

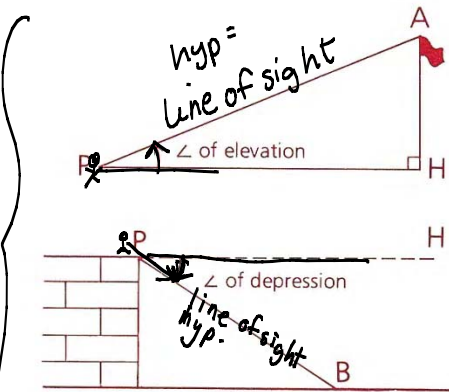
Name
Ms. Kresovic
Adv Geo - per
Wed 2 Mar 2014

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 $(30^\circ, 60^\circ, 90^\circ) \Leftrightarrow (x, x\sqrt{3}, 2x)$ & $(45^\circ, 45^\circ, 90^\circ) \Leftrightarrow (x, x, x\sqrt{2})$

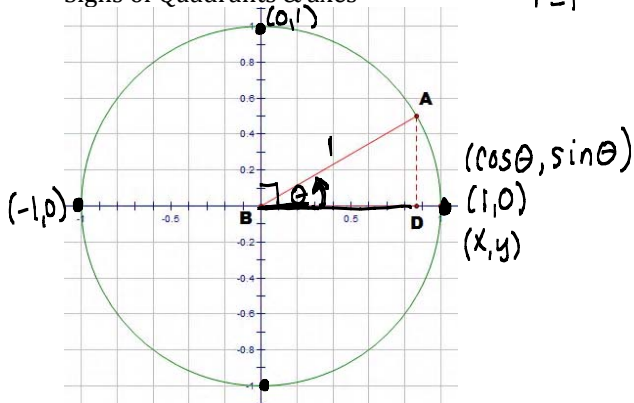


Note Do not forget that an angle of elevation or depression is an angle between a line of sight and the horizontal. Do not use the vertical.

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



$r=1$

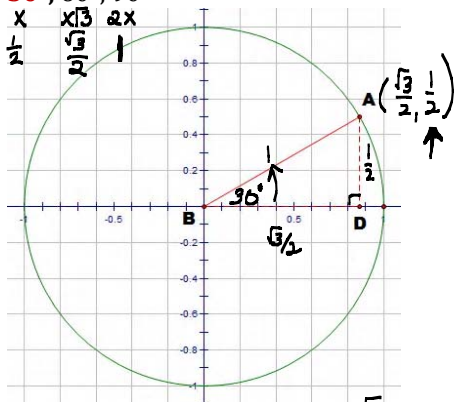
$x:$

$$\begin{aligned}\cos 0^\circ &= 1 \\ \cos 90^\circ &= 0 \\ \cos 180^\circ &= -1 \\ \cos 270^\circ &= 0 \\ \cos 360^\circ &= 1\end{aligned}$$

$y:$

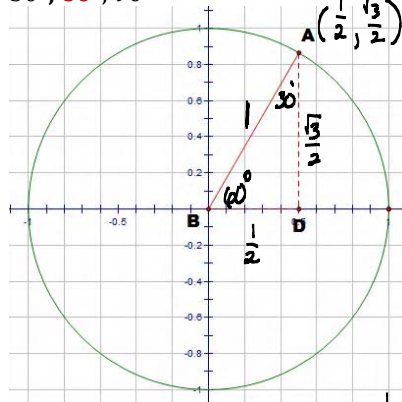
$$\begin{aligned}\sin 0^\circ &= 0 \\ \sin 90^\circ &= 1 \\ \sin 180^\circ &= 0 \\ \sin 270^\circ &= -1 \\ \sin 360^\circ &= 0\end{aligned}$$

30°, 60°, 90°

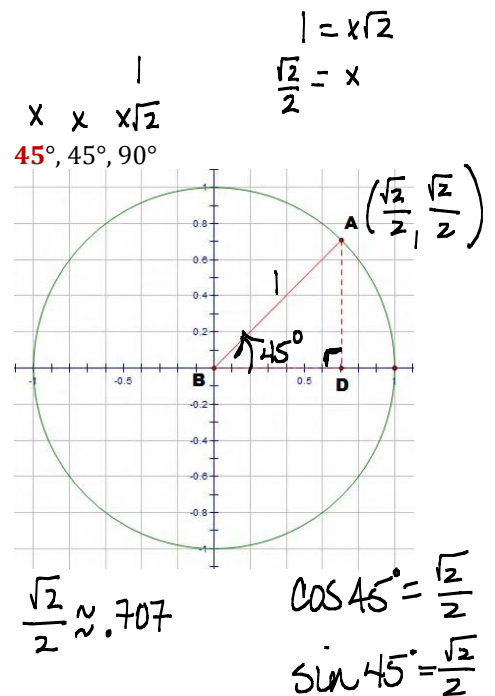


$$\begin{aligned}\frac{\sqrt{3}}{2} &\approx .866 \\ \cos 30^\circ &= \frac{\sqrt{3}}{2} \approx .866 \\ \sin 30^\circ &= \frac{1}{2}\end{aligned}$$

30°, 60°, 90°



$$\begin{aligned}\cos 60^\circ &= \frac{1}{2} \\ \sin 60^\circ &= \frac{\sqrt{3}}{2}\end{aligned}$$



$$\begin{aligned}\frac{\sqrt{2}}{2} &\approx .707 \\ \cos 45^\circ &= \frac{\sqrt{2}}{2} \\ \sin 45^\circ &= \frac{\sqrt{2}}{2}\end{aligned}$$

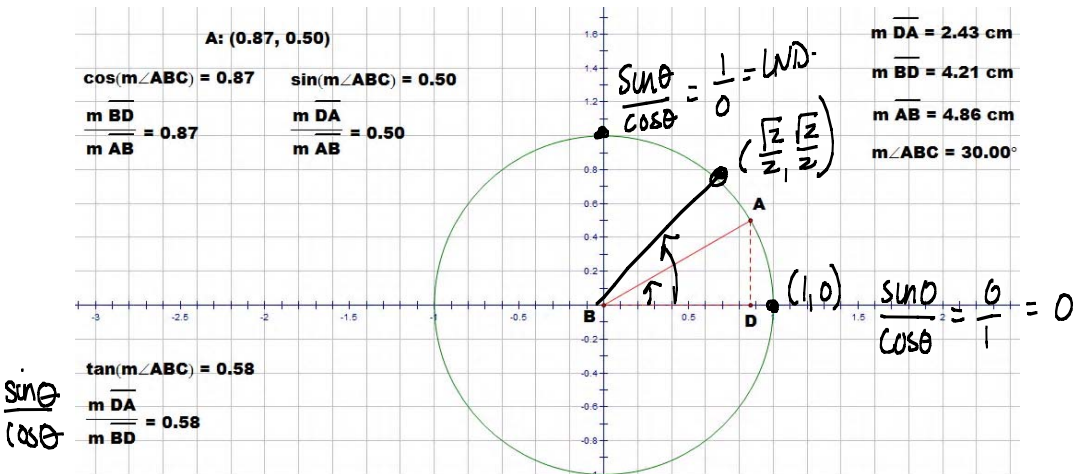


Table of Trigonometric Ratios

$\angle A$	$\sin \angle A$	$\cos \angle A$	$\tan \angle A$	$\angle A$	$\sin \angle A$	$\cos \angle A$	$\tan \angle A$
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				

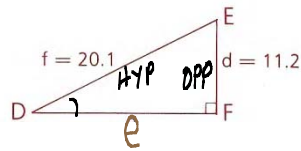
SOH CAH TOA

Problem 1

Given: Right $\triangle DEF$ as shown

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

b e to the nearest tenth



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

$$\sin^{-1}(11.2/20.1) = 33.8633406$$

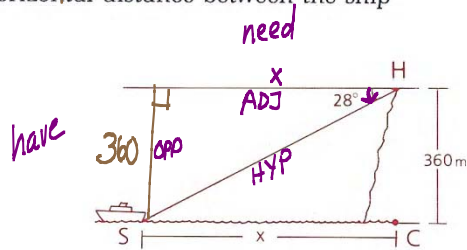
$$\begin{aligned} e: \quad e^2 + d^2 &= f^2 \\ e^2 + (11.2)^2 &= (20.1)^2 \\ e &= \sqrt{20.1^2 - 11.2^2} \end{aligned}$$

$$\sqrt{20.1^2 - 11.2^2} = 16.69041641$$

$$e \approx 16.7$$

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?



$$\tan 28^\circ = \frac{360}{x}$$

$$x \tan 28^\circ = 360$$

$$x = \frac{360}{\tan 28^\circ} \approx 677 \text{ m}$$

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

Method 1: Table

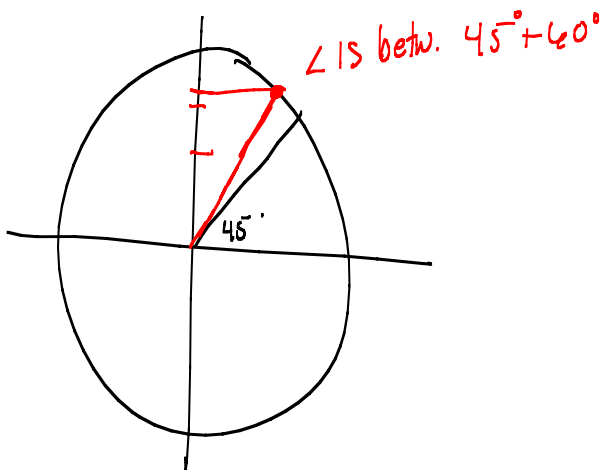
Method 2: Calculator (& what happens)

$$\theta = 50^\circ$$

$$\sin^{-1}(0.7660) \dots\dots\dots 49.99603866$$

$\theta = \text{theta}$
Greek letter

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.



Treat: Trig Unit circle Trick

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

4 sig figs

AMDG

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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 $\sin 60^\circ$

.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 $\cos \angle A = .7071$

$\angle A = \sin^{-1}(0.4067)$

24°

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

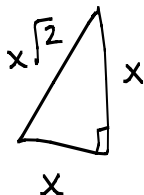
a $\tan \angle A = 1$

b $\sin \angle A = \frac{1}{2}$

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

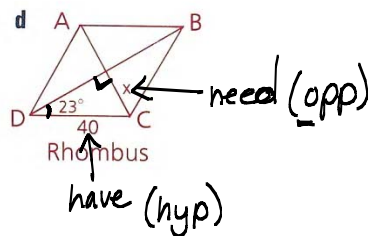
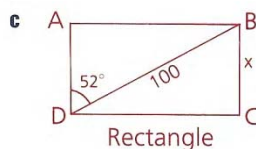
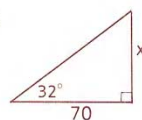
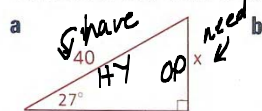
$\angle A = \tan^{-1}(1)$

$A = 45^\circ$



SOH CAH TOA

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



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

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

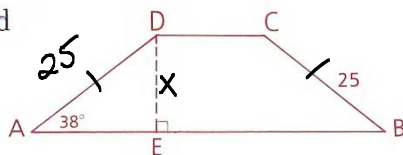
$$x \approx 18$$

$$\sin 23^\circ = \frac{x}{40}$$

$$40 \sin 23^\circ = x$$

$$x \approx 16$$

5 Find the height of isosceles trapezoid ABCD.



5b: Find the area of the trapezoid (above). $A_{\text{TRAP}} = (\text{AVERAGE BASES} \cdot \text{HEIGHT})$

6 Solve each equation for x to the nearest integer.

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

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

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

$$x(\cos 73) = 35$$

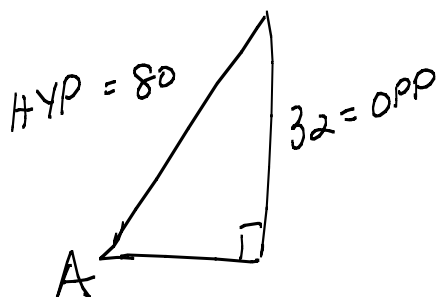
$$x^\circ = \sin^{-1}(29/30)$$

$$x = 35 / (\cos 73)$$

$$x \approx 75^\circ$$

$$x \approx 120$$

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



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

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

$$\approx 24^\circ$$

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

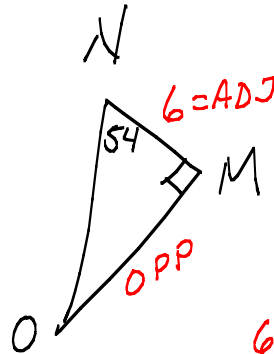
a Find $m\angle E$

$$180 - \frac{360}{5} = 108^\circ$$

b Find $m\angle NOM$

$$90 - 54 = 36^\circ$$

c Find OM to the nearest hundredth

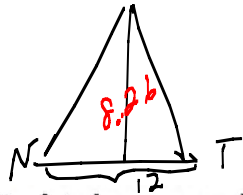


$$\tan 54 = \frac{OM}{6}$$

$$6(\tan 54) = OM$$

$$OM \approx 8.26 \text{ cm}$$

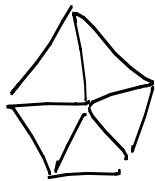
d Find the area of $\triangle NOT$ to the nearest hundredth



$$A = \frac{1}{2} b \cdot h$$

$$A_{\triangle NOT} = \frac{1}{2} 12 \cdot (8.26) \approx 49.56 \text{ cm}^2$$

e Explain how you could find the area of the pentagon



$$A_{\triangle NOT} \cdot 5 = A_{\text{PENTA}}$$

$$(49.56)(5) \approx 247.80 \text{ cm}^2$$

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



$$\angle C = 90^\circ \quad \sin \angle B = \frac{3}{5} \quad \text{SOH CAH TOA}$$

$$\angle B =$$

$$\angle A =$$

$$\angle B = \sin^{-1}(3/5)$$

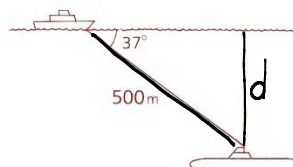
$$\angle B \approx 37^\circ$$

$$\angle A \approx (90 - 37) \approx 53^\circ$$

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?

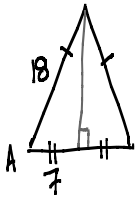
$$\begin{array}{l} \text{have hyp} \\ \text{want opp} \end{array} \left\{ \sin 37^\circ = \frac{d}{500} \right.$$

$$d = 500(\sin 37) \approx 301 \text{ m}$$



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

a Find the base angles to the nearest degree.



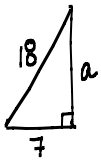
have adj & hyp
need $m\angle$

$$\cos \angle A = \frac{7}{18}$$

$$\angle A = \cos^{-1}\left(\frac{7}{18}\right)$$

$$\angle A \approx 67^\circ$$

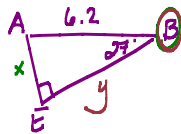
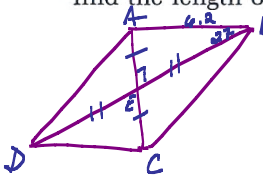
b Find the exact length of the altitude to the base.



$$a^2 + 7^2 = 18^2$$

$$a = \sqrt{18^2 - 7^2} = \sqrt{275} = \sqrt{25} \sqrt{11} = \boxed{5\sqrt{11}}$$

- 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.



have hyp = 6.2
need opp = x

$$\sin 27^\circ = \frac{BE}{6.2}$$

$$6.2(\sin 27^\circ) = BE$$

$$2.81 \approx BE$$

$$2(BE) = AC \approx \boxed{5.6 \text{ cm}}$$

have hyp = 6.2
need adj = y

$$\cos 27^\circ = \frac{AE}{6.2}$$

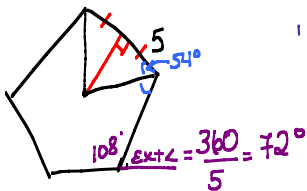
$$6.2(\cos 27^\circ) = AE$$

$$5.52 \approx AE$$

$$11.0 \approx BD$$

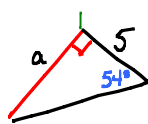
- 14 Find the length of the apothem of a regular pentagon that has a perimeter of 50 cm.

side = 10cm



$$\frac{360}{5} = 72^\circ$$

$$\text{supp of } 72 = 180 - 72 = 108^\circ$$



wrt 54°
have adj
need opp

$$\tan 54^\circ = \frac{a}{5}$$

$$a = 5(\tan 54^\circ)$$

$$a \approx 6.88 \text{ cm}$$

- 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.

SOH CAH TOA

a) have adj
need opp

$$\tan 30^\circ = \frac{a}{100}$$

$$100(\tan 30^\circ) = a$$

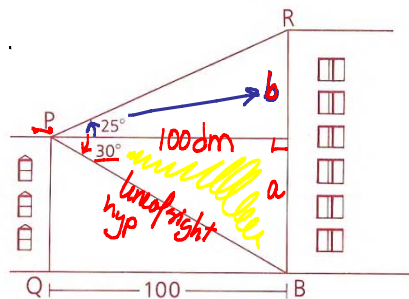
$$57.73 \approx a$$

b) need opp
have adj

$$\tan 25^\circ = \frac{b}{100}$$

$$100(\tan 25^\circ) = b$$

$$46.63 \approx b$$



$$a + b \approx 104 \text{ dm}$$

