# MATHEMATICS

## WORKSHEET_161024

## CHAPTER 09 SOME APPLICATIONS OF TRIGONOMETRY

## (ANSWERS)

**SUBJECT: MATHEMATICS** **MAX. MARKS : 40**

**CLASS : X** **DURATION : 1½ hrs**

**General Instructions:**

(i). **All** questions are compulsory.

(ii). This question paper contains 2**0** questions divided into five Sections A, B, C, D and E.

(iii). **Section A** comprises of **10 MCQs** of **1 mark** each. **Section B** comprises of 4 questions of **2 marks** each. **Section C** comprises of 3 questions of **3 marks** each. **Section D** comprises of 1 question of **5 marks** each and **Section E** comprises of 2 Case Study Based Questions of **4 marks** each.

(iv). There is no overall choice.

(v). Use of Calculators is not permitted

## SECTION – A

**Questions 1 to 10 carry 1 mark each.**

**1.** A pole 6 m high casts a shadow $2\sqrt{3}$ m long on the ground, then the Sun's elevation is:

(a) 60° (b) 45° (c) 30° (d) 90°

Ans. (a) 60°

**2.** The angle of elevation of the top of a 10 m high tree at a point 10 m away from the base of the tower is:

(a) 90° (b) 60° (c) 30° (d) 45°

Ans. (d) 45°

**3.** The angle of elevation of the top of a tower from a point 20 metres away from its base is 45°. The height of the tower is

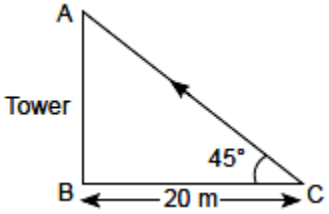
(a) 10 m (b) 20 m (c) 30 m (d) $20\sqrt{3}$ m

Ans. (b) 20 m

$\frac{AB}{BC} = \tan 45°$

$\Rightarrow \frac{AB}{20} = 1$

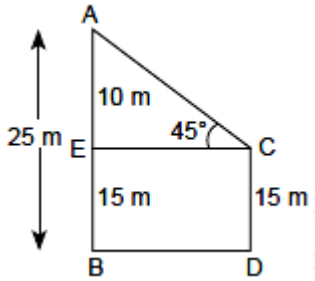
$\Rightarrow AB = 20$ m.




**4.** Two poles are 25 m and 15 m high and the line joining their tops makes an angle of 45° with the horizontal. The distance between these poles is

(a) 5 m (b) 8 m (c) 9 m (d) 10 m

Ans. (d) 10 m




$\frac{AE}{EC} = \tan 45°$

$\Rightarrow \frac{10}{EC} = 1$

$\Rightarrow EC = 10$ m.

**5.** A portion of a 60 m long tree is broken by tornado and the top struck up the ground making an angle of 30° with the ground level. The height of the point where the tree is broken is equal to
(a) 30 m (b) 35 m (c) 40 m (d) 20 m
Ans. (d) 20 m

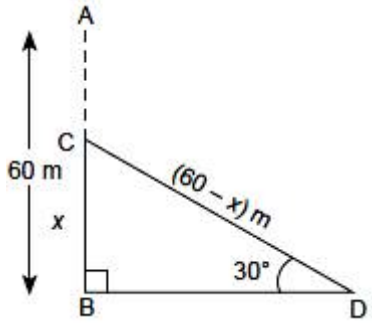
Let AB is the tree which is broken at C.

$$\frac{BC}{DC} = \sin 30°$$

$$\Rightarrow \frac{x}{60-x} = \frac{1}{2}$$

$$\Rightarrow 2x = 60 - x$$

$$\Rightarrow x = 20 \text{ m}$$



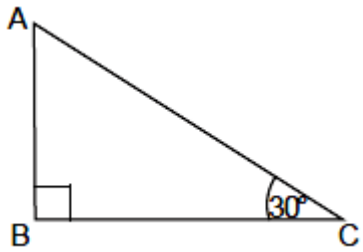

**6.** If the height of the tower and the distance from the tower's foot to a point is increased by 10% then the angle of elevation on the top of the tower is:
(a) decreases (b) do not change (c) increase (d) none of the above
Ans. (b) do not change

**7.** The length of a string between a kite and a point on the ground is 85 m. If the string makes an angle θ with the ground level such that tan θ = 15/8, then height of the kite from the ground is:
(a) 75 m (b) 79.41 m (c) 80 m (d) 72.5 m
Ans. (a) 75 m

**8.** If the length of the ladder placed against a wall is twice the distance between the foot of the ladder and the wall. The angle made by the ladder with the horizontal is:
(a) 60° (b) 30° (c) 45° (d) 22.5°
Ans. (a) 60°

**In the following questions 9 and 10, a statement of assertion (A) is followed by a statement of reason (R). Mark the correct choice as:**
(a) Both assertion (A) and reason (R) are true and reason (R) is the correct explanation of assertion (A).
(b) Both assertion (A) and reason (R) are true but reason (R) is not the correct explanation of assertion (A).
(c) Assertion (A) is true but reason (R) is false.
(d) Assertion (A) is false but reason (R) is true.

**9. Assertion (A):** In the given figure, if AC = 5m, the length of AB is 2.5 m.



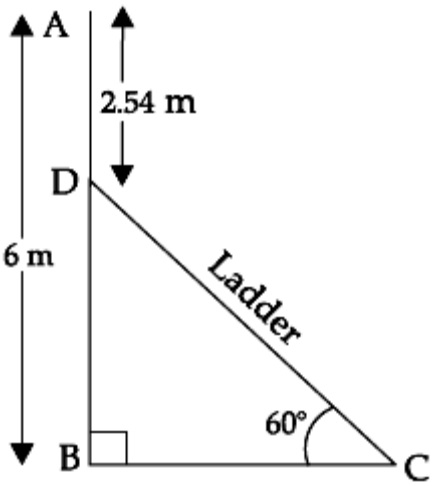

**Reason (R):** $\sin\theta = \frac{AB}{AC} = \frac{Perpendicular}{Hypotenuse}$ in a ΔABC, in which ∠B = 90° and ∠ACB = θ.
Ans. (a) Both assertion (A) and reason (R) are true and reason (R) is the correct explanation of assertion (A).

**10. Assertion (A):** The length of the shadow of a vertical tower is $\sqrt{3}$ times the height of tower. So, the angle of elevation of the Sun at this instant is 45°.
**Reason (R):** The value of tan 45° is 1.
Ans. (d) Assertion (A) is false but reason (R) is true.

## SECTION – B

**Questions 11 to 14 carry 2 marks each.**

**11.** In the given figure, AB is a 6 m high pole and DC is a ladder inclined at an angle of 60° to the horizontal and reaches up to point D of pole. If AD = 2.54 m, find the length of the ladder. (use $\sqrt{3} = 1.73$)




Ans. Given, AD = 2.54 m

$\therefore$ DB = 6 - 2.54 = 3.46 m

In $\Delta BCD$, $\angle B = 90^0$

$$\sin 60^0 = \frac{BD}{DC} \Rightarrow \frac{\sqrt{3}}{2} = \frac{3.46}{DC}$$

$$\Rightarrow DC = \frac{3.46 \times 2}{\sqrt{3}} = \frac{3.46 \times 2}{1.73} = 4m$$

$\therefore$ Length of ladder = 4 m.

**12.** The top of two transmission towers of heights 30 m and 24 m are connected by a wire. If the wire makes an angle of 60° with the horizontal, then find the length of the wire.

Ans. Here, CD = 30 m [height of big tower]

AB = 24 m [height of small tower]

$\therefore$ DE = CD – CE

$\Rightarrow$ DE = CD – AB [$\because$ AB = CE]

$\Rightarrow$DE = 30 – 24

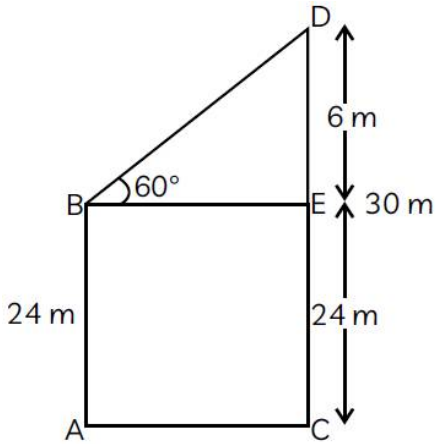
$\Rightarrow$DE = 6 m

In $\Delta BDE$, $\sin 60° = DE/BD$

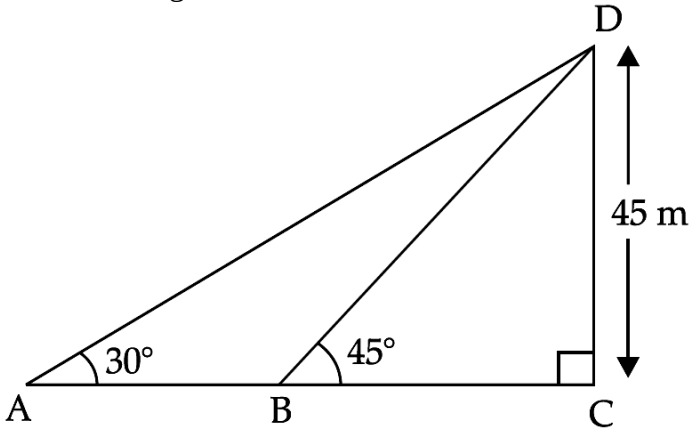
$\Rightarrow \sqrt{3}/2 = 6/BD$

$\Rightarrow$BD = $4\sqrt{3}$m

$\therefore$ The length of wire is $4\sqrt{3}$ m.

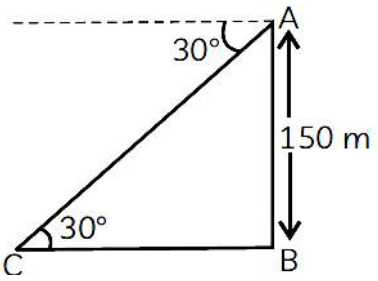



**13.** In the figure below, what is the length of AB ?



Ans. In ΔDBC, tan 45° = DC/BC
⇒ 1 = 45/BC
⇒ BC = 45 m.
In ΔDAC, tan 30° = DC/(AB + BC)
⇒ $1/\sqrt{3} = 45/(AB + 45)$
⇒ $AB + 45 = 45\sqrt{3}$
⇒ $AB = 45(\sqrt{3} - 1)$m

**14.** The angle of depression of a car parked on the road from the top of a 150 m high tower is 30°. Find the distance of the car from the tower (in metres)




Ans. Here, AB is a tower of height 150 m.
In ΔABC, tan 30° = AB/BC
⇒ $1/\sqrt{3} = 150/BC$
⇒ $BC = 150\sqrt{3}$ m
Hence, the distance of the car from the tower is $150\sqrt{3}$ m.

## SECTION – C

**Questions 15 to 17 carry 3 marks each.**

**15.** A person standing on the bank of a river observes that the angle of the elevation of the top of a tree standing on the opposite bank is 60°. When he moves 40 m away from the bank, he finds the angle of elevation to be 30°. Find the height of the tree and the width of the river. ($\sqrt{3}$ = 1.732)

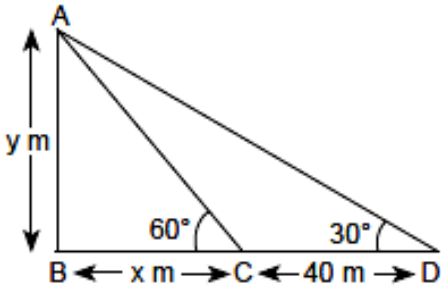
Ans. Let AB is tree and BC is width of river.
Also, let AB = $y$ m and BC = $x$ m
∴ ∠BCA = 60° and ∠BDA = 30°

In right ΔABC, $\frac{AB}{BC}$ = tan 60°

$\Rightarrow \frac{y}{x} = \sqrt{3} \Rightarrow y = \sqrt{3}x$ ...(i)

In right ΔABD, $\frac{AB}{BD}$ = tan 30°

$\Rightarrow \frac{y}{x+40} = \frac{1}{\sqrt{3}} \Rightarrow \sqrt{3}y = x + 40$




$\Rightarrow \sqrt{3}\ (\sqrt{3}x) = x + 40$ [Using (i)]
$\Rightarrow 2x = 40 \Rightarrow x = 20$ m
$\therefore y = \sqrt{3} \times 20 = 1.732 \times 20$
= 34.64 m
∴ Height of tree = 34.64 m and width of river = 20 m

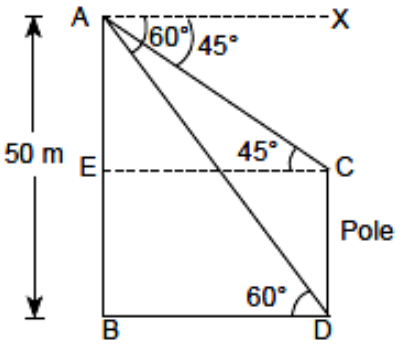
**16.** From the top of a tower 50 m high the angles of depression of the top and bottom of a pole are observed to be 45° and 60° respectively. Find the height of the pole.

Ans. In ΔABD, $\frac{BD}{AB}$ = cot 60°

$\Rightarrow \frac{BD}{50} = \frac{1}{\sqrt{3}} \Rightarrow BD = \frac{50}{\sqrt{3}}$ m

BD = EC $\Rightarrow$ EC = $\frac{50}{\sqrt{3}}m$

In ΔAEC, $\frac{AE}{EC}$ = tan 45°



$\Rightarrow$ AE = EC $\Rightarrow$ AE = $\frac{50}{\sqrt{3}}m$

Now BE = AB – AE = $50 - \frac{50}{\sqrt{3}}$

$= \frac{50\sqrt{3} - 50}{\sqrt{3}} = \frac{50(\sqrt{3}-1)}{\sqrt{3}}$m

DC = BE = $\frac{50(\sqrt{3}-1)}{\sqrt{3}}$m

**17.** The angle of elevation of the top of a building from the foot of the tower is 30° and the angle of elevation of the top of the tower from the foot of the building is 45°. If the tower is 30 m high, find the height of the building.

Ans.

Let height of the building = *h*

In $\Delta$ABC, $\frac{AB}{AC}$ = tan 45° $\Rightarrow$ $\frac{30}{AC} = 1$

$\Rightarrow$ AC = 30 m

In $\Delta$ACD,

$\frac{CD}{AC} = \tan 30°$

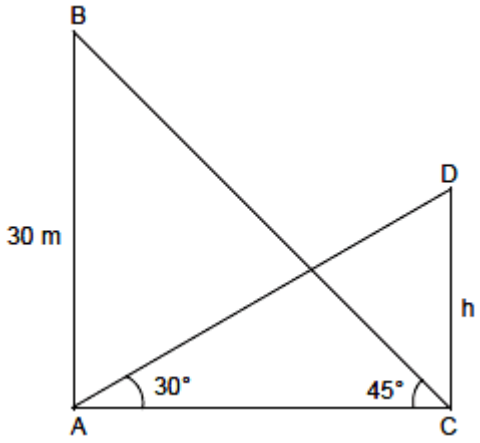
$\frac{h}{30} = \frac{1}{\sqrt{3}}$

$h = \frac{30}{\sqrt{3}}$

$h = \frac{30}{\sqrt{3}} \times \frac{\sqrt{3}}{\sqrt{3}}$

$= \frac{30\sqrt{3}}{3} = 10\sqrt{3}$

$\therefore$ $h = 10\sqrt{3}$ m




**OR**

A man standing on the deck of a ship, which is 10 m above water level, observes the angle of elevation of the top of a hill as 60° and angle of depression of the base of the hill as 30°. Find the distance of the hill from the ship and height of the hill.

Ans. Let CD is deck of ship and AB is hill. CD = BE = 10 m

In $\Delta$BEC, $\frac{CE}{BE}$ = cot 30°

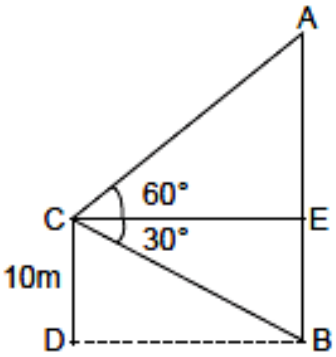
$\Rightarrow$ CE = BE . cot 30° $\Rightarrow$ CE = 10 × $\sqrt{3}$ m = 17.3 m

In $\Delta$AEC, $\frac{AE}{CE}$ = tan 60°

$\Rightarrow$ AE = CE . $\sqrt{3}$ m $\Rightarrow$ AE = 10 × $\sqrt{3}$ × $\sqrt{3}$ m = 30 m

$\therefore$ Height of hill AB = AE + EB = (30 + 10) m = 40 m

Distance of hill CE = 17.3 m




## SECTION – D

**Questions 18 carry 5 marks.**

**18.** A bird is sitting on the top of a tree, which is 80 m high. The angle of elevation of the bird, from a point on the ground is 45°. The bird flies away from the point of observation horizontally and remains at a constant height. After 2 seconds, the angle of elevation of the bird from the point of observation becomes 30°. Find the speed of flying of the bird.

Ans. Let bird is at A and after 2 seconds it reaches at E.

$\therefore$ Distance covered = AE.

In right $\Delta ABC$, $\frac{BC}{AB} = \cot 45° \Rightarrow \frac{BC}{80} = 1 \Rightarrow BC =$ 80 m

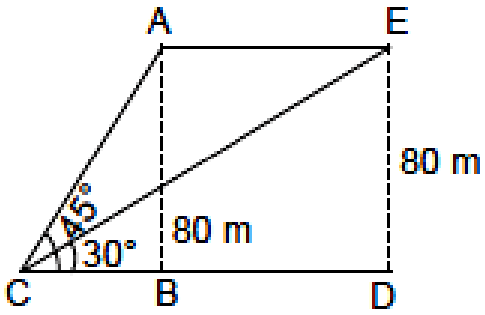
In right $\Delta EDC$, $\frac{DC}{DE} = \cot 30°$

$\Rightarrow DC = 80 \times \sqrt{3}$ [$\because DE = AB$]

Now, $BD = CD - BC = 80\sqrt{3} - 80 = 80(\sqrt{3} - 1) =$ $80 \times 0.732 = 58.56$ m

Now, BD = AE = 58.56 m

$\therefore$ Speed of bird = $\frac{58.56}{2}$ = 29.28 m/sec.




## SECTION – E (Case Study Based Questions)

**Questions 19 to 20 carry 4 marks each.**

**19.** A group of students of class X visited India Gate on an education trip. The teacher and students had interest in history as well. The teacher narrated that India Gate, official name Delhi Memorial, originally called All- India War Memorial, monumental sandstone arch in New Delhi, dedicated to the troops of British India who died in wars fought between 1914 and 1919. The teacher also said that India Gate, which is located at the eastern end of the Rajpath (formerly called the Kingsway), is about 138 feet (42 metres) in height.

(i) What is the angle of elevation if they are standing at a distance of 42 m away from the monument?

(ii) The ratio of the length of a rod and its shadow is 1 : 1. Find the angle of elevation of the Sun.

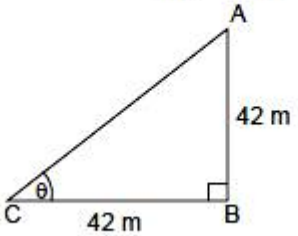
(iii) They want to see the monument at an angle of 60°. So, they want to know the distance where they should stand and hence find the distance.

**OR**

(iii) If the altitude of the Sun is at 60°, then find the height of the vertical tower that will cast a shadow of length 20 m.

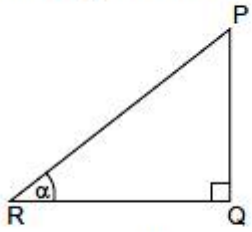
Ans.

(*i*) **Now,** $\tan\theta = \frac{AB}{BC} = \frac{42}{42} = 1$




$\Rightarrow \quad \theta = 45°$

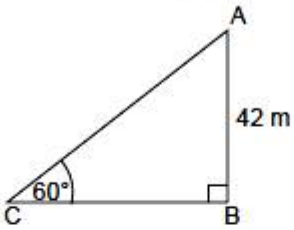
(*ii*) Let PQ be the rod and QR be its shadow.
Let $\alpha$ be the angular elevation of Sun.




So, $\tan\alpha = \dfrac{PQ}{QR} = 1$ [$\because$ PQ : QR = 1 : 1]

$\Rightarrow$ $\alpha = 45°$

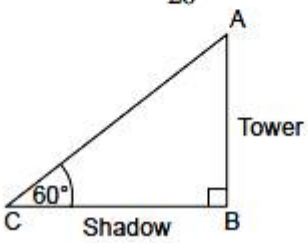
(*iii*) In $\Delta ABC$, $\tan 60° = \dfrac{AB}{QR} \Rightarrow BC = 14\sqrt{3}$




**OR**

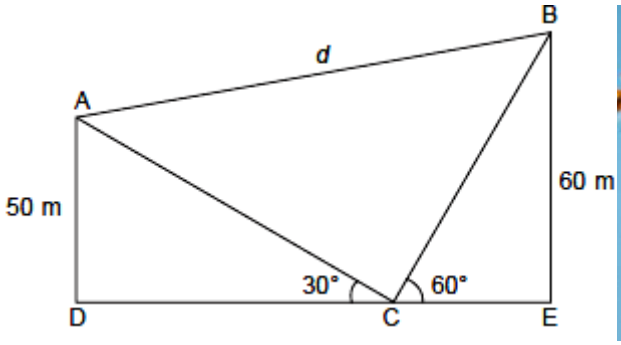
$\tan 60° = \dfrac{AB}{BC}$

$\Rightarrow$ $\sqrt{3} = \dfrac{AB}{20}$




$\Rightarrow$ $AB = 20\sqrt{3}$ m

**20.** Kite festival is celebrated in many countries at different times of the year. In India, every year 14$^{th}$ January is celebrated as International Kite Day. On this day many people visit India and participate in the festival by flying various kinds of kites.
The picture given below, shows three kites flying together.




In given figure, the angles of elevation of two kites (Points A and B) from the hands of a man (Point C) are found to be 30° and 60° respectively. Taking AD = 50 m and BE = 60 m, find
(i) Find CD.
(ii) Find CE.
(iii) Find the lengths of strings used (take them straight) for kites A and B as shown in the figure.

**OR**

Find the distance 'd' between these two kites.

Ans. (i) In ΔADC,

$\tan 30° = \frac{50}{DC} \Rightarrow DC = 50\sqrt{3}$ m

(ii) In ΔBEC,

$\tan 60° = \frac{60}{CE} \Rightarrow CE = \frac{60\sqrt{3}}{3} = 20\sqrt{3}m$

(iii) In ΔADC, $\sin 30° = \frac{50}{AC}$

∴ AC = 100 m

Now, In DBCE, $\sin 60° = \frac{60}{BC} \Rightarrow BC = 40\sqrt{3}$ m

**OR**

Since sum of angles at any point on a line is 180°.

So, ∠ACB = 90°

Now, AC = 100 m, BC = $40\sqrt{3}$ m, then

d = $20\sqrt{37}$ m

[∴ By Pythagoras theorem]