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CLASS X · MATHEMATICS BASIC (241) · CBSE BOARD EXAMINATION 2027

CHAPTER 9 BASIC

Some Applications of Trigonometry

Chapter Practice Booklet · Questions only · Answers in the separate Answer Booklet

6 guided method questions | 31 practice questions | 3 case studies | Basic (430 series) board question index

INSIDE THIS BOOKLET

1	**Chapter Notes** Angles of elevation and depression, which ratio to use, one and two right triangles, speed and time questions, model answers + exam snapshot	2
A	**Guided Practice** 6 fill-in-the-blank method questions	5
B	**NCERT Practice** 18 questions	6
C	**Board Pattern Practice** 13 questions, with frequency stars	8
D	**Case-Based Questions** 3 case studies	9
E	**Board PYQ Index (Basic)** Real 430-series questions by type	11
F	**My Mistakes** Your error log	12

STUDENT DETAILS

NAME _____

CLASS & SECTION _____

ROLL NO. _____

BOOKLET STARTED ON _____

CHAPTER TEST SCORE ____ / 20

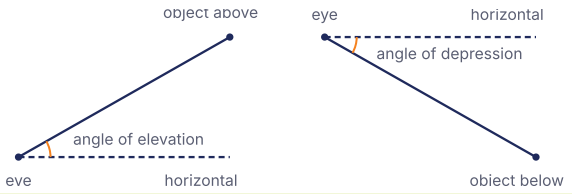
1

READ THIS FIRST · MATHEMATICS BASIC

Chapter Notes

The whole chapter in short-note form: every definition, formula, method and model answer. Revise from here – you should not need the textbook again.

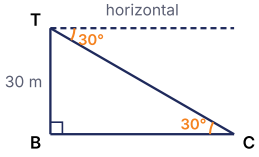
1 Angle of elevation and angle of depression



Line of sight: the line from the eye of the observer to the object.
Angle of elevation: the angle between the line of sight and the horizontal when the object is **above** the eye (you raise your head).
Angle of depression: the angle between the line of sight and the horizontal when the object is **below** the eye (you lower your head).

- Both angles are measured from the **horizontal**, never from the vertical.
- A tower, tree, pole or building stands vertically, so it makes a right angle with the ground.
- The syllabus uses only 30°, 45° and 60°, and at most two right triangles in one question.

2 Angle of depression = angle of elevation



The horizontal through the observer is parallel to the ground, and the line of sight cuts both. So the angle of depression at the top equals the angle of elevation at the bottom (alternate angles).

Put the angle **inside the triangle at the ground point**, then solve as usual.

EXAMPLE

The angle of depression of a boat from the top of a 30 m cliff is 30°. The angle at the boat is 30°, so $\tan 30^\circ = \dfrac{30}{BC}$ and $BC = 30\sqrt{3} \approx 51.96$ m.

3 Which ratio to use

You know / want	Use
height and horizontal distance	$\tan\theta = \dfrac{\text{height}}{\text{distance}}$
height and a slant length (ladder, string, rope, wire)	$\sin\theta = \dfrac{\text{height}}{\text{slant}}$
horizontal distance and a slant length	$\cos\theta = \dfrac{\text{distance}}{\text{slant}}$

θ	30°	45°	60°
sin	$\frac{1}{2}$	$\frac{1}{\sqrt{2}}$	$\frac{\sqrt{3}}{2}$
cos	$\frac{\sqrt{3}}{2}$	$\frac{1}{\sqrt{2}}$	$\frac{1}{2}$
tan	$\frac{1}{\sqrt{3}}$	1	$\sqrt{3}$

Quick facts for height h seen at angle θ from the ground: at 30° the distance is $h\sqrt{3}$; at 45° it is h; at 60° it is $\dfrac{h}{\sqrt{3}}$. Use $\sqrt{3} \approx 1.732$ and $\sqrt{2} \approx 1.414$.

4 Five steps for every question

1. Draw a neat figure: vertical lines for towers and trees, a horizontal line for the ground; mark the right angles. In a 5-mark question the figure earns 1 mark.
2. Mark the given lengths and angles. Call the unknowns h and x.
3. In each right triangle write **one** ratio that links a known side and an unknown side.
4. Solve. With two equations, find the common side first, then the other unknown.
5. Rationalise, put $\sqrt{3} = 1.732$ only in the last line if a decimal is asked, and write the unit.

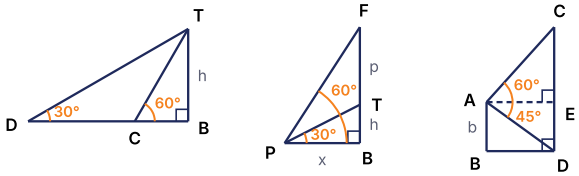
EYE HEIGHT

If the observer's eye is 1.5 m above the ground, the right triangle starts at eye level. Height of the object = (side found from the triangle) + 1.5 m.

5 One right triangle

- **Tower and distance:** $h = x\tan\theta$. From 40 m away at 45°, $h = 40$ m.
- **Ladder, rope, string:** the slant side is the hypotenuse. A 10 m ladder at 60° reaches $10\sin 60^\circ = 5\sqrt{3} \approx 8.66$ m up the wall; its foot is $10\cos 60^\circ = 5$ m from the wall.
- **Find the angle:** work out the ratio and match it with the table. A 6 m pole with a $2\sqrt{3}$ m shadow: $\tan\theta = \dfrac{6}{2\sqrt{3}} = \sqrt{3}$, so the Sun's elevation is 60°.
- **Broken tree:** the bent part is the hypotenuse; height of the tree = standing part + bent part.

6 Two right triangles



- **Two points on one side** (first figure): the height h is common. Write the far distance and the near distance in terms of h, then subtract.
  30° and 60°: far $= h\sqrt{3}$, near $= \dfrac{h}{\sqrt{3}}$, gap $= \dfrac{2h}{\sqrt{3}}$
- **Pole on a tower** (second figure): the distance x is common. One equation for the top of the tower, one for the top of the pole.
- **From the roof of a building** (third figure): draw the horizontal AE. The depression to the foot gives the distance; the elevation to the top gives the part above E. Height = b+ that part.

7 Speed and time questions

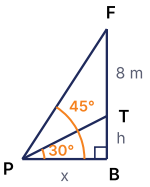
- Distance moved between two sightings = difference of the two horizontal distances.
- Speed $= \dfrac{\text{distance}}{\text{time}}$.
- To change m/s into km/h, multiply by 3.6 (that is, $\frac{18}{5}$).
- At a steady speed, time is proportional to distance.

EXAMPLE

A car drives straight towards a tower and is seen from the top at depressions 30° and then 60°. Its distances from the foot are $h\sqrt{3}$ and $\dfrac{h}{\sqrt{3}}$. It covered $\dfrac{2h}{\sqrt{3}}$ and still has $\dfrac{h}{\sqrt{3}}$ to go, which is half. If the first part took 10 s, it reaches the foot 5 s later.

8 Model answer: pole on a building (5 marks)

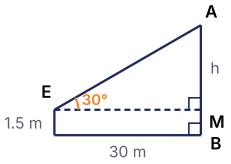
An 8 m flagstaff stands on top of a building. From a point P on the ground the angles of elevation of the bottom and the top of the flagstaff are 30° and 45°. Find the height of the building.



1. Correct figure: building $BT = h$, flagstaff $TF = 8$ m, $PB = x$ 1
2. In $\triangle PBF$: $\tan 45^\circ = \dfrac{h+8}{x} \to x = h + 8$ 1
3. In $\triangle PBT$: $\tan 30^\circ = \dfrac{h}{x} \to x = \sqrt{3}h$ 1
4. $\sqrt{3}h = h + 8 \to h = \dfrac{8}{\sqrt{3}-1}$ 1
5. $h = \dfrac{8(\sqrt{3}+1)}{2} = 4(\sqrt{3}+1) \approx 10.93$ m 1

9 Model answer: eye height (3 marks)

A girl whose eyes are 1.5 m above the ground stands 30 m from a tree. The angle of elevation of the top of the tree from her eyes is 30°. Find the height of the tree.



1. Figure: $EM = GB = 30$ m, eye height $EG = MB = 1.5$ m, $AM = h$ 1
2. $\tan 30^\circ = \dfrac{h}{30} \to h = \dfrac{30}{\sqrt{3}} = 10\sqrt{3} \approx 17.32$ m 1
3. Height of the tree $= 17.32 + 1.5 = 18.82$ m 1

10 Checks that save marks

- Always draw the figure, even if it is not asked for.
- The angle of depression lies outside the triangle. Move it to the ground point before you use it.
- From the ground point, the tower is the **opposite** side and the ground is the **adjacent** side.
- Add the observer's eye height at the end.
- Keep $\sqrt{3}$ until the last line; then write "$\approx$".
- Sense check: a bigger angle of elevation means you are nearer the object.

Exam snapshot

What the board asks, and how to prepare

SYLLABUS 2026–27

- Heights and distances: angle of elevation, angle of depression.
- Simple problems on heights and distances.
- Problems should not involve more than **two right triangles**.
- Angles of elevation and depression are only **30°, 45° and 60°**.

BOARD WEIGHTAGE

12 / 80

Unit V Trigonometry together. Basic papers ask a 1-mark question on an angle of elevation or depression, and a 4–5 mark case study or long answer from this chapter.

MOST ASKED IN BASIC BOARD PAPERS + SAMPLE PAPER 2026–27 (3 PAPERS CHECKED)

How often	Question type	Marks	Papers
★★☆	4–5 marks: a case study or long answer on heights and distances	4–5	2 of 3
★★☆	1 mark: name or find an angle of elevation or depression	1	2 of 3
★☆☆	Angles of depression with speed and time (drone and car)	5	1 of 3

MISTAKES THAT COST MARKS

- Mixing up the angle of elevation and the angle of depression.
- Writing $\tan\theta = \dfrac{\text{distance}}{\text{height}}$ (it is the other way round).
- Swapping $\tan 30^\circ = \dfrac{1}{\sqrt{3}}$ and $\tan 60^\circ = \sqrt{3}$.
- Forgetting the eye height of the observer.
- Not drawing a figure before writing the equations.
- Leaving out the unit (m) in the answer.

HOW TO USE THIS BOOKLET

1. **Day 1:** Notes, then Part A (guided methods) – fill every blank.
2. **Day 2:** Part B (NCERT practice). Do every MUST DO question first.
3. **Day 3:** Part C (board pattern), Part D (case studies) and the real board questions in Part E.
4. **Wed 6 Jan: zero-period chapter test – 20 marks in 40 minutes, without the booklet.**
5. Check every answer in the Answer Booklet. Write each mistake on the My Mistakes page.

RULES AT A GLANCE

Height and distance	$\tan\theta = \dfrac{h}{x}$
Height and slant	$\sin\theta = \dfrac{h}{\text{slant}}$
Depression	equals the elevation at the ground point
30° / 45° / 60°	distance $= h\sqrt{3}\,/\,h\,/\,\dfrac{h}{\sqrt{3}}$
Speed	m/s $\times \dfrac{18}{5}$ = km/h

A

PART A · LEARN THE METHODS

Guided Practice

Fill in the blanks to learn each board method step by step. Then use the same steps on your own in Part B.

One right triangle

A1. From a point 20 m from the foot of a tower, the angle of elevation of its top is 60°. Complete the steps to find the height of the tower. MUST DO [2]

Height and distance, so use _____. $\tan 60^\circ = \dfrac{h}{\text{___}} \rightarrow h = 20 \times \text{___} = \text{____}$ m

A2. A kite string 50 m long makes 30° with the ground. Complete the steps to find the height of the kite. [2]

The string is the slant side, so use _____. $\sin 30^\circ = \dfrac{h}{\text{___}} \rightarrow h = 50 \times \text{___} = \text{____}$ m

A3. A 9 m pole casts a shadow $3\sqrt{3}$ m long. Complete the steps to find the angle of elevation of the Sun. [2]

$\tan\theta = \dfrac{\text{height}}{\text{shadow}} = \dfrac{\text{___}}{\text{___}} = \text{___} \rightarrow \theta = \text{___}$

A4. A boy whose eyes are 1.2 m above the ground stands 25 m from a flagpole. The angle of elevation of its top from his eyes is 45°. Complete the steps to find the height of the flagpole. [2]

Part above eye level $= 25 \times \tan 45^\circ =$ ___ m. Add the eye height: ___ + ___ = ___ m

Depression and two triangles

A5. From the top of a 15 m building, the angle of depression of a scooter on the road is 45°. Complete the steps to find how far the scooter is from the building. MUST DO [2]

Angle of elevation of the top from the scooter = ___ (alternate angles). $\tan 45^\circ = \frac{\text{___}}{d} \rightarrow d =$ ___ m

A6. The angles of elevation of the top of a 30 m tower from two points on the same side of it are 30° and 60°. Complete the steps to find the distance between the points. MUST DO [2]

Far point: $\frac{30}{\tan 30^\circ} =$ ____ m. Near point: $\frac{30}{\tan 60^\circ} =$ ____ m

Distance = ____ − ____ = ____ ≈ ____ m

B

PART B · NCERT PRACTICE

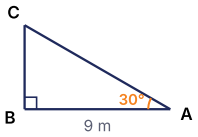
NCERT Practice

The same skills as the NCERT examples and exercises, with new numbers. Basic papers are built on NCERT, so finish every question.

One right triangle

B1. A rope 16 m long is stretched tight from the top of a vertical pole to a peg on the ground. It makes an angle of 30° with the ground. Find the height of the pole. MUST DO [2]

B2. A storm breaks a tree. The top part bends over and its tip touches the ground 9 m from the foot of the tree, making 30° with the ground. Find the height of the tree before it broke. MUST DO [3]



B3. A park has two slides. Find the length of each slide. [2]

(i) for small children: the top is 1.8 m high and the slide makes 30° with the ground

(ii) for older children: the top is 3 m high and the slide makes 60° with the ground

B4. The angle of elevation of the top of a tower from a point on the ground 45 m from its foot is 30°. Find the height of the tower. MUST DO [2]

B5. A kite flies 75 m above the ground. Its string, tied to a point on the ground, makes 60° with the ground. Find the length of the string, taking it to be straight. [2]

B6. A 12 m pole casts a shadow $4\sqrt{3}$ m long. The angle of elevation of the Sun is: [1]

(a) 30° (b) 45° (c) 60° (d) 90°

B7. A 10 m ladder leans against a wall and makes 60° with the ground. How far is its foot from the wall? [1]

(a) 5 m (b) $5\sqrt{3}$ m (c) $10\sqrt{3}$ m (d) 20 m

Two right triangles

B8. A boy whose eyes are 1.6 m above the ground stands some distance from a building 31.6 m high. As he walks towards the building, the angle of elevation of its top from his eyes changes from 30° to 60°. How far did he walk? MUST DO [3]

B9. From a point on the ground, the angles of elevation of the bottom and the top of a mobile tower fixed on a 24 m high building are 45° and 60°. Find the height of the tower. MUST DO [3]

B10. A statue 2 m tall stands on a pedestal. From a point on the ground, the angle of elevation of the top of the statue is 60° and that of the top of the pedestal is 45°. Find the height of the pedestal. [3]

B11. The angle of elevation of the top of a building from the foot of a tower is 30°, and the angle of elevation of the top of the tower from the foot of the building is 60°. The tower is 60 m high. Find the height of the building. [3]

B12. Two poles of equal height stand exactly opposite each other on the two sides of a road 100 m wide. From a point on the road between them, the angles of elevation of their tops are 60° and 30°. Find the height of the poles and the distances of the point from them. [4]

B13. A TV tower stands on one bank of a canal. From a point on the other bank, directly opposite the tower, the angle of elevation of its top is 60°. From a point 30 m further back on the same line, the angle is 30°. Find the height of the tower and the width of the canal. [4]

Angles of depression

B14. From the top of a 9 m high building, the angle of elevation of the top of a tower is 60° and the angle of depression of its foot is 45°. Find the height of the tower. MUST DO [3]

B15. From the top of a 60 m high lighthouse, the angles of depression of two ships on the same side of it, in line with its foot, are 30° and 45°. Find the distance between the ships. MUST DO [3]

B16. A girl whose eyes are 1.5 m above the ground sees a balloon drifting horizontally at a height of 61.5 m above the ground. The angle of elevation of the balloon from her eyes is 60°. Some time later it is 30°. How far did the balloon move? [3]

B17. A straight road leads to the foot of a tower. A man at the top sees a car at an angle of depression of 30°, coming towards the tower at a steady speed. Eight seconds later the angle of depression is 60°. How much longer will the car take to reach the foot of the tower? MUST DO [3]

B18. The angle of depression of a car from the top of a 20 m building is 45°. The distance of the car from the foot of the building is: [1]

(a) 10 m (b) $\frac{20}{\sqrt{3}}$ m (c) 20 m (d) $20\sqrt{3}$ m

C

PART C · BOARD PATTERN (BASIC)

Board Pattern Practice

Question types from real Mathematics Basic papers (430 series) and the 2026–27 Sample Paper. ★★★ = asked in all 3 papers checked · ★★ = 2 papers · ★ = 1 paper.

ASSERTION–REASON: HOW TO ANSWER

(a) Both A and R are true, and R is the correct explanation of A.
(b) Both A and R are true, but R is not the correct explanation of A.
(c) A is true, but R is false.
(d) A is false, but R is true.

One right triangle: a height, a length or an angle

★★☆ 2 of 3 papers · 1–4 marks

C1. The angle of elevation of the top of a 24 m high tower from a point $8\sqrt{3}$ m from its foot is: [1] MUST DO

(a) $30°$ (b) $45°$ (c) $60°$ (d) $90°$

C2. A kite string 80 m long makes $30°$ with the ground. The height of the kite is: MUST DO [1]

(a) 40 m (b) $40\sqrt{3}$ m (c) $80\sqrt{3}$ m (d) 160 m

C3. A ladder makes $60°$ with the ground and its foot is 3.5 m from the wall. The length of the ladder is: [1]

(a) $3.5\sqrt{3}$ m (b) 7 m (c) $7\sqrt{3}$ m (d) 14 m

C4. ASSERTION–REASON [1]

Assertion (A): The angle of elevation of the top of a 30 m tower from a point 30 m from its foot is $60°$.

Reason (R): $\tan 45^\circ = 1$.

C5. A tree 12 m high casts a shadow. Find the length of the shadow when the Sun's elevation is (i) $30°$ (ii) $60°$. MUST DO [2]

C6. A vertical pole 10 m high is held by a wire from its top to a point on the ground. The wire makes $45°$ with the ground. Find the length of the wire and the distance of the point from the foot of the pole. [2]

Two right triangles: two angles, or a pole on a tower

★☆☆ 1 of 3 papers · 5 marks

C7. The angle of elevation of the top of a tower from a point 4 m from its foot is $60°$. Find the angle of elevation of its top from a point 12 m from its foot, on the same line. [2]

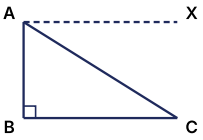
C8. A flagstaff 7 m long is fixed on top of a tower. From a point on the ground, the angles of elevation of the top of the flagstaff and the top of the tower are $60°$ and $45°$. Find the height of the tower. (Use $\sqrt{3} = 1.732$.) MUST DO [5]

C9. Rhea and Kabir stand on level ground on opposite sides of a lamp post, in line with its foot and 80 m apart. The angles of elevation of the top of the post from Rhea and Kabir are $30°$ and $60°$. Find the height of the post and the distance of each of them from it. MUST DO [5]

Angles of depression

★★☆ 2 of 3 papers · 1–5 marks

C10. In the figure, AB is a building, C is a car on the road and AX is horizontal. The angle of depression of the car from A is: [1]



MUST DO

(a) $\angle BAC$ (b) $\angle XAC$ (c) $\angle ABC$ (d) $\angle BAX$

C11. From the top of a 50 m cliff, the angle of depression of a boat is 60°. The distance of the boat from the foot of the cliff is: [1]

(a) $50\sqrt{3}$ m (b) 25 m (c) 100 m (d) $\dfrac{50\sqrt{3}}{3}$ m

C12. From the top of an 80 m high lighthouse, the angles of depression of two boats on opposite sides of it, in line with its foot, are 60° and 45°. (Use $\sqrt{3} = 1.732$.) MUST DO [5]

(i) Find the distance between the boats.

(ii) The boat seen at 60° sails straight away from the lighthouse until its angle of depression is 30°. How far does it sail?

C13. A drone hovers $75\sqrt{3}$ m above a straight road. It sees a car coming towards the point directly below it at an angle of depression of 30°. Ten seconds later the angle of depression is 60°. Find the speed of the car in m/s and in km/h. MUST DO [5]

D

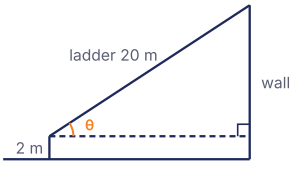
PART D · SECTION E STYLE

Case-Based Questions

Each case carries 4 marks (1 + 1 + 2), as in Section E of the board paper. Underline the numbers in the passage before you start.

D1. Case Study · Fire-Brigade Ladder [4]

A fire-brigade truck parks beside a building. Its ladder is 20 m long and its lower end is hinged on the truck 2 m above the ground. The ladder can be raised to different angles θ with the horizontal.



(i) If $\theta = 60^\circ$, how high above the ground does the top of the ladder reach? [1]

(ii) For $\theta = 60^\circ$, find the horizontal distance from the lower end of the ladder to the wall. [1]

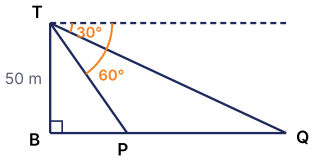
(iii) A person waits at a window 12 m above the ground. At what angle θ must the ladder be set to just reach the window? [2]

OR

(iii) If $\theta = 45^\circ$, find the height reached by the top of the ladder and the horizontal distance to the wall. [2]

D2. Case Study · Coastguard Lighthouse [4]

A coastguard stands at the top T of a 50 m high lighthouse. She sees two boats P and Q on the same side of the lighthouse, in line with its foot B, at angles of depression of 60° and 30°.



(i) How far is boat P from the foot of the lighthouse? [1]

(ii) How far is boat Q from the foot of the lighthouse? [1]

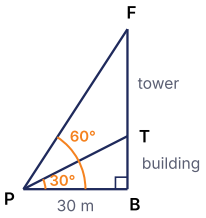
(iii) Find the distance between the two boats. [2]

OR

(iii) Boat Q sails straight towards the lighthouse at 2 m/s. How long does it take to reach the position of boat P? [2]

D3. Case Study · Tower on a Rooftop [4]

A mobile tower TF stands on the flat roof of a building BT. From a point P on the ground, 30 m from the foot B of the building, the angle of elevation of the top of the building is 30° and that of the top of the tower is 60°.



(i) Find the height of the building. [1]

(ii) Find the height of the top of the tower above the ground. [1]

(iii) Find the height of the tower. [2]

OR

(iii) Find the length of the line of sight from P to the top of the tower, and from P to the top of the building. [2]

E

PART E · REAL BOARD QUESTIONS

Board PYQ Index (Basic)

Real questions from the Mathematics Basic (430 series) papers and the 2026–27 Sample Paper, by type. Open the official paper and solve the listed questions.

Frequency	Question type	Marks	Where asked (year: paper code, question number)	Practise here
★★☆	**One right triangle: an angle of elevation, a ladder**	1–4	**2026:** 430/1/2 Q11 · **2025:** 430/1/1 Q36 (case study)	A1–A4, B1–B7, C1–C6, D1
★★☆	**Angles of depression (name the angle; a drone and a car)**	1–5	**2025:** 430/1/1 Q12 · **SQP 2026–27:** Q35(A)	A5, B14–B18, C10–C13, D2
★☆☆	**Two right triangles (a statue on a pedestal)**	5	**SQP 2026–27:** Q35(B)	A6, B8–B13, C7–C9, D3

Papers checked (3): 2026 – 430/1/2 (Section A only could be read online) · 2025 – 430/1/1 · CBSE Sample Paper 2026–27 (Mathematics Basic). Sets of one code family share most questions, so they count as one paper. Download the official papers from cbse.gov.in → Previous Year Question Papers → Mathematics Basic.

PART F · YOUR RECORD

F My Mistakes

Write down each mistake from this chapter, including the chapter test.

Every wrong answer is a free lesson. Write it here, find the rule you missed, and redo the question after three days. Bring this page to class before the next test.

Date	Part & Q No.	What went wrong	Correct rule or method	Redone ✓