line *l* || line m**		[Corresponding angles test]



3. In the adjoining figure, if ∠a ≅ ∠b and ∠*x* ≅ ∠*y*, then prove that line *l* || line n.

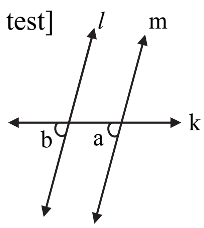


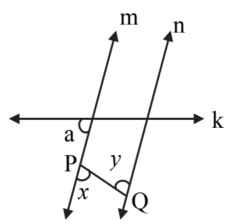
Given: ∠a ≅ ∠b and ∠*x* ≅ ∠*y*

To prove: line *l* || line n

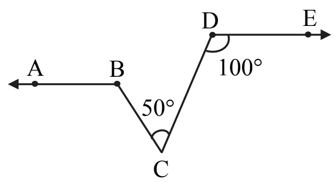
***Proof*:**

	∠a ≅ ∠b		[Given]
	But, ∠a and ∠b are corresponding angles on lines *l* and m when line k is the transversal.		
∴	*line l || line m*	(i)	[Corresponding angles test]
	∠*x* ≅ ∠*y*		[Given]
	But, ∠*x* and ∠*y* are alternate angles on lines m and n when seg PQ is the transversal.		
∴	*line m || line n*	(ii)	[Alternate angles test]
∴	From (i) and (ii),		
	line *l* || line n		[If two lines are parallel to the third line, then they are parallel to each other.]



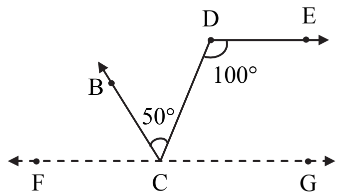


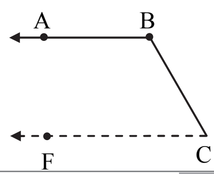
4. In the adjoining figure, if ray BA || ray DE, ∠C = 50° and ∠D = 100°. Find the measure of ∠ABC.
(Hint: Draw a line passing through point C and parallel to line AB.)



***Solution*:**

	line FG || ray BA		[Construction]
	Ray BA || ray DE		[Given]
∴	line FG || ray DE		[If two lines are parallel to the third line, then they are parallel to each other.]
∴	m∠DCF = m∠EDC		[Alternate angles]
∴	m∠DCB + m∠BCF = 100°		[∵ ∠DCF = ∠DCB + ∠BCF]
∴	50° + m∠BCF = 100°		
∴	*m∠BCF = 50°*	(i)	
	Now, line FG || ray BA and seg BC is their transversal.		



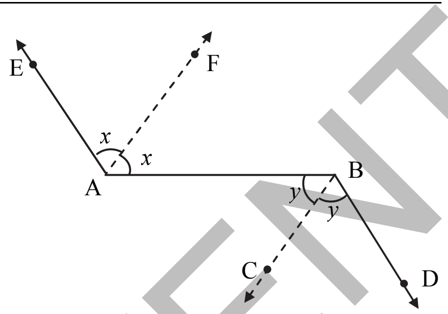


SAMPLE CONTENT

∴	m∠ABC + m∠BCF = 180°	[Interior angles]
∴	m∠ABC + 50° = 180°	[From (i)]
∴	**m∠ABC = 130°**	

---

5. In the adjoining figure, ray AE || ray BD, ray AF is the bisector of ∠EAB and ray BC is the bisector of ∠ABD. Prove that line AF || line BC.

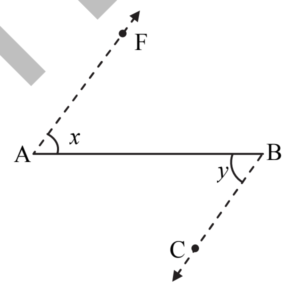


Given: Ray AE || ray BD, and
ray AF and ray BC are the bisectors of ∠EAB and ∠ABD respectively.

To prove: line AF || line BC

***Proof*:**

	Ray AE || ray BD and seg AB is their transversal.	
∴	∠EAB = ∠ABD	[Alternate angles]
∴	$\frac{1}{2}$ ∠EAB = $\frac{1}{2}$ ∠ABD	[Multiplying both sides by $\frac{1}{2}$]
∴	∠FAB = ∠ABC	[Rays AF and BC are the bisectors of ∠EAB and ∠ABD]
	But, ∠FAB and ∠ABC are alternate angles on lines AF and BC when seg AB is the transversal.	
∴	**line AF || line BC**	[Alternate angles test]



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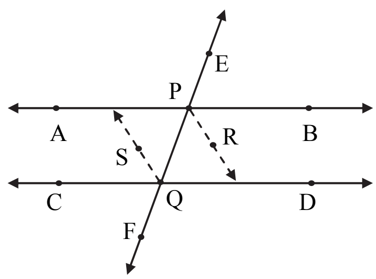
6. A transversal EF of line AB and line CD intersects the lines at point P and Q respectively. Ray PR and ray QS are parallel and bisectors of ∠BPQ and ∠PQC respectively. Prove that line AB || line CD.



Given: Ray PR || ray QS
Ray PR and ray QS are the bisectors of ∠BPQ and ∠PQC respectively.

To prove: line AB || line CD

***Proof*:**

	Ray PR || ray QS and seg PQ is their transversal.	
∴	∠SQP = ∠QPR	[Alternate angles]
∴	2(∠SQP) = 2(∠QPR)	[Multiplying both sides by 2]
∴	∠PQC = ∠QPB	[Rays PR and QS are bisectors of ∠BPQ and ∠PQC]
	But, ∠PQC and ∠QPB are alternate angles on lines AB and CD when line PQ is the transversal.	
∴	**line AB || line CD**	[Alternate angles test]

SAMPLE CONTENT

Problem Set – 2

1. Select the correct alternative and fill in the blanks in the following statements.

i. If a transversal intersects two parallel lines then the sum of interior angles on the same side of the transversal is _______.
(A) 0° (B) 90° (C) 180° (D) 360°

ii. The number of angles formed by a transversal of two lines is _______.
(A) 2 (B) 4 (C) 8 (D) 16

iii. A transversal intersects two parallel lines. If the measure of one of the angles is 40°, then the measure of its corresponding angle is _______
(A) 40° (B) 140° (C) 50° (D) 180°

iv. In ΔABC, ∠A = 76°, ∠B = 48°, then ∠C = _______.
(A) 66° (B) 56° (C) 124° (D) 28°

v. Two parallel lines are intersected by a transversal. If measure of one of the alternate interior angles is 75° then the measure of the other angle is _______.
(A) 105° (B) 15° (C) 75° (D) 45°

Answers:

i. (C) ii. (C) iii. (A) iv. (B)
v. (C)

Hints:

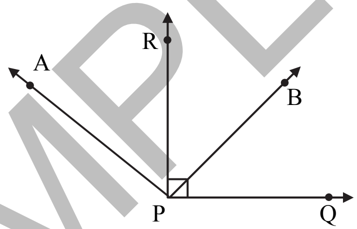
iv. In ΔABC, ∠A + ∠B + ∠C = 180°
∴ ∠C = 180° – 76° – 48° = 56°

---

2. Ray PQ and ray PR are perpendicular to each other. Points B and A are in the interior and exterior of ∠QPR respectively. Ray PB and ray PA are perpendicular to each other.
Draw a figure showing all these rays and write -

i. A pair of complementary angles
ii. A pair of supplementary angles
iii. A pair of congruent angles.

***Solution*:**



i. Complementary angles:
∠RPQ = 90° [ray PQ ⊥ ray PR]
∴ ∠RPB + ∠BPQ = 90° [Angle addition property]
∠APB = 90° [ray PA ⊥ ray PB]
∴ ∠APR + ∠RPB = 90°
∴ Pairs of complementary angles:
a. **∠RPB and ∠BPQ**
b. **∠APR and ∠RPB**

ii. Supplementary angles:
∠APB + ∠RPQ = 90° + 90° = 180°
∴ **∠APB and ∠RPQ are a pair of supplementary angles.**

SAMPLE CONTENT

iii. Congruent angles:

a. **∠APB ≅ ∠RPQ** [Each is of 90°]

b. ∠APB = ∠RPQ

∴ ∠APR + ∠RPB = ∠RPB + ∠BPQ [Angle addition property]

∴ ∠APR = ∠BPQ

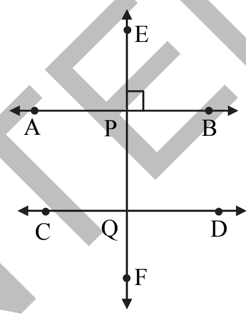
∴ **∠APR ≅ ∠BPQ**

---

3. Prove that, if a line is perpendicular to one of the two parallel lines, then it is perpendicular to the other line also.

Given: line AB || line CD and line EF intersects them at P and Q respectively.
line EF ⊥ line AB

To prove: line EF ⊥ line CD



***Proof*:**

line AB || line CD and line EF is their transversal.

∴ *∠EPB ≅ ∠PQD* ... (i) [Corresponding angles]

line EF ⊥ line AB [Given]

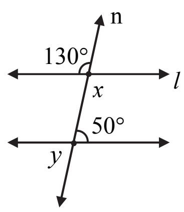
∴ *∠EPB = 90°* ... (ii)

∴ ∠PQD = 90° [From (i) and (ii)]

∴ **line EF ⊥ line CD**

---

4. In the adjoining figure, measures of some angles are shown. Using the measures find the measures of ∠*x* and ∠*y* and hence show that line *l* || line m.



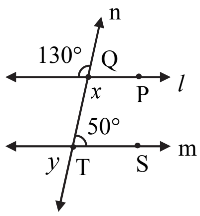
***Proof*:**

∠*x* = 130°
∠*y* = 50° } [Vertically opposite angles]

Here, m∠PQT + m∠QTS = 130° + 50°
= 180°

But, ∠ PQT and ∠ QTS are a pair of interior angles on lines *l* and m when line n is the transversal.

∴ **line *l* || line m** [Interior angles test]



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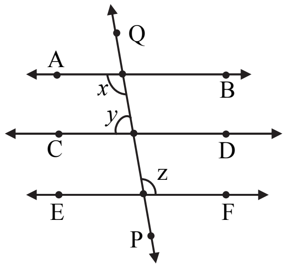
5. In the adjoining figure, Line AB || line CD || line EF and line QP is their transversal. If *y* : z = 3 : 7 then find the measure of ∠*x*.



***Solution*:**

∠DHI = ∠GHC [Vertically opposite angles]

∴ ∠DHI = *y*

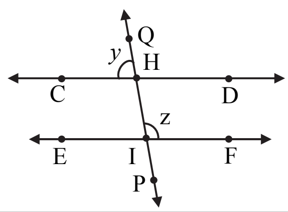
$\frac{y}{z} = \frac{3}{7}$ [Given]

∴ $y = \frac{3}{7}z$ ... (i)

Now, line CD || line EF and line QP is their transversal.

∴ ∠DHI + ∠HIF = 180° [Interior angles]

∴ *y* + z = 180°



SAMPLE CONTENT

∴ $\frac{3}{7}z + z = 180°$ [From (i)]

∴ 3z + 7z = 180° × 7 [Multiplying both sides by 7]

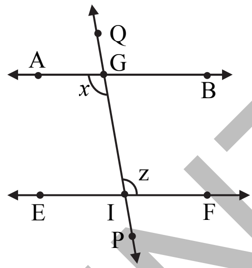
∴ 10z = 1260°

∴ *z = 126°* (ii)

Line AB || line EF and line QP is their transversal.

∴ ∠*x* = ∠z [Alternate angles]

∴ **∠*x* = 126°** [From (ii)]



6. In the adjoining figure, if line q || line r, line p is their transversal and if a = 80°, find the values of f and g.

***Solution*:**

i. ∠a = 80° [Given]

∠c = ∠a [Vertically opposite angles]

∴ *∠c = 80°* (i)

Now, line q || line r and line p is their transversal.

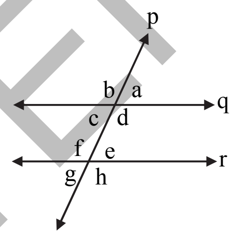
∴ ∠g = ∠c [Corresponding angles]

∴ **∠g = 80°** [From (i)]

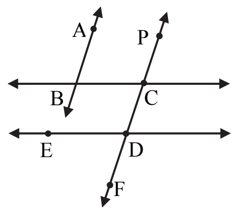
ii. Also, ∠f + ∠c = 180° [Interior angles]

∴ ∠f + 80° = 180° [From (i)]

∴ **∠f = 100°**



7. In the adjoining figure, if line AB || line CF and line BC || line ED then prove that ∠ABC = ∠FDE.



Given: line AB || line CF and line BC || line ED

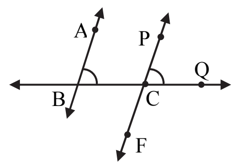
To prove: ∠ABC = ∠FDE

***Proof*:**

line AB || line PF and line BC is their transversal.

∴ *∠ABC = ∠PCQ* (i) [Corresponding angles]

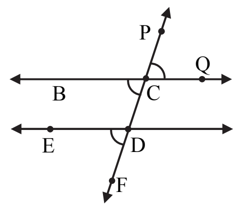
∠PCQ = ∠BCD (ii) [Vertically opposite angles]



line BC || line ED and line CD is their transversal.

∴ *∠BCD = ∠FDE* (iii) [Corresponding angles]

∴ **∠ABC = ∠FDE** [From (i), (ii) and (iii)]

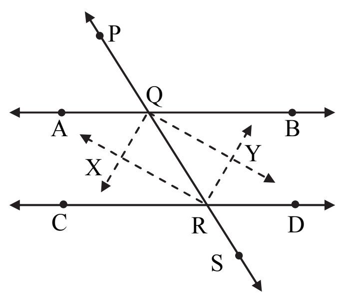


8. In the adjoining figure, line PS is a transversal of parallel line AB and line CD. If Ray QX, ray QY, ray RX, ray RY are angle bisectors, then prove that □ QXRY is a rectangle.

Given: line AB || line CD

Rays QX, RX, QY, RY are the bisectors of ∠AQR, ∠QRC, ∠BQR and ∠QRD respectively.

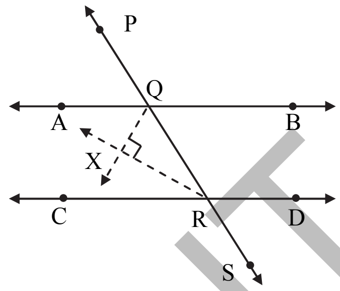
To prove: □QXRY is a rectangle.

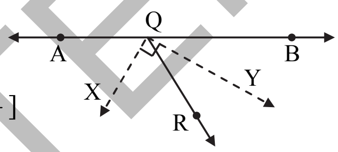


SAMPLE CONTENT

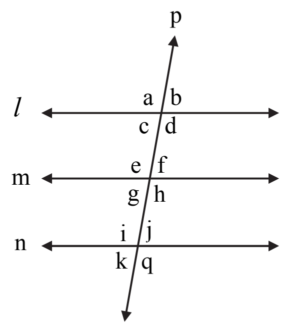
***Proof*:**

	Line AB ∥ line CD and line PS is their transversal.		
∴	∠AQR + ∠QRC = 180°		[Interior angles]
∴	$\frac{1}{2}$ ∠AQR + $\frac{1}{2}$ ∠QRC = $\frac{1}{2}$ × 180°		[Multiplying both sides by $\frac{1}{2}$]
∴	*∠XQR + ∠XRQ = 90°*	(i)	[Rays QX and RX are the bisectors of ∠AQR and ∠QRC]
	Now, in ΔXQR, ∠XQR + ∠XRQ + ∠QXR = 180°		[Sum of the measures of the angles of a triangle is 180°.]
∴	90° + ∠QXR = 180°		[From (i)]
∴	*∠QXR = 90°*	(ii)	
	Also, ∠AQR + ∠BQR = 180°		[Angles in a linear pair]
∴	$\frac{1}{2}$ ∠AQR + $\frac{1}{2}$ ∠BQR = $\frac{1}{2}$ × 180°		[Multiplying both sides by $\frac{1}{2}$]
∴	∠XQR + ∠YQR = 90°		[Rays QX and QY are the bisectors of ∠AQR and ∠BQR]
∴	*∠XQY = 90°*	(iii)	[Angle addition property]
	Similarly we can prove that,		
	∠QYR = ∠XRY = 90°	(iv)	
∴	**□QXRY is a rectangle.**		[From (ii), (iii) and (iv)]





Multiple Choice Questions



1. In the adjacent figure, which of the following is a pair of alternate exterior angles?
   (A) ∠a, ∠f (B) ∠e, ∠j
   (C) ∠d, ∠e (D) ∠f, ∠k

2. In the adjacent figure which of the following is not a pair of corresponding angles?
   (A) ∠c, ∠e (B) ∠q, ∠h
   (C) ∠c, ∠k (D) ∠d, ∠h

3. In the adjacent figure, if line *l* ∥ line m ∥ line n, then which of the following options is correct?
   (A) ∠d + ∠e = 180° (B) ∠h + ∠j = 180°
   (C) ∠g + ∠f = 180° (D) ∠i + ∠h = 180°

4. If the interior angles formed by a transversal of two distinct line are _______, then the two lines are parallel.
   (A) congruent (B) complementary
   (C) supplementary (D) none of these.

5. If ∠a and ∠b are angles in a linear pair, and ∠a and ∠d are corresponding angles, then ∠b + ∠d =
   (A) 2∠b (B) 90° (C) 180° (D) < 180°

6. The sum of the measures of any two alternate angles is equal to _______ times the measure of any of the those angles.
   (A) one (B) two (C) three (D) half

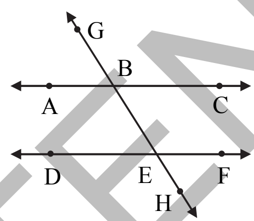
7. In a right angled triangle ABC, if ∠B = 90°, then ∠A + ∠C =
   (A) 45° (B) 90° (C) 180° (D) none of these

SAMPLE CONTENT

8. If in a pair of interior angles on the same side of transversal, the measure of one angle is less than 90°, then the measure of the other angle will be
   (A) equal to 90° (B) greater than 90° but less than 180°
   (C) less than 90° (D) greater than 180°

9. If the ratio of the measures of the interior angles on the same side of the transversal is 5 : 4, then the measure of the smaller angle is
   (A) 40° (B) 50° (C) 80° (D) 100°

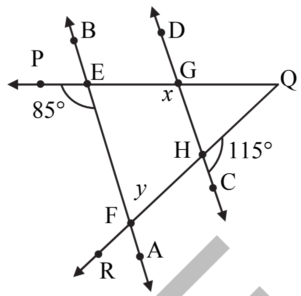
10. In the adjacent figure, if ∠ABE : ∠BED = 3 : 7, then, ∠CBE : ∠BEF =
   (A) 3 : 7
   (B) 3 : 10
   (C) 7 : 3
   (D) 10 : 3



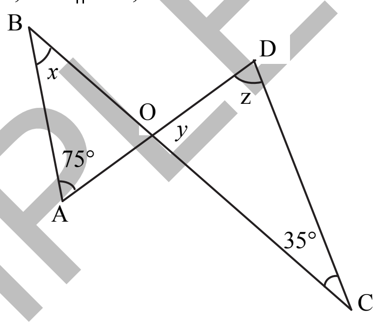
Additional Problems for Practice

Based on Practice Set 2.1

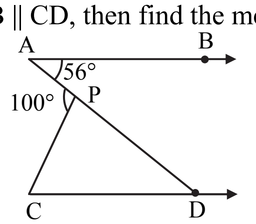
1. In the figure below, if line AB || line CD, then find the values of x and y.



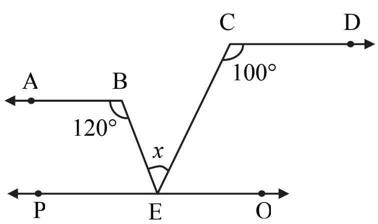
2. In the figure below, AB || CD, then find the values of x, y and z.



3. In the figure below, if AB || CD, then find the measures of ∠PCD and ∠CPD.

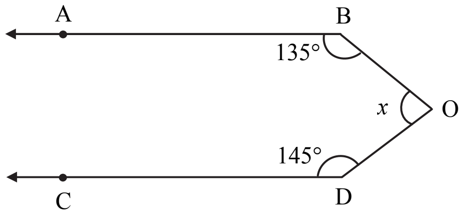


4. In the figure below, if line AB || line CD, then find the value of x.

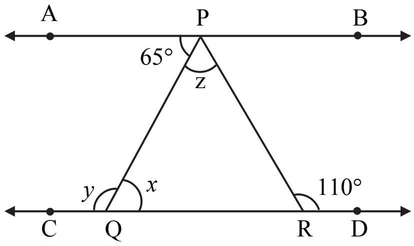


SAMPLE CONTENT

5. In the figure below, AB || CD, then find the value of x.

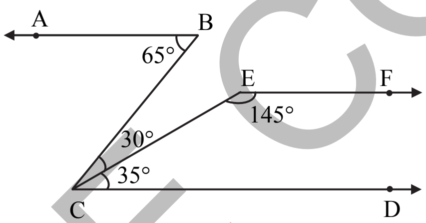


6. In the figure below, line AB || line CD, then find the values of x, y and z.

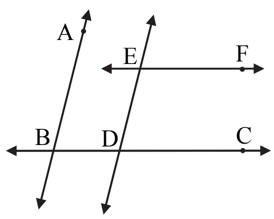


Based on Practice Set 2.2

1. Prove that the bisector of a pair of interior angles formed on the same side of the transversal are perpendicular to each other.
2. In the figure below, m∠ABC = 65°, m∠DCE = 35°, m∠CEF = 145°, m∠BCE = 30°, then prove that ray AB || ray EF.

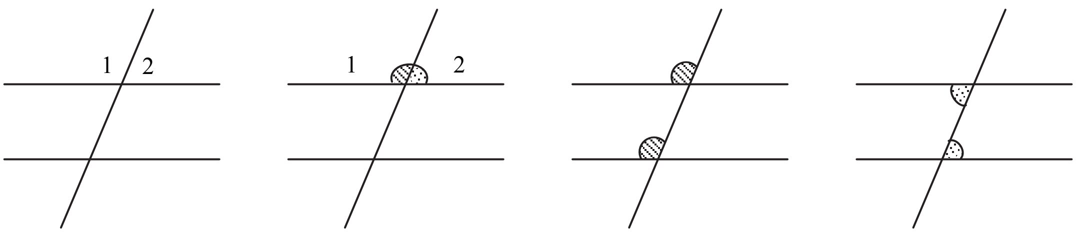


3. In the adjacent figure, line AB || line ED and line EF || line DC, then prove that ∠ABC and ∠DEF are supplementary.



Apply your knowledge

1. **To verify the properties of angles formed by a transversal of two parallel lines.** (Textbook pg. no. 14)
Take a piece of thick coloured paper. Draw a pair of parallel lines and a transversal on it. Paste straight sticks on the lines. Eight angles will be formed. Cut pieces of coloured paper, as shown in the figure, which will just fit at the corners of ∠1 and ∠2. Place the pieces near different pairs of corresponding angles, alternate angles and interior angles and verify their properties.



[Students should attempt the above activity on their own.]

SAMPLE CONTENT

Practice Test

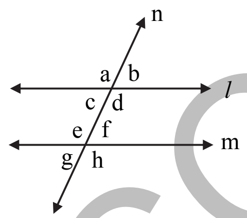
Total marks: 25

1. Choose the correct alternative for each of the following questions. [5]

i. If two lines intersect each other, then
   (A) the pair of alternate angles are congruent.
   (B) the pair of vertically opposite angles are congruent.
   (C) the pair of corresponding angles are congruent.
   (D) the pair of interior angles are supplementary.

ii. If a transversal intersects two parallel lines, then which of the following is not true?
   (A) A pair of corresponding angles is congruent.
   (B) A pair of interior angles is complementary.
   (C) A pair of alternate angles is congruent.
   (D) A pair of interior angles is supplementary.

iii. In the figure given below if line *l* || line m, and line n is their transversal, then which of the following statements is incorrect?



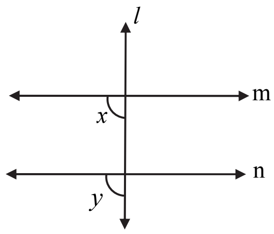
(A) a + b = 180° (B) d + f = 180°
(C) e + g = 180° (D) c + f = 180°

iv. Find the measure of the alternate angle of the angle which is in linear pair with the angle of measure of 65°.
   (A) 65° (B) 25° (C) 115° (D) 130°

v. Which of the following pairs is a pair of interior angles formed by two parallel lines and on the same side of the transversal?
   (A) 30°, 60° (B) 30°, 150° (C) 60°, 130° (D) 50°, 120°

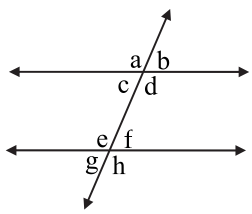
2. Attempt the following. [6]

i. In the figure below, if $\angle x = 84°$ and $\angle y = 83°$, then state whether the statement 'line m || line n' is true or false. Justify.



ii. Prove that if a line is perpendicular to two coplanar lines, then those two lines are parallel to each other.

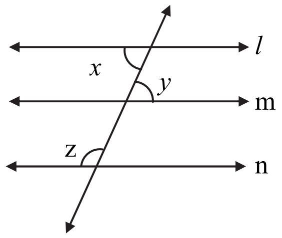
iii. In the adjoining figure, write down the pairs of alternate exterior angles.



SAMPLE CONTENT

3. Attempt the following. **[9]**

i. In the adjoining figure, if $\angle x \cong \angle y$ and $x + z = 180°$, then prove that line m || line n.

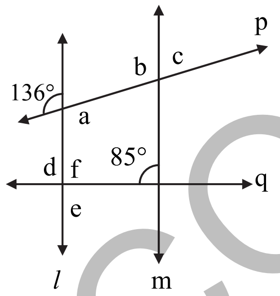


ii. If a transversal intersects two parallel lines, then show that the bisectors of any pair of alternate angles are also parallel.

iii. Prove that the sum of the measures of all the angles of a triangle is 180°.

4. Attempt any of the following. **[5]**

i. In the figure given below, line l || line m. Find the measures of ∠a, ∠b, ∠c, ∠d and ∠f using the measures given.



ii. Prove that if a transversal intersects two parallel lines then the quadrilateral formed by the angle bisectors of the interior angles on both sides of the transversal is a rectangle.

Answers

Multiple Choice Questions

1. (D) 2. (A) 3. (B) 4. (C) 5. (C) 6. (B) 7. (B) 8. (B) 9. (C) 10. (C)

Additional Problems for Practice

Based on Practice Set 2.1

1. $x = 85°$, $y = 65°$
2. $x = 35°$, $y = 70°$, $z = 75°$
3. ∠PCD = 44°, ∠CPD = 80°
4. $x = 40°$
5. $x = 80°$
6. $x = 65°$, $y = 115°$, $z = 45°$

Practice Test

1. i. B ii. B iii. D iv. C v. B

2. i. False iii. ∠a and ∠h; ∠b and ∠g

4. i. ∠a = 136°, ∠b = 136°, ∠c = 44°, ∠d = 85°, ∠f = 95°

SAMPLE CONTENT

Std.IX

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