Name
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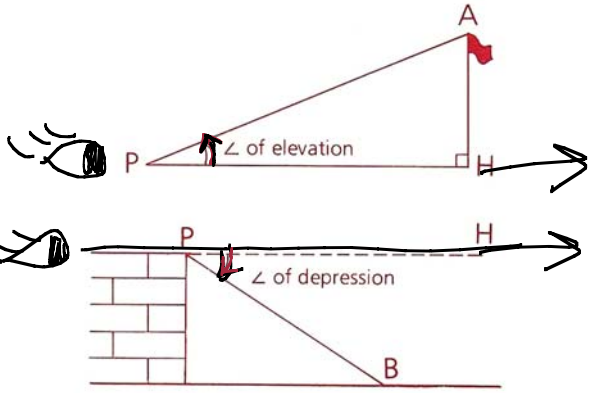
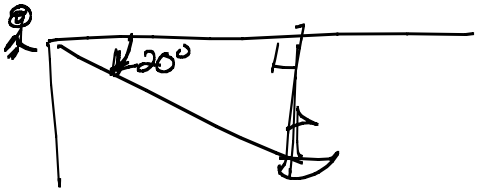
Adv Geo – per
Mon 25 Mar 2013

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°, 60°, 90°) ⇔ (x, x√3, 2x) & (45°, 45°, 90°) ⇔ (x, x, x√2)

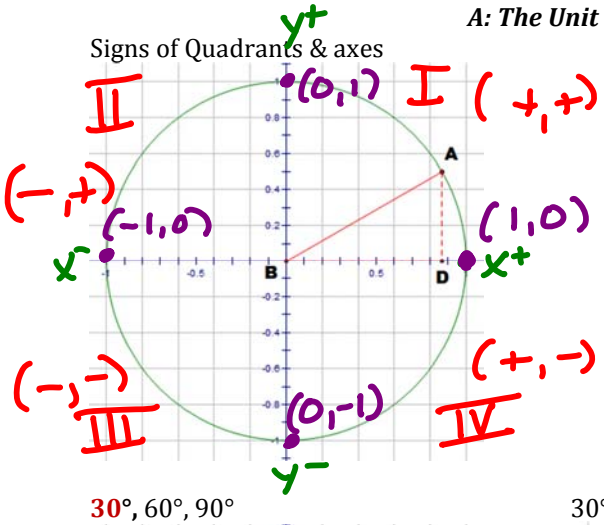




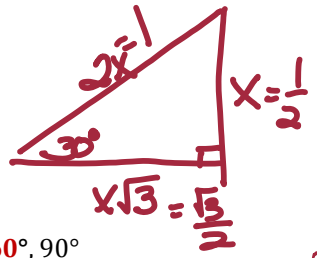
Note Do not forget that an angle of elevation or depression is an angle between a line of sight and the *horizontal*. Do not use the vertical.

Q: How can I find the trigonometric value of any angle?!?
A: The Unit Circle (which you will study in depth next year).

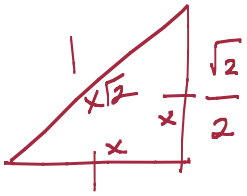
Signs of Quadrants & axes



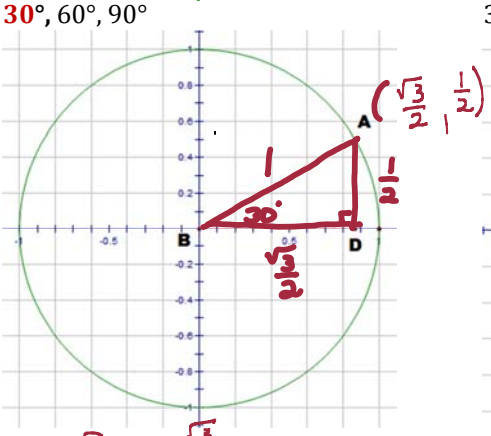
(x, y) → (cos B, sin B)



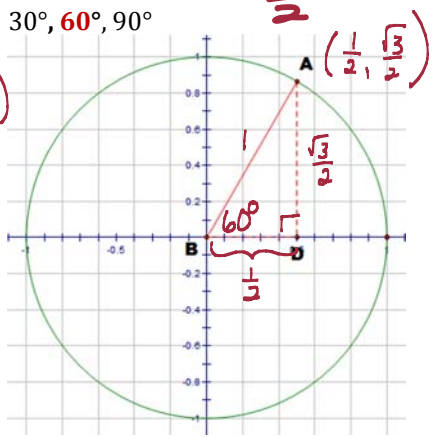
If 2x = 1, x = 1/2



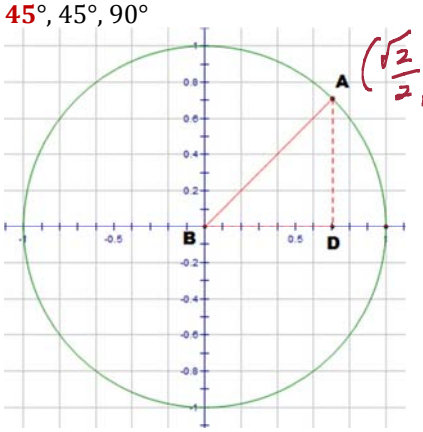
30°, 60°, 90°



30°, **60°**, 90°



45°, 45°, 90°



Cos B = √3/2

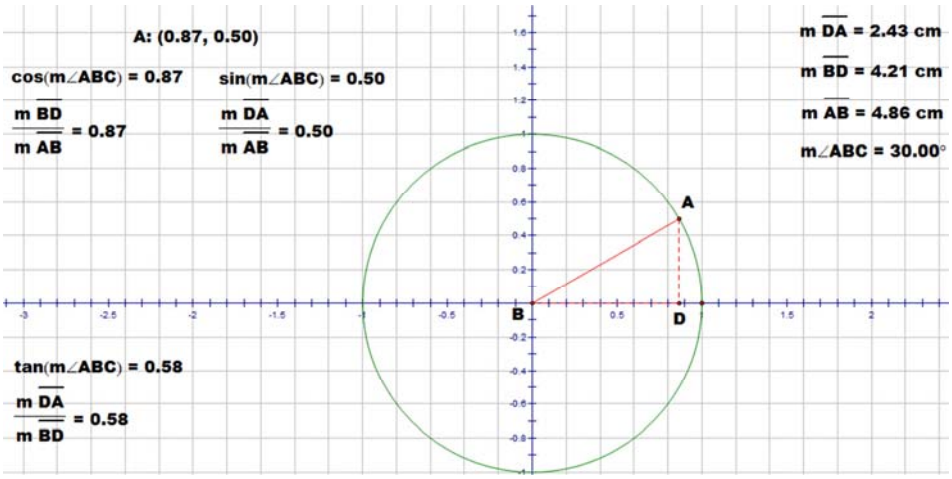


Table of Trigonometric Ratios

∠A	sin ∠A	cos ∠A	tan ∠A	∠A	sin ∠A	cos ∠A	tan ∠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				

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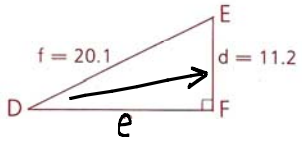
Problem 1 *Given: Right △DEF as shown*
Find: **a** *m∠D to the nearest degree*
b *e to the nearest tenth*



a: Table → $\sin\angle D = \frac{OP}{Hy}$

$\sin\angle D = 11.2/20.1$

```
sin∠D= 11.2/20.1
       .5572139303
```

33°	.5446
34°	.5592

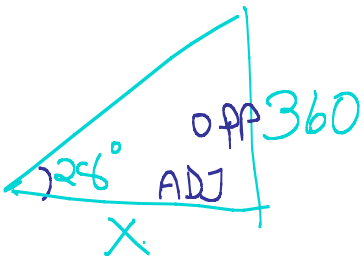
$33° < (m\angle D) < 34°$

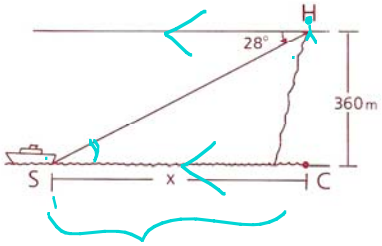
b. Calc → $\sin\angle D = 11.2/20.1$ mode: degrees

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

```
sin⁻¹(11.2/20.1)
      33.8633406
```

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?*





$\tan 28° = \frac{360}{x}$ → $x(\tan 28°) = 360$ →

$x = 360/\tan(28°) \approx 677\text{m}$

```
360/tan(28)
      677.0615275
```

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

Method 1: Table

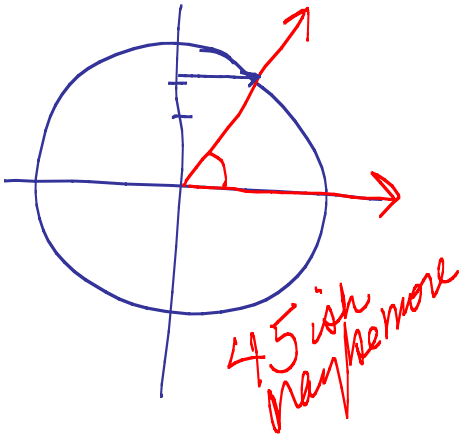
$\sin\theta = 0.7660$

49°	.7547
θ = 50°	.7660
51°	.7771

Method 2: Calculator (& what happens)

```
sin⁻¹(.7660)
      49.99603866
```

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

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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° **b** tan 52° **c** cos 5° **d** tan 45° **e** sin 60°

a. sin 21° = .3584

b. tan 52° = 1.2799

c. cos 5° ≈ .9962

d. tan 45° = 1

e. sin 60° = .8660

2 Using the table, find m∠A in each case.

a sin ∠A = 0.4067 **b** tan ∠A = 3.4874 **c** cos ∠A = .7071

24° .4067

$\angle A = \tan^{-1}(3.4874)$
$\angle A \approx 74°$

$\angle A = \cos^{-1}(.7071)$
$\angle A \approx 45°$

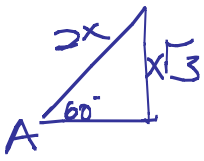
3 Without using the table, find m∠A in each case.

a tan ∠A = 1 **b** sin ∠A = $\frac{1x}{2x} = \frac{opp}{hyp}$ **c** sin ∠A = $\frac{\sqrt{3}}{2}$

$\tan\angle = \frac{opp}{adj}$

$\angle A = 45°$

x 30° | x√3 60 | 2x 90



$A = 60°$

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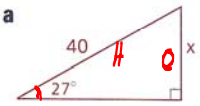
4 In each case, find x to the nearest integer.

a

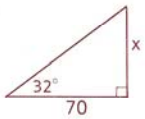


$\sin 27° = \frac{x}{40}$

$40(\sin 27°) = x$

$18 \approx x$

b

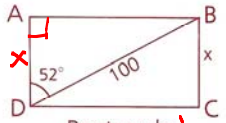


$\tan 32 = \frac{x}{70}$

$70 \tan 32 = x$

$x \approx 44$

c



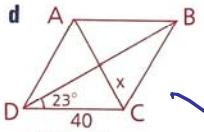
Rectangle

$\cos 52 = \frac{x}{100}$

$100 \cos 52 = x$

$x \approx 62$

d



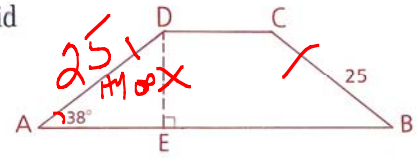
Rhombus

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

$x = 40 \sin 23$

$x \approx 16$

5 Find the height of isosceles trapezoid ABCD.



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

$25(\sin 38°) = x$

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

6 Solve each equation for x to the nearest integer.

a $\sin 25° = \frac{x}{40}$

$x = 40 \sin 25$

$x \approx 17$

b $\cos 73° = \frac{35}{x}$

$x \cdot \cos 73 = 35$

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

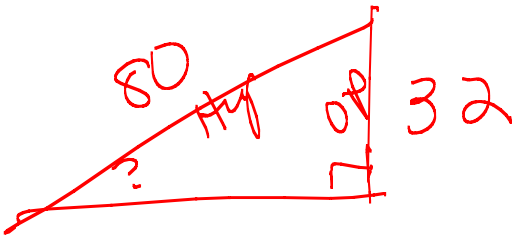
$x \approx 120$

c $\sin x° = \frac{29}{30}$

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

$x \approx 75$

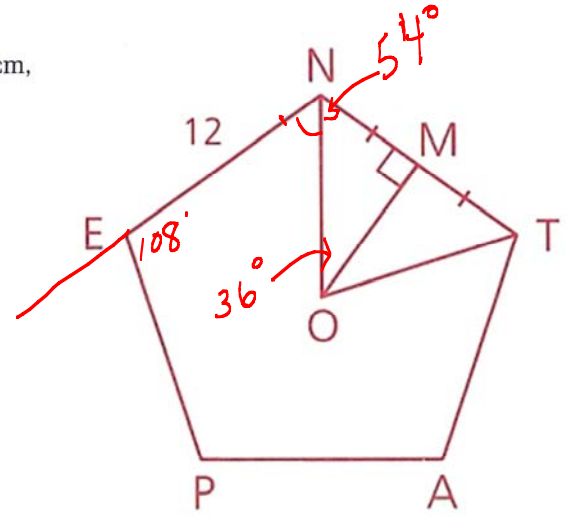
7 A department-store escalator is 80 ft long. If it rises 32 ft vertically, find the angle it makes with the floor.



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

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

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

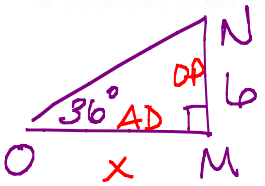


a Find m∠E

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

b Find m∠NOM $= 36°$

c Find OM to the nearest hundredth



$\sin\angle O = \frac{OP}{AD}$ → $x(\sin 36°) = 6$

$\sin 36° = \frac{6}{x}$ → $x = \frac{6}{\sin 36°}$

6/sin(36)
10.2078097

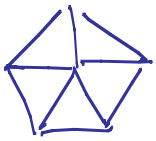
$x \approx 10.21$

d Find the area of △NOT to the nearest hundredth

$A_{\triangle NOT} = \frac{1}{2} b \cdot h$

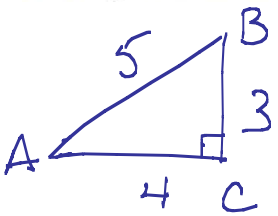
$\frac{1}{2}(12)(10.21) = 61.26$

e Explain how you could find the area of the pentagon



$A_{PENTAGON} = 5A_{\triangle} = 5(61.26) = 306.3$

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



$m\angle A$

$\sin A = 3/5$

$A \approx 37°$

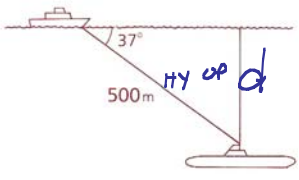
$90 - 37 \cong 53° \approx m\angle B$

$m\angle A = 37°$

$m\angle B = 53°$

$m\angle C = 90°$

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?



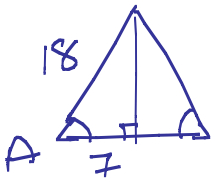
$\sin 37° = \frac{d}{500m}$

$500m(\sin 37°) = d$

$d = 300.908\,m$

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

a Find the base angles to the nearest degree.



$\cos A = \frac{7}{18} \approx 67°$

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

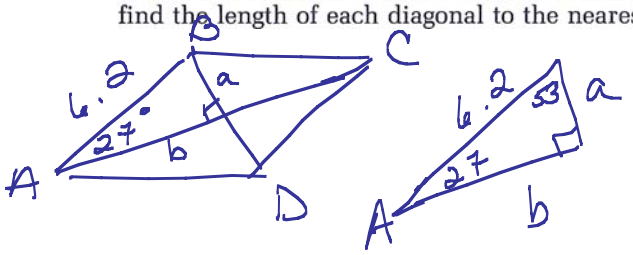
using trig: $\sin 67° = \frac{x}{18} \rightarrow x = 18(\sin 67°)$

$x \approx 16.569$

using pyth: $a^2 + 7^2 = 18^2 \rightarrow \sqrt{18^2 - 7^2} = a = \sqrt{324 - 49} = \sqrt{275}$

$a = 5\sqrt{11}$

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.



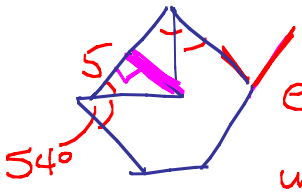
$\sin 27° = \frac{a}{6.2}$ & $\cos 27 = \frac{b}{6.2}$

$6.2(\sin 27) = a$ $\quad (\cos 27)6.2 = b$

$a = 2.815$ $\quad AC = 11.0$

$\times 2 \Rightarrow BD = 5.6$

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

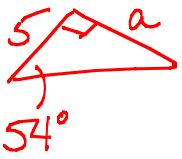


→ ⊥ to side

side = 10

ext $\angle = \frac{360}{5} = 72°$

int $\angle = 180 - 72° = 108°$

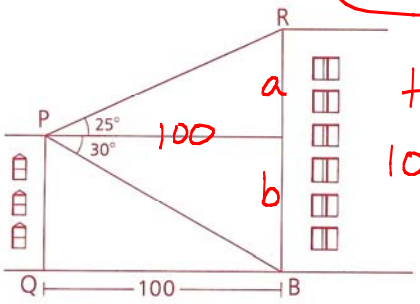


$\tan 54° = \frac{a}{5}$

$5\tan 54° = a$

$a \approx 6.882$

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.



$\tan 25° = \frac{a}{100}$

$a = 100\tan 25° \approx 46.631$

$\tan 30° = \frac{b}{100}$

$100\tan 30° = b$

$57.74 \approx b$

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