

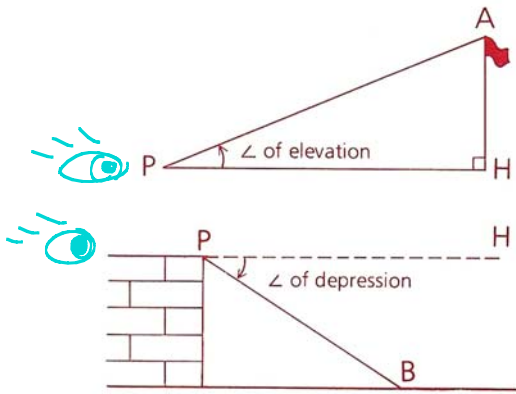
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Adv Geo – per
Mon 25 Mar 2013

9-10: Trigonometric Ratios

Objective: After studying this section, I can use trigonometric ratios to solve right triangles.

Prior Knowledge: SOH CAH TOA.

Special families of right triangles $(30^\circ, 60^\circ, 90^\circ) \Leftrightarrow (x, x\sqrt{3}, 2x)$ & $(45^\circ, 45^\circ, 90^\circ) \Leftrightarrow (x, x, x\sqrt{2})$

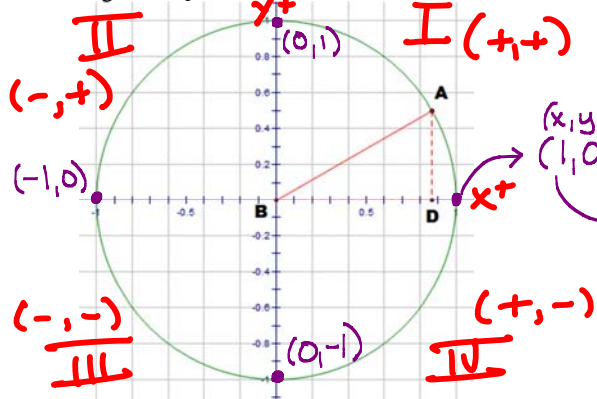


Note Do not forget that an angle of elevation or depression is an angle between a line of sight and the horizontal. Do not use the vertical.

Q: How can I find the trigonometric value of any angle?!?

A: The Unit Circle (which you will study in depth next year).

Signs of Quadrants & axes



Make sure calc in DEGREE mode.

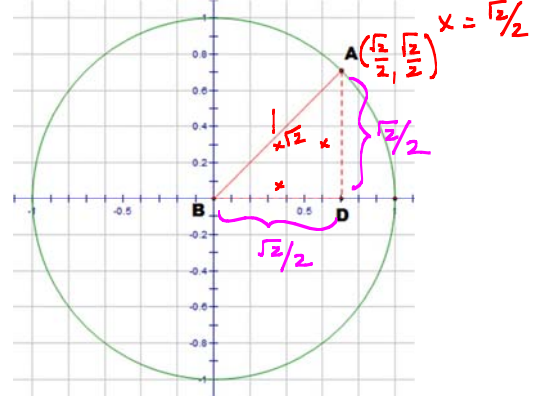
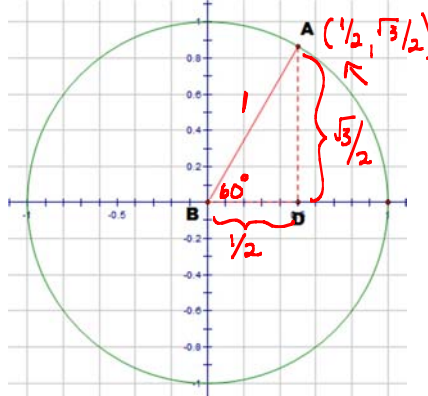
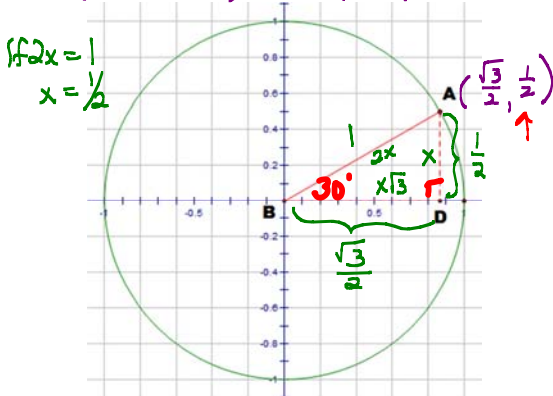
(x, y)
 $(1, 0)$
 $(\cos B, \sin B)$

$$\tan B = \frac{\sin B}{\cos B}$$

$(30^\circ, 60^\circ, 90^\circ) \Leftrightarrow (x, x\sqrt{3}, 2x)$

$30^\circ, 60^\circ, 90^\circ$

$45^\circ, 45^\circ, 90^\circ$



$\sin B = \cos A$
Always

SOH CAH

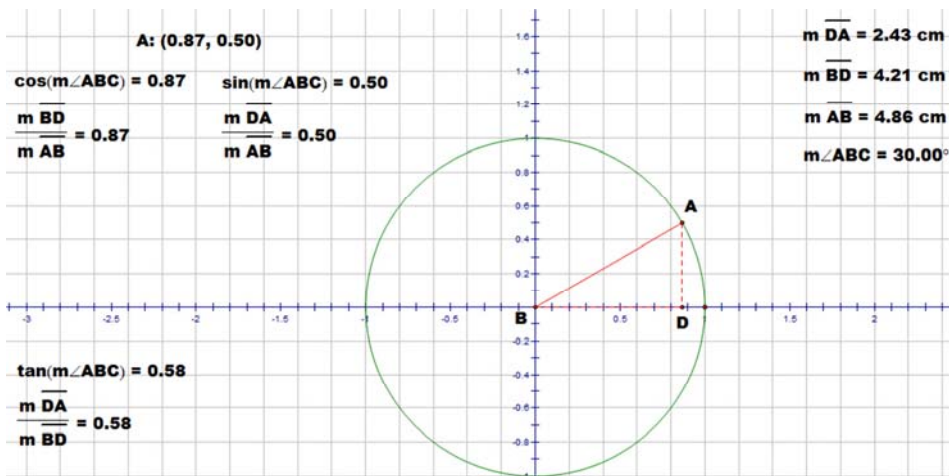


Table of Trigonometric Ratios

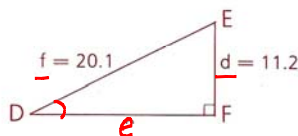
$\angle A$	$\sin \angle A$	$\cos \angle A$	$\tan \angle A$	$\angle A$	$\sin \angle A$	$\cos \angle A$	$\tan \angle A$
1°	.0175	.9998	.0175	46°	.7193	.6947	1.0355
2°	.0349	.9994	.0349	47°	.7314	.6820	1.0724
3°	.0523	.9986	.0524	48°	.7431	.6691	1.1106
4°	.0698	.9976	.0699	49°	.7547	.6561	1.1504
5°	.0872	.9962	.0875	50°	.7660	.6428	1.1918
6°	.1045	.9945	.1051	51°	.7771	.6293	1.2349
7°	.1219	.9925	.1228	52°	.7880	.6157	1.2799
8°	.1392	.9903	.1405	53°	.7986	.6018	1.3270
9°	.1564	.9877	.1584	54°	.8090	.5878	1.3764
10°	.1736	.9848	.1763	55°	.8192	.5736	1.4281
11°	.1908	.9816	.1944	56°	.8290	.5592	1.4826
12°	.2079	.9781	.2126	57°	.8387	.5446	1.5399
13°	.2250	.9744	.2309	58°	.8480	.5299	1.6003
14°	.2419	.9703	.2493	59°	.8572	.5150	1.6643
15°	.2588	.9659	.2679	60°	.8660	.5000	1.7321
16°	.2756	.9613	.2867	61°	.8746	.4848	1.8040
17°	.2924	.9563	.3057	62°	.8829	.4695	1.8807
18°	.3090	.9511	.3249	63°	.8910	.4540	1.9626
19°	.3256	.9455	.3443	64°	.8988	.4384	2.0503
20°	.3420	.9397	.3640	65°	.9063	.4226	2.1445
21°	.3584	.9336	.3839	66°	.9135	.4067	2.2460
22°	.3746	.9272	.4040	67°	.9205	.3907	2.3559
23°	.3907	.9205	.4245	68°	.9272	.3746	2.4751
24°	.4067	.9135	.4452	69°	.9336	.3584	2.6051
25°	.4226	.9063	.4663	70°	.9397	.3420	2.7475
26°	.4384	.8988	.4877	71°	.9455	.3256	2.9042
27°	.4540	.8910	.5095	72°	.9511	.3090	3.0777
28°	.4695	.8829	.5317	73°	.9563	.2924	3.2709
29°	.4848	.8746	.5543	74°	.9613	.2756	3.4874
30°	.5000	.8660	.5774	75°	.9659	.2588	3.7321
31°	.5150	.8572	.6009	76°	.9703	.2419	4.0108
32°	.5299	.8480	.6249	77°	.9744	.2250	4.3315
33°	.5446	.8387	.6494	78°	.9781	.2079	4.7046
34°	.5592	.8290	.6745	79°	.9816	.1908	5.1446
35°	.5736	.8192	.7002	80°	.9848	.1736	5.6713
36°	.5878	.8090	.7265	81°	.9877	.1564	6.3138
37°	.6018	.7986	.7536	82°	.9903	.1392	7.1154
38°	.6157	.7880	.7813	83°	.9925	.1219	8.1443
39°	.6293	.7771	.8098	84°	.9945	.1045	9.5144
40°	.6428	.7660	.8391	85°	.9962	.0872	11.4301
41°	.6561	.7547	.8693	86°	.9976	.0698	14.3007
42°	.6691	.7431	.9004	87°	.9986	.0523	19.0811
43°	.6820	.7314	.9325	88°	.9994	.0349	28.6363
44°	.6947	.7193	.9657	89°	.9998	.0175	57.2900
45°	.7071	.7071	1.0000				

Problem 1

Given: Right $\triangle DEF$ as shown

Find: a $m\angle D$ to the nearest degree

b e to the nearest tenth



(a) $m\angle D: \sin D = \frac{o}{h} = \frac{11.2}{20.1}$

11.2/20.1		
.5572139303	33°	.5446
	34°	.5592

$$\sin D = \frac{11.2}{20.1}$$

$$m\angle D = \sin^{-1}(11.2/20.1)$$

$$m\angle D = \sin^{-1}(11.2/20.1) = 33.8633406^\circ$$

(b)

Pythag Thm

$$e^2 + d^2 = f^2$$

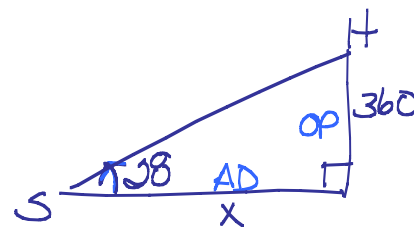
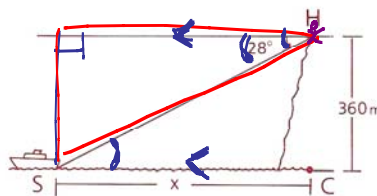
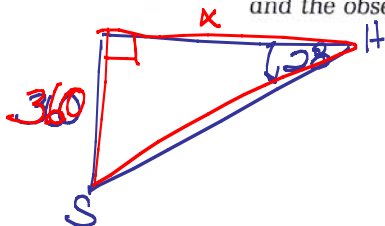
$$e^2 + (11.2)^2 = (20.1)^2$$

$$e^2 = 20.1^2 - 11.2^2$$

$$e = \sqrt{20.1^2 - 11.2^2} \approx \sqrt{(20.1^2 - 11.2^2)} \approx 16.7$$

Problem 2

To an observer on a cliff 360 m above sea level, the angle of depression of a ship is 28° . What is the horizontal distance between the ship and the observer?



$$\tan 28 = \frac{op}{ad}$$

$$\times \tan 28 = 360 / \times$$

$$\times \tan 28 = 360$$

$$\times = 360 / \tan 28$$

$$\times \approx 677 \text{ m}$$

$$\theta = \text{theta}$$

Problem 3 Given the trig value, find the angle: If $\sin \theta = 0.7660$, find θ .

Method 1: Table

$$\sin \theta = 0.7660$$

table $\rightarrow 50^\circ$

Method 2: Calculator (& what happens)

$$\sin \theta = 0.7660$$

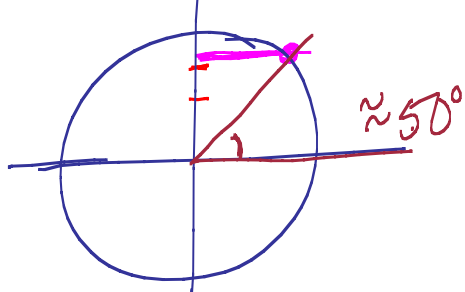
$$\theta = \sin^{-1}(0.7660)$$

$$\sin^{-1}(0.7660)$$

$$49.99603866 \approx 50^\circ$$

Method 3 (unless it's a special, this method is the least accurate if it's a quick sketch):

I don't have a table or calculator, but I can use the unit circle.



$$\sin \theta = .7660$$

Treat: Trig Unit circle Trick

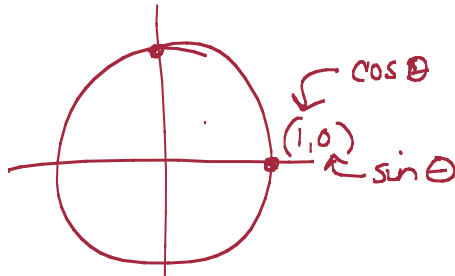
<http://www.youtube.com/watch?v=1-hrT1Ys390>

9-10: Trigonometric Ratios: 1-12, 14, & 15

1 Find each of the following in the Table of Trigonometric Ratios.

- a $\sin 21^\circ$ b $\tan 52^\circ$ c $\cos 5^\circ$ d $\tan 45^\circ$ e $\sin 60^\circ$

table: 0.3584



2 Using the table, find $m\angle A$ in each case.

a $\sin \angle A = 0.4067$

b $\tan \angle A = 3.4874$

c $\cos \angle A = .7071$

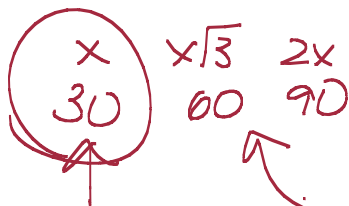
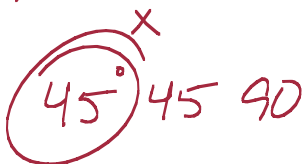
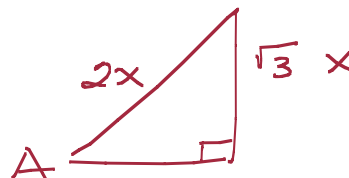
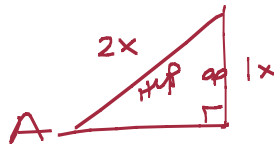
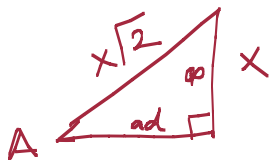
$\angle A = 24^\circ$

3 Without using the table, find $m\angle A$ in each case.

a $\tan \angle A = 1 = \frac{x}{x}$
 $\tan \rightarrow \frac{0}{A}$

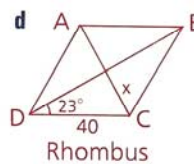
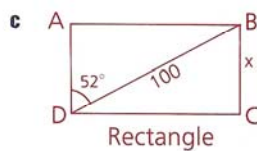
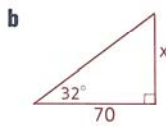
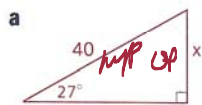
b $\sin \angle A = \frac{x}{2x} = \frac{0}{4}$

c $\sin \angle A = \frac{\sqrt{3}}{2}$



SOH CAH TOA

4 In each case, find x to the nearest integer.



$$\sin \angle = \frac{op}{hyp}$$

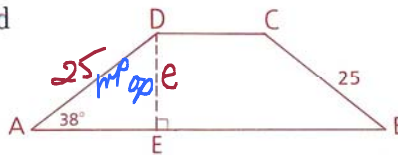
$$\sin 27 = \frac{x}{40}$$

$$40(\sin 27) = x$$

$$18.15 \approx x$$

$$40 * \sin(27) = 18.15961999$$

5 Find the height of isosceles trapezoid ABCD.



$$\sin 38 = \frac{e}{25}$$

$$25(\sin 38) = e \approx 15.39$$

5b. Find the area of the trapezoid (above).

know
 $\angle$
ratio

want
ratio
 $\angle$

use...
trig function
inverse

$$\sin 30 = ?$$

$$\sin ? = \frac{1}{2} \rightarrow$$

$$? = \sin^{-1}(1/2)$$

6 Solve each equation for x to the nearest integer.

a $\sin 25^\circ = \frac{x}{40}$

$$40(\sin 25) = x$$

b $\cos 73^\circ = \frac{35}{x}$

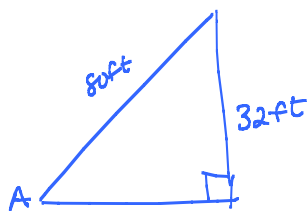
$$x \cdot \cos 73 = 35$$

$$x = \frac{35}{\cos 73}$$

c $\sin x^\circ = \frac{29}{30} = .96$

$$75^\circ < x^\circ < 76^\circ$$

7 A department-store escalator is 80 ft long. If it rises 32 ft vertically, find the angle it makes with the floor.



$$\sin A = \frac{32}{80}$$

$$\rightarrow 24^\circ > A > 23^\circ$$

$$A = \sin^{-1}(32/80)$$

$$A \approx 23.58^\circ$$

8 Given the regular pentagon shown, with center at O and EN = 12 cm,

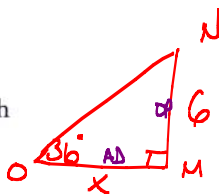
a Find $m\angle E$

$$\text{ext } \angle - \text{int } \angle = \text{ext } \angle$$

$$180 - \left(\frac{360}{5}\right) = 108^\circ$$

b Find $m\angle NOM = 36^\circ$

c Find OM to the nearest hundredth

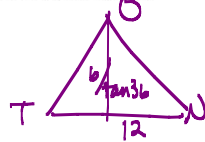


$$\tan 36^\circ = \frac{6}{x} \rightarrow \frac{x}{6} = \frac{1}{\tan 36^\circ}$$

$$x = \frac{6}{\tan 36^\circ} \text{ EXACT}$$

$$x \approx 8.26 \leftarrow \text{estimate}$$

d Find the area of $\triangle NOT$ to the nearest hundredth

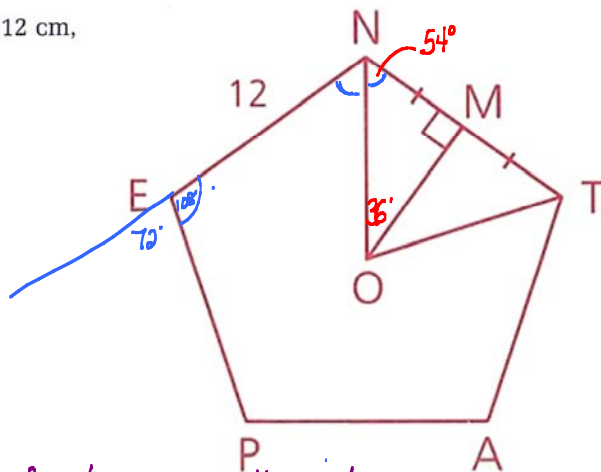


$$\begin{aligned} A_{\triangle NOT} &= \frac{1}{2} b \cdot h \\ &= \frac{1}{2} (12) \left(\frac{6}{\tan 36^\circ} \right) \\ &= \frac{36}{\tan 36^\circ} \\ &\approx 49.55 \end{aligned}$$

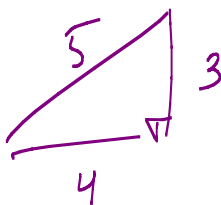
e Explain how you could find the area of the pentagon



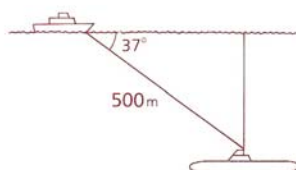
$$5(A_{\triangle NOT}) \approx 247.75$$



9 Find, to the nearest degree, the angles of a (3, 4, 5) triangle.



10 A sonar operator on a cruiser detects a submarine at a distance of 500 m and an angle of depression of 37° . How deep is the sub?



11 The legs of an isosceles triangle are each 18. The base is 14.

a Find the base angles to the nearest degree.

b Find the exact length of the altitude to the base.

12 One diagonal of a rhombus makes an angle of 27° with a side of the rhombus. If each side of the rhombus has a length of 6.2 in., find the length of each diagonal to the nearest tenth of an inch.

14 Find the length of the apothem of a regular pentagon that has a perimeter of 50 cm.

15 Two buildings are 100 dm apart across a street. A sunbather at point P finds the angle of elevation of the roof of the taller building to be 25° and the angle of depression of its base to be 30° . Find the height of the taller building to the nearest decimeter.

