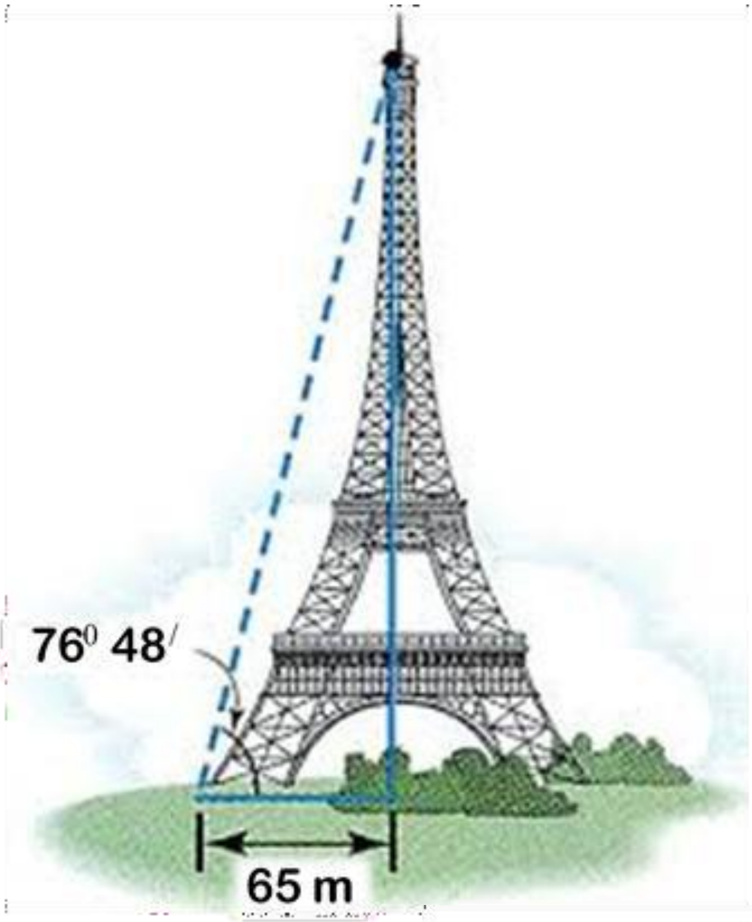
18.TRIGONOMETRY

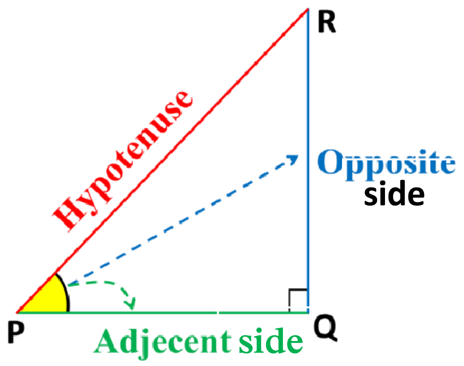


By studying this lesson you will be able to,

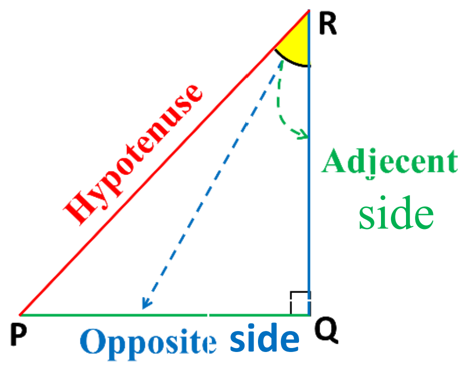
- ❒ **Identify the trigonometric ratios sine, cosine and tangent.**
- ❒ **Perform calculations related to triangles using sine, cosine and tangents tables.**

Identify the opposite and adjacent side of a right angle triangle according to a given angle.

consider $R\hat{P}Q$;

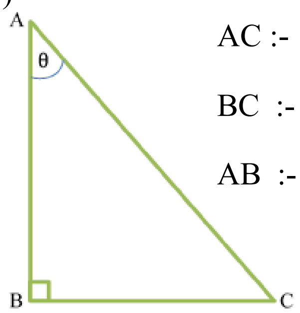


consider $P\hat{R}Q$;



Name the sides according to the given angle

1)

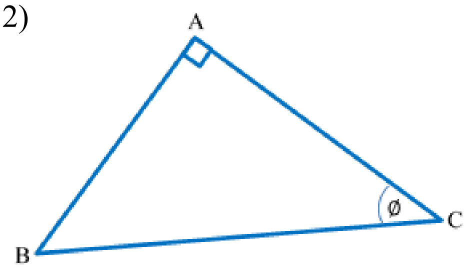


AC :- Hypotenuse

BC :- ....

AB :- ....

2)

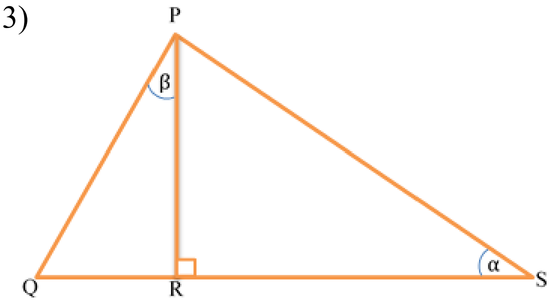


Opposite side :-..........

Adjacent side :-..........

Hypotenuse side :-..........

3)



Considering α ,

PR :- ....

PS :- ....

RS :- ....

Considering β

Opposite side :- ....

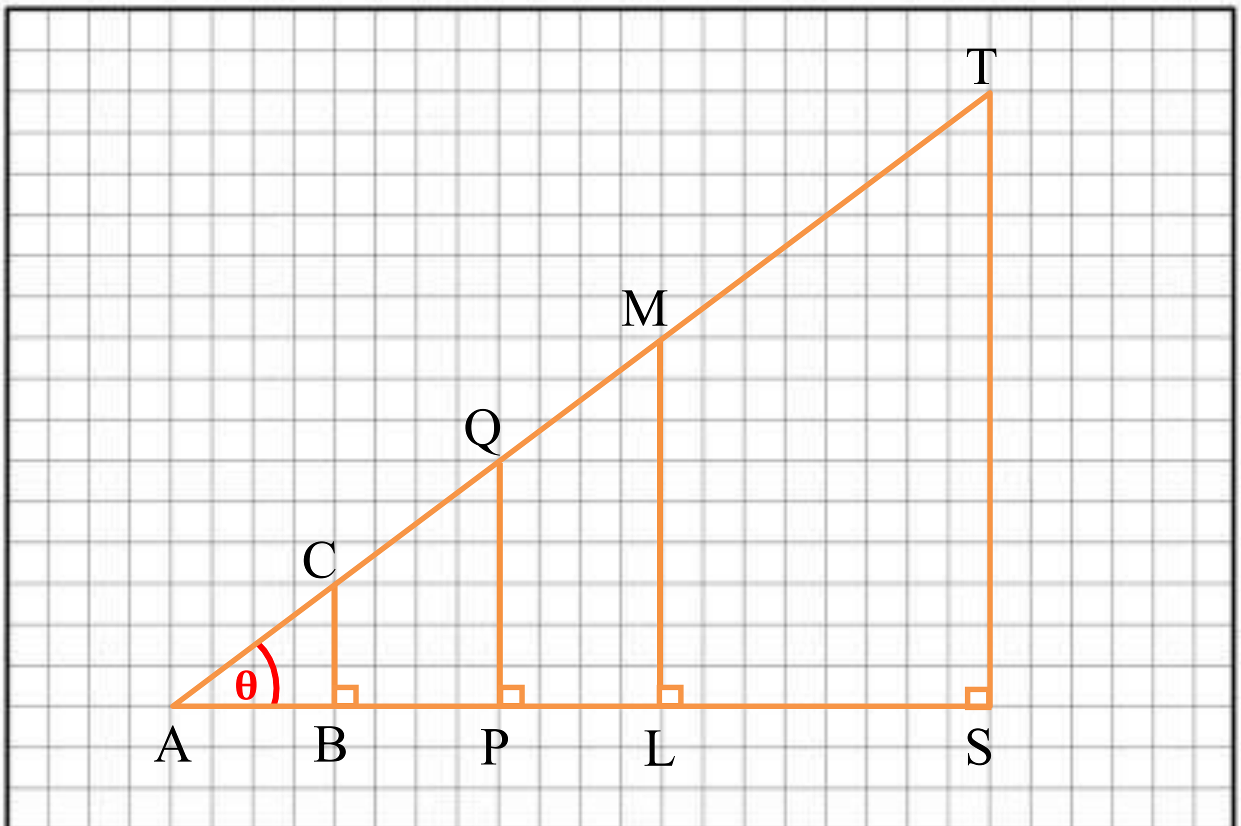
Adjacent side :- ....

Hypotenuse side :- ....

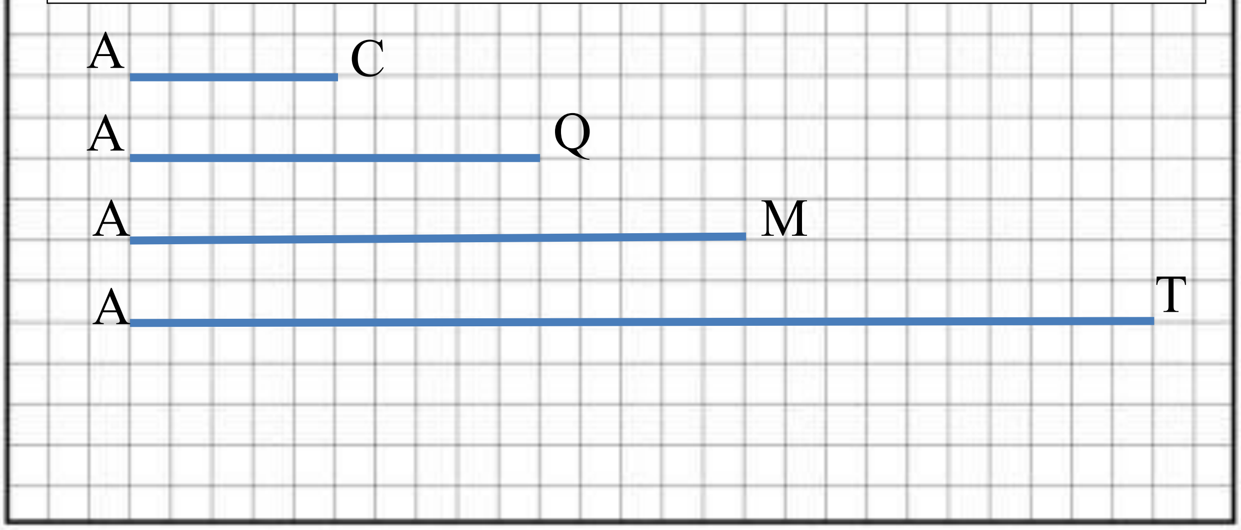
Complete the exercise 18. 1 .
(Grade 11 maths text book part -III - pg : 13)

Investigate the relationship between two sides of a right-angled triangle and an angle of the triangle.

Engage in the following activity, using the lengths of the sides of the triangles.



The length of AC, AQ, AM, AT sides are given bellow by using the grid
(measure the length by using the given squares .)



Complete the table given below by considering the angle θ

Right angled triangle	Length of the Opposite side (no of squares)	Length of the Adjacent side (no of squares)	Length of the hypotenuse (no of squares)	Opposite hypotenuse	Adjacent hypotenuse	Opposite Adjacent
ABC	....	4	5	....	$\frac{4}{5} = 0.8$	....
APQ						
ALM						
AST						

- After completing the above table you will comprehend the relationship between the considered angle and the sides of the triangle.

  Although the lengths of the sides of the triangle are different considering the angle **θ**;

$$\frac{\textit{Length of opposite side}}{\textit{Length of hypotenuse}} \quad = \textbf{constant.}$$

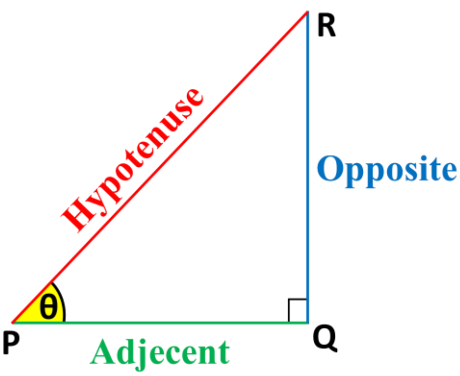
This Constant *is called* the sine ratio of θ **. ("sin θ")**

$$\frac{\textit{Length of adjacent side}}{\textit{Length of hypotenuse}} = \textbf{constant.}$$

This Constant *is called* the cosine ratio of θ **. ("cos θ")**

$$\frac{\textit{Length of opposite side}}{\textit{Length of adjacent side}} = \textbf{constant.}$$

This Constant *is called* the tanjent ratio of θ ("tan **θ**")



$$(\sin \theta) = \frac{\textbf{length of opposite side}}{\textbf{hypotenuse}} = \frac{RQ}{PR}$$

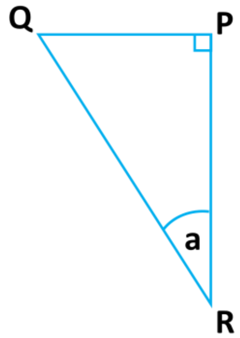
$$(\cos \theta) = \frac{\textbf{length of adjecside}}{\textbf{hypotenuse}} = \frac{PQ}{PR}$$

$$(\tan \theta) = \frac{\textbf{length of opposite side}}{\textbf{length of adjecent side}} = \frac{RQ}{PQ}$$

Exercise.

1) Write the trigonometric ratios (in terms of given angle.)

i.

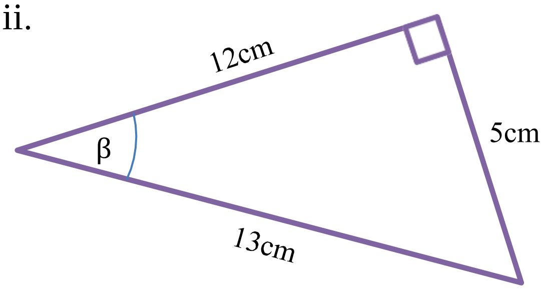


$\sin a = \frac{PQ}{QR}$

$\cos a = \frac{\cdots\cdots\cdots}{\cdots\cdots\cdots}$

$\tan a = \frac{\cdots\cdots\cdots}{\cdots\cdots\cdots}$

ii.

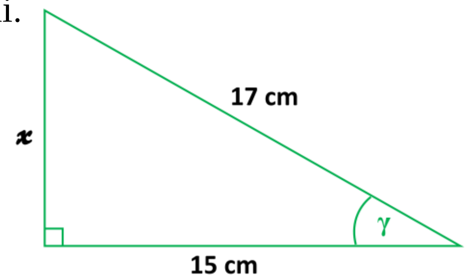


$\text{Sin } \beta = \frac{5cm}{13cm} = \frac{5}{13}$

$\text{Cos } \beta = \frac{\cdots\cdots\cdots}{\cdots\cdots\cdots} = \frac{\cdots\cdots}{\cdots\cdots}$

$\tan \beta = \frac{\cdots\cdots\cdots}{\cdots\cdots\cdots} = \frac{\cdots\cdots}{\cdots\cdots}$

iii.



$\sin \gamma = \frac{\cdots\cdots}{\cdots\cdots} = \frac{\cdots\cdots}{\cdots\cdots}$

$\cos \gamma = \frac{\cdots\cdots\cdots}{\cdots\cdots\cdots} = \frac{\cdots\cdots}{\cdots\cdots}$

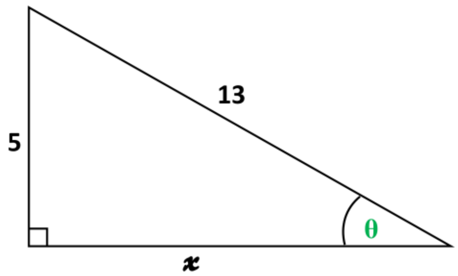
$\tan \gamma = \frac{\cdots\cdots\cdots}{\cdots\cdots\cdots} = \frac{\cdots\cdots}{\cdots\cdots}$

Hint : use the Pythagoras theorem to find x

2). If $\sin \theta = \frac{5}{13}$ $\quad find\ tan\ \theta\ and\ cos\ \theta$

Hint : $Given \sin \theta = \frac{5}{13} = \frac{opposite}{hypotenuse}$

like in the part (iii) You can use the Pythagorean theorem and find x and accordingly you can find $tan\ \theta$ $and\ cos\ \theta$



3). If $\cos x = 0.6$ $\quad finsin \quad nd\ tan\ x.$ (Hint : $0.6 = \frac{6}{10}$ therefore, $\cos x = \frac{6}{10}$)

Complete the exercise 18. 2

(Grade 11 maths textbook part -III - pg : 17)

❖ The constant of the ratio of sin, cos and tan for each angle are different.

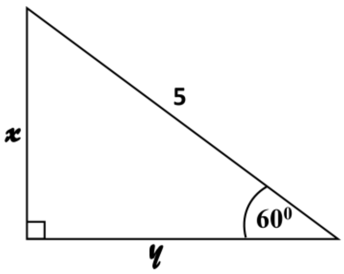
Trigonometric ratios for angles 30^0, 45^0, 60^0

	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	$\sqrt{3}$

Solve the following problems using the table above.

1). i) Find x and y (Indicate the answer in surds when required.)

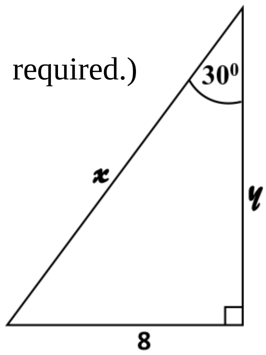
ii) Show that $\tan 60^0 = \sqrt{3}$.



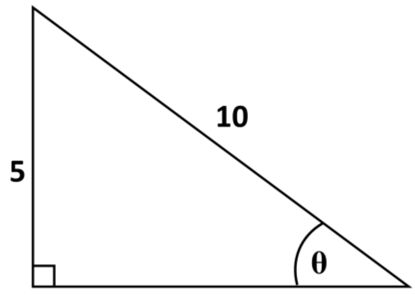
$\sin 60^0 = \frac{x}{5}$ $\sin 60^0 = \frac{\sqrt{3}}{2}$, $\frac{\sqrt{3}}{2} = \frac{x}{5}$ $x = \frac{5\sqrt{3}}{2}$	$\cos 60^0 = \frac{y}{5}$ $\frac{1}{2} = \frac{y}{5}$ $y = \frac{5}{2}$	$\tan 60^0 = \frac{x}{y} = \frac{\frac{5\sqrt{3}}{2}}{\frac{5}{2}}$ $= \frac{5\sqrt{3}}{2} \div \frac{5}{2}$ $= \frac{\cancel{5}\sqrt{3}}{\cancel{2}} \times \frac{\cancel{2}}{\cancel{5}}$ $= \sqrt{3}$

2). i) Find x and y (Indicate the answer in surds when required.)

ii) Show that $\tan 30^0 = \frac{1}{\sqrt{3}}$



3). Find the angle **θ** by using the sides given



$$\sin\theta = \frac{\text{opposite}}{\text{hypotenuse}}$$

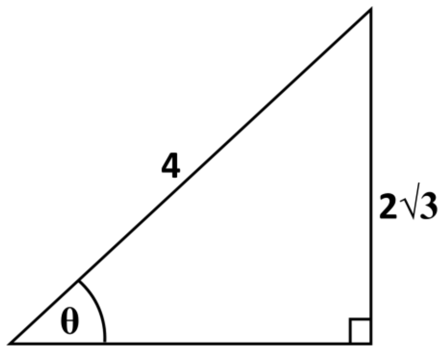
$$\sin\theta = \frac{5}{10}$$

$$\sin\theta = \frac{1}{2}$$

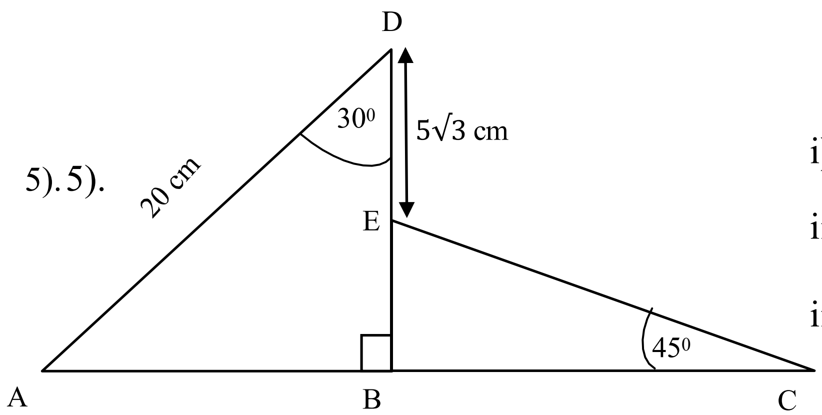
according to the table $\sin 30^0 = \frac{1}{2}$

therefore $\theta = 30^0$

4). Find the angle **θ** by using the sides given.



5). 5).



i) Find AB .

ii) Find BD

iii) Show that CE = $5\sqrt{6}cm$.

6). Evaluate.

i. $\sin 45^0 + \cos 45^0$

ii. $\sin 60^0 \cos 30^0$ $(\sin 60^0 \cos 30^0 = \sin 60^0 \times \cos 30^0)$

iii. $\sin 30^0 \cos 30^0 + \sin 60^0 \cos 60^0$

iv. $\tan 45^0 + \sin 30^0 + \cos 60^0$

vi. $\tan 30^0 \cos 30^0 + \tan 60^0 \sin 60^0$

7). Verify that $\sin 60^0 \cdot \tan 30^0 = \sin 30^0$

- If the above statement is true, the left hand side should be equal to right hand side (L.H.S. = R.H.S.)
- Therefore, when we verify a statement like above, simplify the L.H.S. and R.H.S. separately and state whether **L.H.S. = R.H.S**

Considering the statement given,

L.H.S. $= \sin 60^0 \times \tan 30^0$

$= \frac{\sqrt{3}}{2} \times \frac{1}{\sqrt{3}}$

$= \frac{1}{2}$

R.H.S. $= \sin 30^0$

$= \frac{1}{2}$

Therefore L.H.S $=$ R.H.S

8). Verify the following statements.

i. $\frac{\sin 30°}{\cos 30°} = \tan 30^0$

ii. $\sin 45^0 \cos 45^0 = \sin 30^0$

iii. $\cos 30^0 \tan 30^0 = \sin 45^0 \cos 45^0 + \tan 45^0$

iv. $\tan 30^0 = \dfrac{\tan 60^0 - \tan 30^0}{1 + \tan 60^0 \tan 30^0}$

v. $\text{Sin } 60^0 = 2 \text{ Sin}30^0 . \text{ Cos}30^0$

Complete the exercise 18. 3

(Grade 11 maths text book part -III - pg : 21)

Trigonometric tables

- "Degree" is the unit that expresses the magnitude of angles.
- A degree is further subdivided into equal parts called "minutes".

Therefore, 1 Degree = 60 minutes

$$1^0 = 60^/$$

- $30^0\,35^/$ read as 30 degrees and 35minutes.
- Likewise 40^0 can be expressed as $39^0\,60^/$

$$40^0 = 39^0\,60^/$$

- The trigonometric ratios for all the angles between 0^0 to 90^0 are tabulated.
- They are known as trigonometric tables. Will Identify how we can use it.
  (The tables are given in gr 11 –part III from Pg. 148 – 151.)

Find the sin ratio of a given angle using a trigonometric table.

- The following examples shows how to use the natural Sin table.

1. Get the value of sin 13^0 (Let $13^0 = 13^0\,0^/$)

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NATURAL SINES

	0′	10′	20′	30′	40′	50′	60′		Mean Differences 1′	2′	3′	4′	5′	6′	7′	8′	9′
10°	0.17[illegible]6	0.1765	0.1794	0.1822	0.1851	0.1880	0.1908	79	3	6	9	11	14	17	20	23	26
11	.19[illegible]8	.1937	.1965	.1994	.2022	.2051	.2079	78	3	6	9	11	14	17	20	23	26
12	.20[illegible]9	.2108	.2136	.2164	.2193	.2221	.2250	77	3	6	9	11	14	17	20	23	26
13	.2250	.2278	.2306	.2334	.2363	.2391	.2419	76	3	6	8	11	14	17	20	23	25
14	.24[illegible]9	.2447	.2476	.2504	.2532	.2560	.2588	75	3	6	8	11	14	17	20	23	25

$$\sin 13^0 = \sin 13^0\,0^/ = 0.2250$$

2. Get sin 13⁰ 50′.

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NATURAL SINES

									මධ්‍යක අන්තර இடை வித்தியாசங்கள் Mean Differences								
	0′	10′	20′	30′	40′	50′	60′		1′	2′	3′	4′	5′	6′	7′	8′	9′
10°	0.1736	0.1765	0.1794	0.1822	0.1851	[illegible]	0.1908	79	3	6	9	11	14	17	20	23	26
11	.1908	.1937	.1965	.1994	.2022	[illegible]	.2079	78	3	6	9	11	14	17	20	23	26
12	.2079	.2108	.2136	.2164	.2193	[illegible]	.2250	77	3	6	9	11	14	17	20	23	26
13	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.2391	.2419	76	3	6	8	11	14	17	20	23	25
14	.2419	.2447	.2476	.2504	.2532	.2560	.2588	75	3	6	8	11	14	17	20	23	25

$$\sin 13^0\, 50' = 0.2391$$

3. Get sin 13⁰ 57′.

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NATURAL SINES

									මධ්‍යක අන්තර இடை வித்தியாசங்கள் Mean Differences								
	0′	10′	20′	30′	40′	50′	60′		1′	2′	3′	4′	5′	6′	7′	8′	9′
10°	0.1736	0.1765	0.1794	0.1822	0.1851	[illegible]	0.1908	79	3	6	9	11	14	17	[illegible]	23	26
11	.1908	.1937	.1965	.1994	.2022	[illegible]	.2079	78	3	6	9	11	14	17	[illegible]	23	26
12	.2079	.2108	.2136	.2164	.2193	[illegible]	.2250	77	3	6	9	11	14	17	[illegible]	23	26
13	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.2391	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	20	23	25
14	.2419	.2447	.2476	.2504	.2532	.2560	.2588	75	3	6	8	11	14	17	20	23	25

$$\sin 13^0\, 57' = 0.2391 + 0.0020 = \underline{\underline{0.2411}}$$

Rough Work

$$\begin{array}{r} 0.2391 \\ +0.0020 \\ \hline 0.2411 \end{array}$$

$$\sin 13^0\, 57' = 0.2411$$

Find the angle corresponding to a given sin ratio

1. If $\sin x = 0.7716$ find x . (follow the steps given in Red.)

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	0′	10′	20′	30′	40′	50′	60′		1′	2′	3′	4′	5′	6′	7′	8′	9′
									Mean Differences								
45°	0.7071	0.7092	0.7112	[illegible]	[illegible]	0.7173	0.7193	44°	2	4	6	8	[illegible]	12	14	16	18
46	.7193	.7214	.7234	[illegible]	[illegible]	.7294	.7314	43	2	4	6	8	[illegible]	12	14	16	18
47	.7314	.7333	.7353	[illegible]	[illegible]	.7412	.7431	42	2	4	6	8	[illegible]	12	14	16	18
48	.7431	.7451	.7470	[illegible]	[illegible]	.7528	.7547	41	2	4	6	8	[illegible]	12	13	15	17
49	.7547	.7566	.7585	[illegible]	[illegible]	.7642	.7660	40°	2	4	6	8	[illegible]	11	13	15	17
50°	[illegible]	[illegible]	[illegible]	0.7716	[illegible]	0.7753	0.7771	39	2	4	6	7	[illegible]	11	13	15	17
51	.7771	.7790	.7808	.7826	[illegible]	.7862	.7880	38	2	4	5	7	[illegible]	11	13	14	16
52	.7880	.7898	.7916	.7934	[illegible]	.7969	.7986	37	2	4	5	7	[illegible]	11	12	14	16
53	.7986	.8004	.8021	.8039	[illegible]	.8073	.8090	36	2	3	5	7	[illegible]	10	12	14	16
54	.8090	.8107	.8124	.8141	[illegible]	.8175	.8192	35	2	3	5	7	[illegible]	10	12	14	15
55	0.8192	0.8208	0.8225	0.8241	[illegible]	0.8274	0.8290	34	2	3	5	7	[illegible]	10	12	13	15
56	[illegible]	[illegible]	[illegible]	[illegible]	.8355	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	8	10	11	13	14
57	.8387	.8403	.8418	.8434	.8450	.8465	.8480	32	2	3	5	6	8	9	11	13	14
58	.8480	.8496	.8511	.8526	.8542	.8557	.8572	31	2	3	5	6	8	9	11	12	14
59	.8572	.8587	.8601	.8616	.8631	.8646	.8660	30°	1	3	4	6	7	9	10	12	13

Therefore ,

If $\sin x = 0.7716$, Then $x = 50^0\, 30^/$

2. If $\sin y = 0.8363$, consider the way of finding y.

(Follow the steps given in Blue)

- 0.8363 value is not available at once.
- Then we have to consider the lowest and as well as nearest value for 0.8363. It is 0.8355 Find the location of 0.8355. .
- So the relevant angle is $56^0\, 40^/$.
- Now subtract 0.8355 from 0.8363.
- It is (0.8363 - 0.8355) = 0.0008 .
- Now 8 is called the mean difference.
- The angle which it belongs is $5^/$.

Adding the Mean difference taken from the column.

Therefore,

If $\sin y = 0.8363$, $y = 56^0\, 40^/ + 5^/$

$y = 56^0\, 45^/$

3. If sin p = 0.7064 , consider the way of finding y.

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NATURAL SINES

	0′	10′	20′	30′	40′	50′	60′		1′	2′	3′	4′	5′	6′	7′	8′	9′
41	.6561	.6583	.6604	.6626	.6648	.6670	.6691	48	2	4	7	9	11	13	15	17	20
42	.6691	.6713	.6734	.6756	.6777	.6799	.6820	47	2	4	6	9	11	13	15	17	19
43	.6820	.6841	.6862	.6848	.6905	.6926	.6947	46	2	4	6	8	11	13	15	17	19
44	.6947	.6967	.6988	.7009	.7030	.7050	.7071	45	2	4	6	8	10	12	15	17	19

(Mean Differences: මධ්‍යක අන්තරය / இடை வித்தியாசங்கள்)

- **0.7064** value is not available at once.
- Then we have to consider the lowest and as well as nearest value for **0.7064.** It is **0.7050** Find the location of **0.7050.**
- So the relevant angle is **$44^0\ 50^/$**.
- Now subtract 0.7064 from 0.7050.
- It is (**0.7064** – **0.7050**) = **0.0014**.
- Now 14 is called the mean difference.
- But 14 is not in the Mean difference table. Then we consider the nearest value it is 15.
- The angle which it belongs is **$7^/$**.
- Therefore,

If sin p = 0.7064 , $\quad p = 44^0\, 50^/ + 7^/$

$$p = 44^0\, 57^/$$

Complete the exercise.

1). Find each of the following values using trigonometric tables

i). sin 49^0 ii). sin $72^0\ 20^/$ iii). sin $67^0\ 34^/$

2). Find the angle θ corresponding to each trigonometric ratio.

i). sin θ = 0.3497 ii). sin θ = 0.6765 iii). sin θ = 0.4200

Answers

1) i). 0.7547 ii). 0.9528 iii). 0.9243

2) i). 23° ii). 42° 39′ iii). 24° 50′

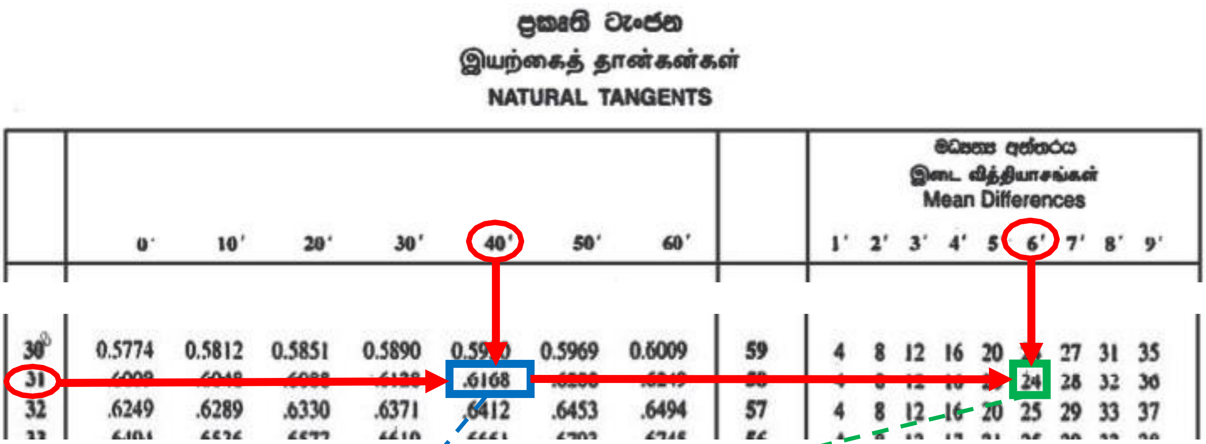
Find the tan ratio of a given angle using a trigonometric table.

- The natural tangent table should be used when it is necessary to find the tangent of a given angle and the angle corresponding to the tangent.

- The methodology used to find sine ratios can be followed

Study the example given below.

- Get tan $31^0\ 46^/$



	0′	10′	20′	30′	40′	50′	60′		1′	2′	3′	4′	5′	6′	7′	8′	9′
30°	0.5774	0.5812	0.5851	0.5890	[illegible]	0.5969	0.6009	59	4	8	12	16	20	[illegible]	27	31	35
31	[illegible]	[illegible]	[illegible]	[illegible]	.6168	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	24	28	32	36
32	.6249	.6289	.6330	.6371	.6412	.6453	.6494	57	4	8	12	16	20	25	29	33	37

$\tan 31^0\ 46^/ = 0.6168 + 0.0024 = 0.6192$

Rough work

0.6168
$+0.0024$
0.6192

$\tan 31^0\ 46^/\ \ 0.6192$

Engage in the exersice.

1). Evaluate

i). $\tan 63^0$ ii). $\tan 26^0\ 40^/$ iii). $\tan 55^0\ 19^/$

2). Find θ.

i). $\tan \theta = 0.2126$ ii). $\tan \theta = 2.628$ iii). $\tan \theta = 0.9556$

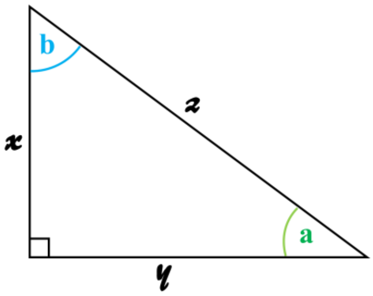
Answers

1) i). 1.963 ii). 0.5022 iii). 1.4452

2) i). 12° ii). 69° 10′ iii). 43° 42′

The relationship between sin and cos ratios at a given angle

- **Consider the right-angled triangle below.**



$$\sin a = \frac{x}{z}$$

$$\cos b = \frac{x}{z}$$

- Accordingly **sin a** = cos b.
- Since the sum of the three interior angles of a triangle is 180^0,

$a + b + 90^0 = 180^0$

$a + b = 180^0$

$a = 90^0 - b$

- Therefore $\cos b = \sin (90^0 - b)$

Eg :	Eg :
$\cos 30^0 = \sin (90^0 - 30^0)$ $\cos 30^0 = \sin 60^0$ This is also confirmed by the table below which has been studied before.	$\cos (43^0 32') = \sin (90^0 - 43^0 32')$ $\cos (43^0 32') = \sin (46^0 28')$

	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	$\sqrt{3}$

Rough work

It can be written as $90^0 = 89^0 60'$

$$\begin{array}{r} 89^0\ 60' \\ -\ 43^0\ 32' \\ \hline 46^0\ 28' \end{array}$$

- Accordingly if you need the value of $\cos (43^0 32')$. you can find the value of $\sin (46^0 28')$ It is equal to the $\cos (43^0 32')$.

Find the cos ratio of a given angle using a trigonometric table.

- It is known that cos θ = sin (**90⁰ -** θ) Therefore, you can use the Sin table instead of cosine table.
- The columns shown in blue in the natural sine table below are used to find sin ratios.
- And the things in yellow used to deal with Cosines.

ප්‍රකෘති සයින
இயற்கைச் சைன்கள்
NATURAL SINES

	0′	10′	20′	30′	40′	50′	60′		1′	2′	3′	4′	5′	6′	7′	8′	9′
45°	0.7071	0.7092	0.7112	0.7133	0.7153	0.7173	0.7193	44°	2	4	6	8	10	12	14	16	18
46	.7193	.7214	.7234	.7254	.7274	.7294	.7314	43	2	4	6	8	10	12	14	16	18
47	.7314	.7333	.7353	.7373	.7392	.7412	.7431	42	2	4	6	8	10	12	14	16	18
48	.7431	.7451	.7470	.7490	.7509	.7528	.7547	41	2	4	6	8	10	12	13	15	17
49	.7547	.7566	.7585	.7604	.7623	.7642	.7660	40°	2	4	6	8	9	11	13	15	17
50°	0.7660	0.7679	0.7698	0.7716	0.7735	0.7753	0.7771	39	2	4	6	7	9	11	13	15	17
51	.7771	.7790	.7808	.7826	.7844	.7862	.7880	38	2	4	5	7	9	11	13	14	16
52	.7880	.7898	.7916	.7934	.7951	.7969	.7986	37	2	4	5	7	9	11	12	14	16
53	.7986	.8004	.8021	.8039	.8056	.8073	.8090	36	2	3	5	7	9	10	12	14	16
54	.8090	.8107	.8124	.8141	.8158	.8175	.8192	35	2	3	5	7	8	10	12	14	15
80°	0.9848	0.9853	0.9858	0.9863	0.9868	0.9872	0.9877	9	0	1	1	2	2	3	3	4	4
81	.9877	.9881	.9886	.9890	.9894	.9899	.9903	8	0	1	1	2	2	3	3	3	4
82	.9903	.9907	.9911	.9914	.9918	.9922	.9925	7	0	1	1	2	2	2	3	3	3
83	.9925	.9929	.9932	.9936	.9939	.9942	.9945	6	0	1	1	1	2	2	2	3	3
84	.9945	.9948	.9951	.9954	.9957	.9959	.9962	5	0	1	1	1	1	2	2	2	3
85	0.9962	0.9964	0.9967	0.9969	0.9971	0.9974	0.9976	4									
86	.9976	.9978	.9980	.9981	.9983	.9985	.9986	3									
87	.9986	.9988	.9989	.9990	.9992	.9993	.9994	2									
88	.9994	.9995	.9996	.9997	.9997	.9998	.9998	1									
89	0.9998	0.9999	0.9999	1.0000	1.0000	1.0000	1.0000	0°									
	60′	50′	40′	30′	20′	10′	0′		1′	2′	3′	4′	5′	6′	7′	8′	9′

මධ්‍යන්‍ය අන්තරය
இடை வித்தியாசங்கள்
Mean Differences

(අන්තරය ඉතා කුඩා බැවින් වගු ගත කිරීම අනවශ්‍යය.)

ප්‍රකෘති කෝසයින
இயற்கைக் கோசைன்கள்
NATURAL COSINES

1. Get the value of cos $(41^0\,20^/)$

Method i : Using natural Sin table

$\cos(41^0\,20^/) = \sin(90^0 - 41^0\,20^/)$

$\cos(41^0\,20^/) = \sin(48^0\,40^/)$

Rough Work

$90^0 = 89^0\,60'$

$$\begin{array}{r} 89^0\,60' \\ -\,41^0\,20' \\ \hline 48^0\,40' \end{array}$$

- (Using natural Sin table) get the value of sin $(48^0\,40^/)$

  (Follow the steps given in Red)

- Value of $\sin(48^0\,40^/) = 0.7509$ therefore, value of $\cos(41^0\,20^/)$ also 0.7509

Method ii : Using the Cosine table

- To find the cos ratio of a considered angle using only cos you have to use the yellow coloumns in the above table'.
- The value of cos $(41^0\,20')$ can be obtained as 0.7509 by the steps shown in **green** in the table above.

2. Find the value of cos $(52^0\,38^/)$

35	0.5736	0.5760	0.5783	0.5807	0.5831	0.5854	0.5878	54	2	5	7	9	12	14	17	19	21
36	.5878	.5901	.5925	.5948	.5972	.5995	.6018	53	2	5	7	9	12	14	16	19	21
37	.6018	.6041	.6065	.6088	[illegible]	[illegible]	[illegible]	52	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	18	21
38	.6157	.6180	.6202	.6225	.6248	.6271	.6293	51	2	5	7	9	11	14	16	18	20
39	.6293	.6316	.6338	.6361	.6383	.6406	.6428	50°	2	4	7	9	11	13	16	18	20
40°	0.6428	0.6450	0.6472	0.6494	0.6517	0.6539	0.6561	49	2	4	7	9	11	13	15	18	20
41	.6561	.6583	.6604	.6626	.6648	.6670	.6691	48	2	4	7	9	11	13	15	17	20
42	.6691	.6713	.6734	.6756	.6777	.6799	.6820	47	2	4	6	9	11	13	15	17	19
43	.6820	.6841	.6862	.6884	.6905	.6926	.6947	46	2	4	6	8	11	13	15	17	19
44	.6947	.6967	.6988	.7009	.7030	.7050	.7071	45	2	4	6	8	10	12	15	17	19
	60′	50′	40′	30′	20′	10′	0′		1′	2′	3′	4′	5′	6′	7′	8′	9′

ප්‍රකෘති කෝසයින
இயற்கைக் கோசைன்கள்
NATURAL COSINES

cos $(52^0\,38^/)$ = 0.6088 - 0.0018 = 0.6070

cos $(52^0\,38^/)$ = 0.6070

Rough work

$$\begin{array}{r} 0.6088 \\ -\,0.0018 \\ \hline 0.6070 \end{array}$$

Find the angle corresponding to a given cos ratio

1. If cos $x = 0.6583$ consider the way of finding x.(follow the things in RED)

35	0.5736	0.5760	0.5783	0.5807	0.5831	0.5854	0.5878	54	2	5	7	9	12	14	17	19	21
36	.5878	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	53	[illegible]	[illegible]	7	9	12	14	16	19	21
37	.6018	.6041	.6065	.6088	.6111	.6134	.6157	52	2	5	[illegible]	9	12	14	16	18	21
38	[illegible]	.6180	.6202	.6225	.6248	.6271	.6293	51	2	5	[illegible]	9	11	14	16	18	20
39	[illegible]	.6316	.6338	.6361	.6383	.6406	.6428	50°	2	4	[illegible]	9	11	13	16	18	20
40°	[illegible]	0.6450	0.6472	0.6494	0.6517	0.6539	0.6561	49	2	4	[illegible]	9	11	13	15	18	20
41	[illegible]	.6583	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	48	2	4	[illegible]	9	11	13	15	17	20
42	[illegible]	[illegible]	.6734	.6756	.6777	.6799	.6820	47	2	4	[illegible]	9	11	13	15	17	19
43	[illegible]	[illegible]	.6862	.6848	.6905	.6926	.6947	46	2	4	[illegible]	8	11	13	15	17	19
44	[illegible]	[illegible]	.6988	.7009	.7030	.7050	.7071	45	2	4	[illegible]	8	10	12	15	17	19
	60′	50′	40′	30′	20′	10′	0′		1′	2′	3′	4′	5′	6′	7′	8′	9′

ප්‍රකෘති කෝසයින
இயற்கைக் கோசைன்கள்
NATURAL COSINES

If cos $x = 0.6583$, then $x = 48^0 50^/$

2. If cos $y = 0.5885$ find the value of y (consider the things in Blue)

- 0.5885 value is not available at once.
- Then we have to consider the lowest and as well as nearest value for 0.5885. It is 0.5878 Find the location of 0.5878.
- So the relevant angle is $53^0\ 60^/$.
- Now subtract 0.5878 from 0.5885.
- It is (0.5885 – 0.5878) = 0.0007.
- Now 0.0007 is called the mean difference.
- The angle which it belongs is $3^/$.
- **There for**

Subtract
the Mean difference
taken from the
column.

If cos $y = 0.5885$, $y = 53^0\ 60^/ - 3^/$

$y = 53^0\ 57$

Exercise.

1). Evaluate by using the trigonometric tables .

i). $\cos 62^0$ ii). $\cos 29^0\, 50^{/}$ iii). $\cos 35^0\, 26^{/}$

2). Find θ.

i). $\cos\theta = 0.7660$ ii). $\cos\theta = 0.9100$ iii). $\cos\theta = 0.4136$

Answers

1). i). 0.4695 ii). 0.8675 iii). 0.8148

2). i) 40° ii). 24° 30' iii). 65° 34'

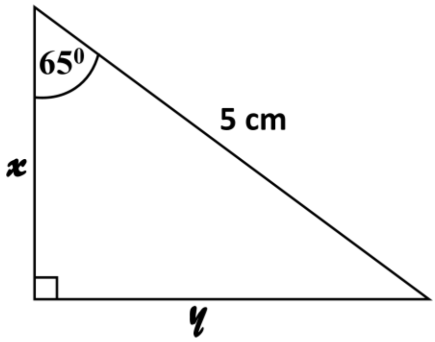
Complete the exercise 18. 4

(Grade 11 maths text book part -III - pg : 29)

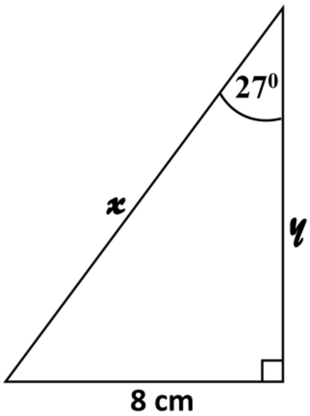
Solve using the trigonometric tables.

1) ***Find x and y .***

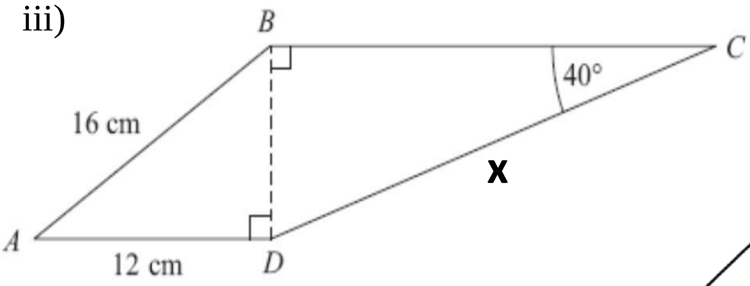
i)



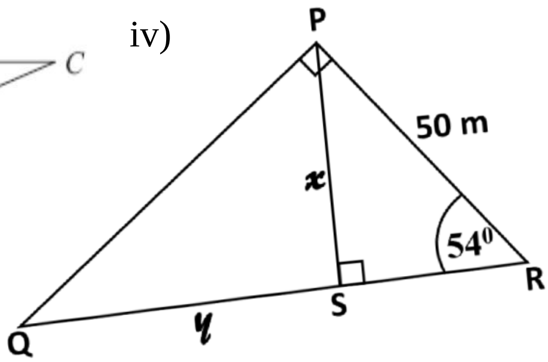
ii)



iii)

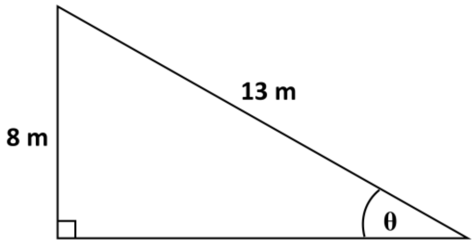


iv)

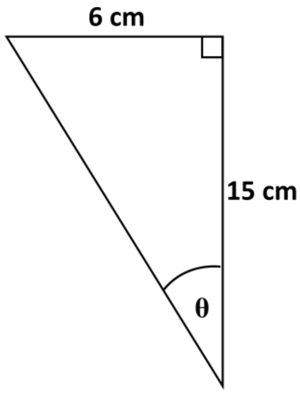


2) Find θ.

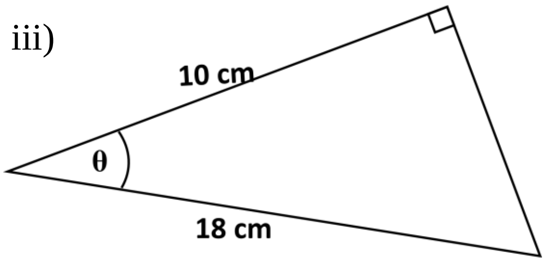
i)



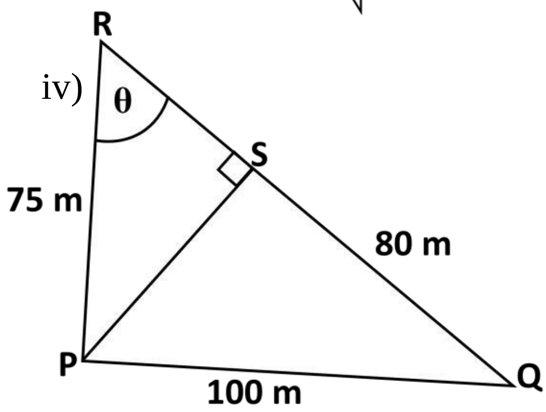
ii)



iii)



iv)



Complete the excersice 18. 5
(Grade 11 maths text book part -III - pg : 31- 32)

Angles in horizontal plane.

- Prior knowledge of bearings is required here.
- It shows the location of another place related to one place.
- The magnitude of the angle measured clockwise from north to the location is indicated by three digits.

- **Let's solve the following problem.**

Below it is given how a paddy field,Hii tree, and a well located.The hii tree is located 50m away on a bearing of 030^0 from the well. A coner of the paddy field is observerd on a bearing of 120^0 by the Hii tree. The same coner of the paddy field is appeared on a bearing of 080^0 from the well.

i) Sketch the diagram and identify the right angled triangle.

ii) Find the least distance from the well to that coner of the paddy field using the trignometric tables.

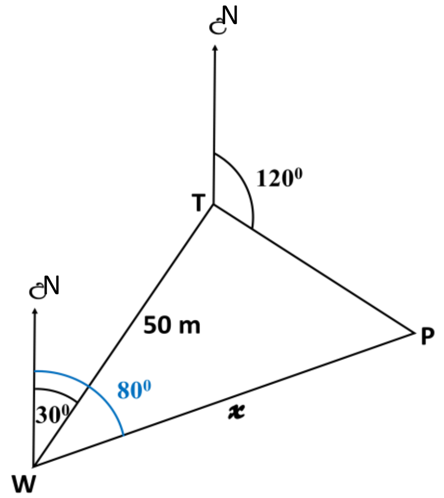
Let's see how to solve the above problem.

sketch the diagram

T – Hii tree

W – well

P – coner of the paddy field



Identify the right angled triangle .

$a + 30^0 = 180^0$ (Allied angles)

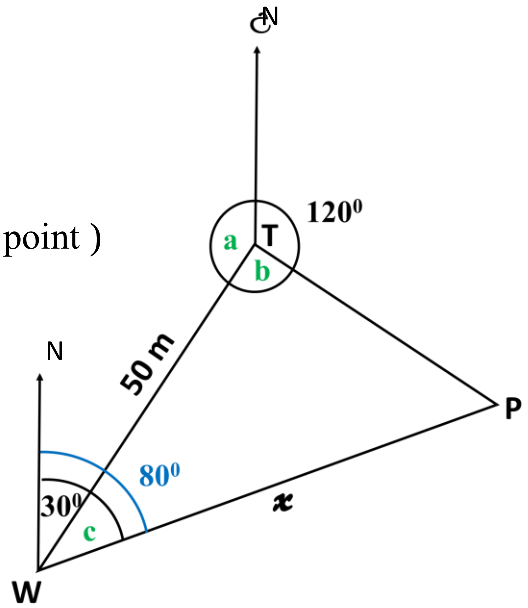
$a = 150^0$

$a + b + 120^0 = 360^0$ (Sum of angles around the point)

$b = 90^0$

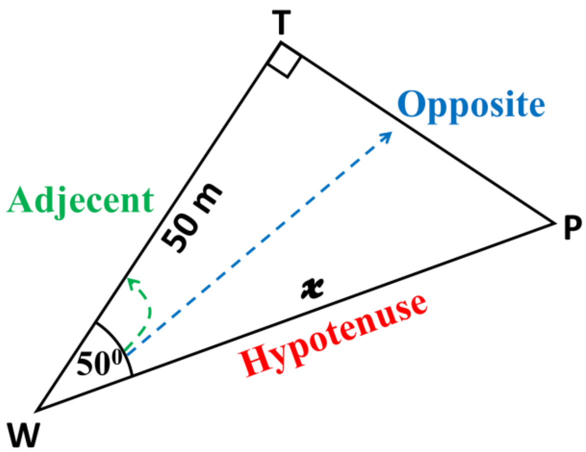
Therfore WPT *is a right-angled triangle.*

Hence $c + 30^0 = 80^0$ $c = 50^0$



Consider the WPT triangle.

(It is considered x as the lenear distance from the well to the corner of the paddy field.)



$$\cos 50^0 = \frac{TW \text{ (adjecent)}}{PW \text{ (hypotenues)}}$$

$$\cos 50^0 = \frac{50}{x}$$

$$0.6428 = \frac{50}{x}$$

$$x = \frac{50}{0.6428}$$

$$x = \frac{50}{0.6428}$$

$$\lg x = \lg\left(\frac{50}{0.6428}\right)$$

$$= \lg 50 - \lg 0.6428$$

$$= 2.6990 - \bar{1}8080$$

$$= 1.8910$$

$$x = \text{antilog } 2.8910$$

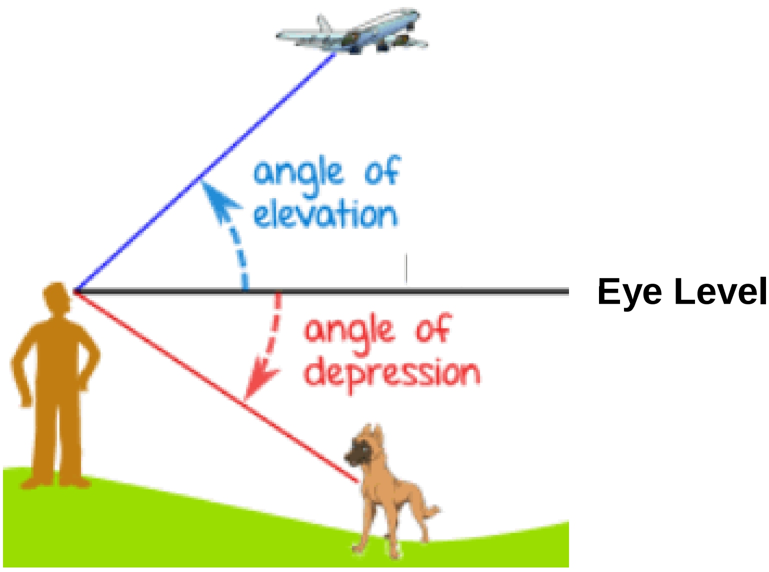
$$= 77.8$$

$\underline{x = 77.8}$ m

Complete the excersice 18. 7
(Grade 11 maths text book part -III - pg : 38 - 39)

Angles on vertical plane.

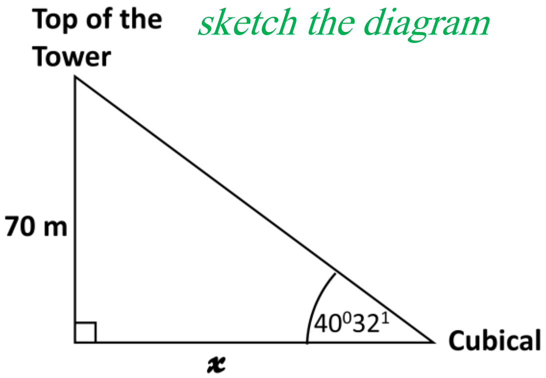
- Recall on angle of elevation and angle of depression.
- Assume that the eye level and the ground level is parallel. Angle of elevation and angle of depression are always made with the horizontal level.
    - An angle of elevation is defined as the angle formed between the line of vision and the eye level of an observer is looking at an object above the eye level.
    - An angle of depression is defined as the angle formed between the line of vision and the eye level (horizontal level) of an observer when the observer is looking at an object below the eye level.



- Let's see how to solve the problem below.

It is necessary to construct a cubical from the base of the tower to observe the top of a 70 m high vertical tower. The angle of elevation of the top of the tower, from the cubical should be 40^0 32^1
By sketching the diagram we can find the distance from tha base of the tower.

sketch the diagram



We can select the tangent ratio according to the given data (opposite and the adjacent)

$\tan 40^0 32^/ = \frac{70}{x}$

$0.8551 = \frac{70}{x}$

$0.8551\, x = 70$

$x = \frac{70}{0.8551}$

$= 81.86$

Simplify using logrithm

$\lg x = \lg(\frac{70}{0.8551})$

$\lg x = \lg 70 - \lg 0.8551$

$= 1.8451 - \bar{1}.9321$

$= 1.9130$

$x = \text{antilog } 1.9130$

$x = 81.83$

If x is the distance from the base of the tower to the cubical

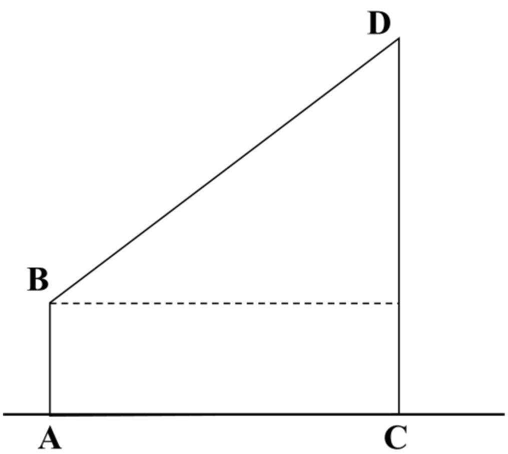
$x = 82$ m (to the nearest meter)

Work on exercise.

1). Here is an image of a 4.5 m tall (AB) tree on a horizontal plane and CD is a tower 50 m away from it, the angle of elevation of the tower is 42^0

i) Copy the diagram and insert the given data into the figure.

ii) By using the trigonometric tables find the height of the tower to the nearest second

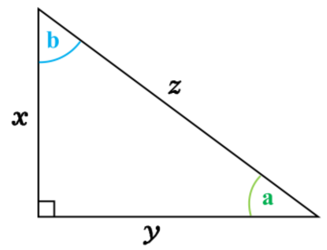


Complete the exercise 18. 7
(Grade 11 maths text book part -III - pg : 35 - 36)

Revision exercise

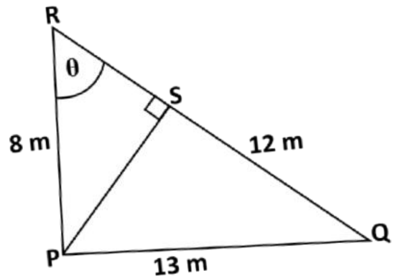
1). In the given figure the ratio $\frac{x}{z}$ describes the trigonometric ratio of ,

i) tan a   ii). cos a   iii). cos b   iv). sin b

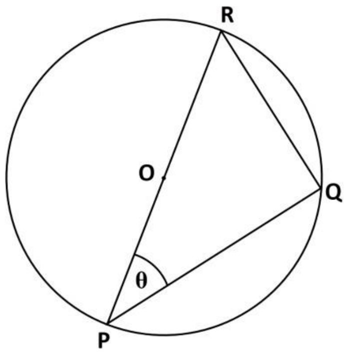


2). Fill the blank according to the diagram given.

$\sin \theta = \frac{\dots\dots\dots}{8}$

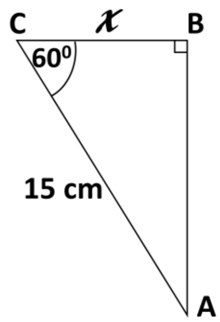


3). The figure shows a circle where the center is O points. P, Q and R lien on the circumference. Write trigonometric ratio of cos θ in terms of the sides of the relevant triangle.

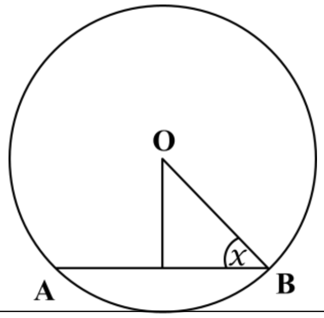


4).If $\tan \theta = \frac{5}{12}$, find $\cos \theta$.

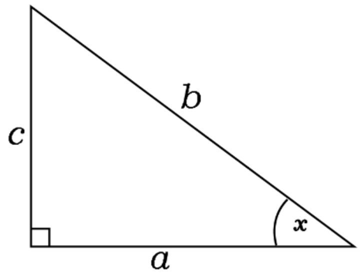
5). Evaluate x from the given figure.



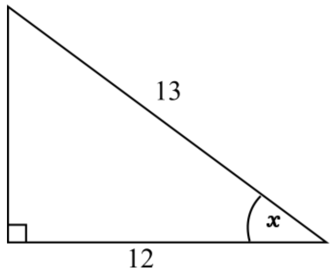
6). This is circle where the center O and the diameter is 10cm.The length of the chord is AB = 8 cm. Write down the trigonometric ratio of cos x.



7). According to the imformation given in the diagrm write $\dfrac{\sin x}{\cos x}$ in its simplest form.write the sin and cosine ratio and simlify the given expression.



8). Evaluate cos (90 – x) using the data in the figure.



Content

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