Examples 0 in The Basics

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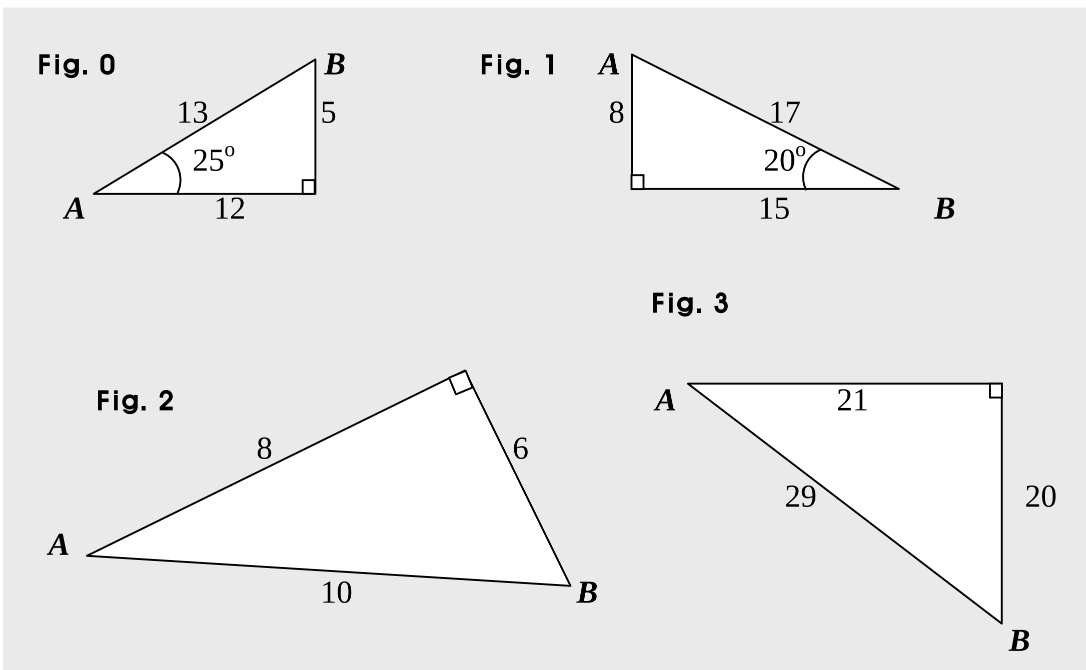
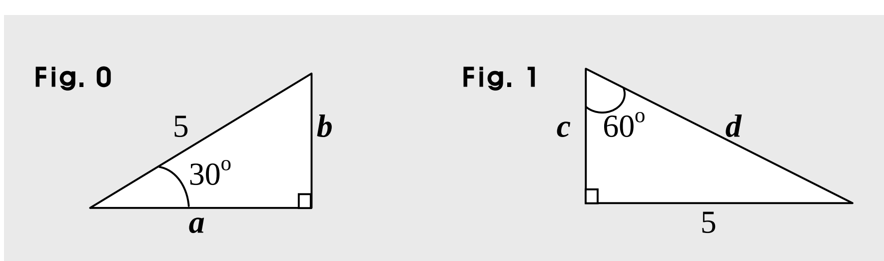
0. Find **sin *A***, **cos *A***, **tan *A***, **sin *B***, **cos *B***, and **tan *B*** in each of Fig. 0, 1, 2, and 3 below.

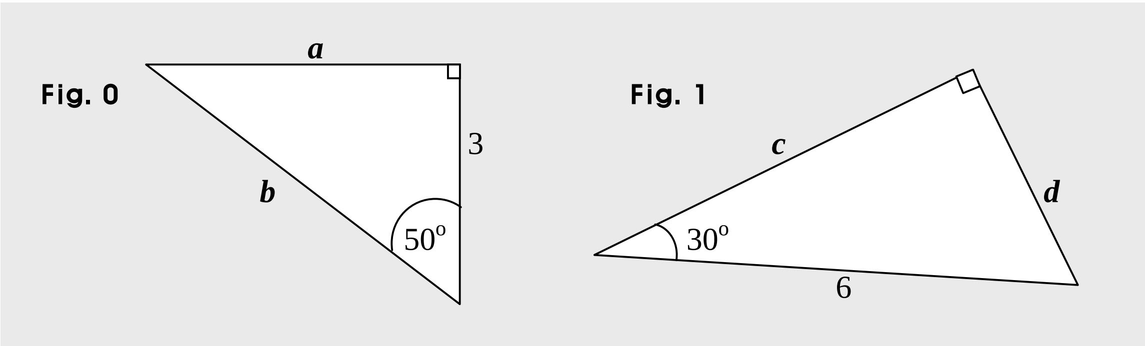
Note that in Fig. 0, **sin *A*** = **sin** 25^{o},so the angle ***A*** is 25^{o}. And the same idea applies to all the angles in all the figures. So for another instance, in Fig. 1, the angle ***B*** is 20^{o}.



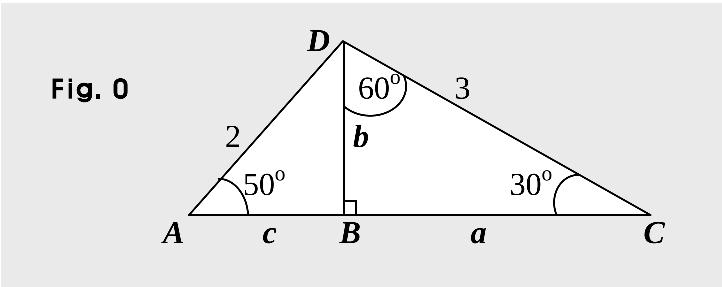
1. Assuming **sin 30° = 0.5**, **cos 30° = 0.866**, **sin 60° = 0.866**, and **cos 60 = 0.5**, find the values of ***a***, ***b***, ***c***, and ***d*** below.



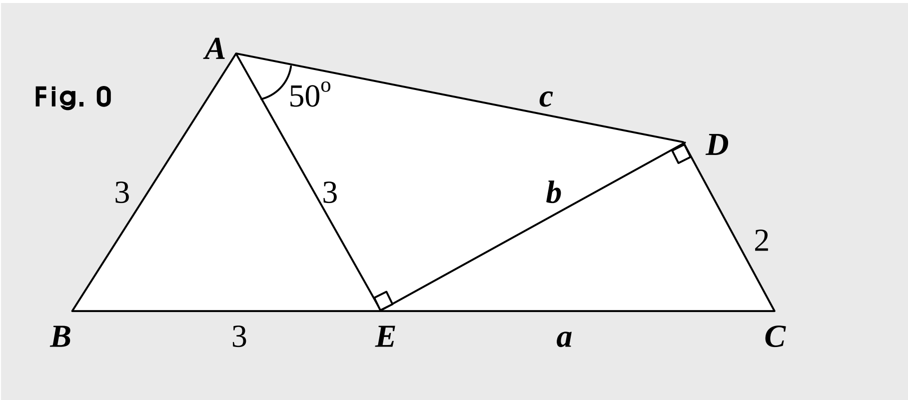
2. Assuming **sin 50° = 0.766**, **cos 50° = 0.643**, **sin 30° = 0.5**, **cos 30° = 0.866**, **sin 60° = 0.866**, and **cos 60 = 0.5**, find the values of ***a***, ***b***, and ***c*** below.



3. Assuming **sin 50° = 0.766**, **cos 50° = 0.643**, **sin 30° = 0.5**, **cos 30° = 0.866**, **sin 60° = 0.866**, and **cos 60 = 0.5**, find the values of ***a***, ***b***, and ***c*** below.



4. Find ***a***, ***b***, ***c***, and the area of a tetragon ***ABCD*** below assuming **sin 50° = 0.766**, **cos 50° = 0.643**, **sin 30° = 0.5**, **cos 30° = 0.866**, **sin 60° = 0.866**, and **cos 60 = 0.5**.

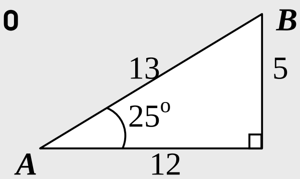


Suggestions or Solutions
To the Problem 0

0. Find **sin *A***, **cos *A***, **tan *A***, **sin *B***, **cos *B***, and **tan *B*** in each of Fig. 0, 1, 2, and 3 below.

Note that in Fig. 0, **sin *A*** = **sin** 25^o, so the angle ***A*** is 25^o. Thus, the angle ***B*** is 65^o, since ***A* + *B* =** 90^o, and the other angle is 90^o, because the sum of all the three angles in a triangle is 180^o.

Fig. 0



To begin with, what is the sine?

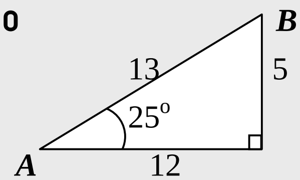
The sine is about the opposite, and is the ratio of the opposite to the hypotenuse. So the sine is the opposite over the hypotenuse. Now in Fig. 0, for sin ***A***, the opposite is 5 and the hypotenuse is 13, so we get **sin *A*** = 5/13 = $\frac{5}{13}$. Next, what is the cosine?

The cosine is about the adjacent, and is the ratio of the adjacent to the hypotenuse. So the cosine is the adjacent over the hypotenuse. Thus, in Fig. 0, for cos ***A***. the adjacent is 12, and the hypotenuse is 13, so we get **cos *A* =** 12/13 = $\frac{12}{13}$. Next, what is the tangent?

The tangent is the slope. What slope?

It is the slope of the hypotenuse, and is the ratio of the opposite to the adjacent. So the tangent is the opposite over the adjacent. Thus, in Fig. 0, for tan ***A***, the opposite is 5, and the adjacent is 12, so we get **tan *A* =** 5/12 = $\frac{5}{12}$. Next, what is **sin *B***?

Fig. 0



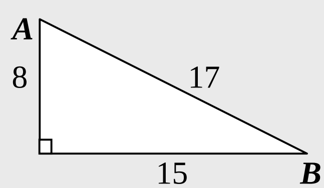
The sine is the opposite over the hypotenuse. So in Fig. 0, for sin ***B***, the opposite is 12 and the hypotenuse is 13, so we get **sin *B*** = 12/13 = $\frac{12}{13}$.

Next, the cosine is the adjacent over the hypotenuse. Thus, in Fig. 0, for cos ***B***. the adjacent is 5, and the hypotenuse is 13, so we get **cos *B* =** 5/13 = $\frac{5}{13}$.

Next, the tangent is the slope of the hypotenuse, and is the opposite over the adjacent. So in Fig. 0, for **tan *B***, the opposite is 12, and the adjacent is 5, so we get **tan *B* =** 12/5 = $\frac{12}{5}$.

Next, moving on to Fig. 1, we have this:

Fig. 1



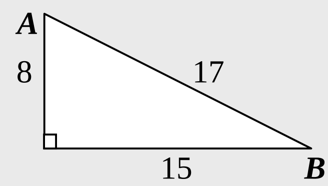
First off, the sine is the opposite over the hypotenuse. So in Fig. 1, for sin ***A***, the opposite is 15 and the hypotenuse is 17, so we get **sin *A*** = 15/17 = $\frac{15}{17}$.

Next, the cosine is the adjacent over the hypotenuse. Thus, in Fig. 1, for cos ***A***. the adjacent is 8, and the hypotenuse is 17, so we get **cos *A* =** $\frac{8}{17}$.

Next, the tangent is the slope of the hypotenuse, and is the opposite over the adjacent. Thus, in Fig. 1, for **tan *A***, the opposite is 15, and the adjacent is 8, so **tan *A* =** $\frac{15}{8}$.

Next, the sine is the opposite over the hypotenuse. So in Fig. 1, for sin ***B***, the opposite is 8 and the hypotenuse is 17, so we get **sin *B*** = $\frac{8}{17}$.

Fig. 1

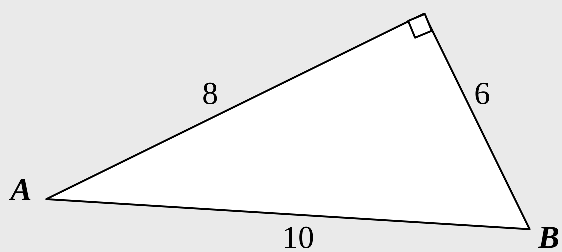


Next, the cosine is the adjacent over the hypotenuse. Thus, in Fig. 1, for cos ***B***. the adjacent is 15, and the hypotenuse is 17, so we get **cos *B* =** $\frac{15}{17}$.

Next, the tangent is the slope of the hypotenuse, and is the opposite over the adjacent. Thus, in Fig. 1, for **tan *B***, the opposite is 8, and the adjacent is 15, so **tan *B* =** $\frac{8}{15}$.

Now, moving on to Fig. 2, we have this:

Fig. 2



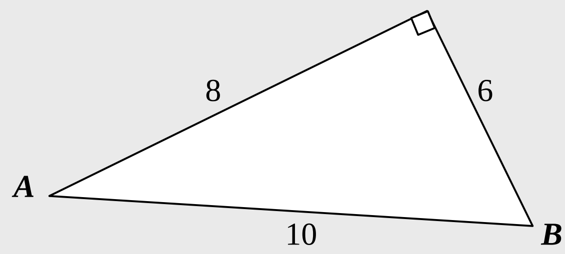
First, the sine is the opposite over the hypotenuse. So in Fig. 2, for sin ***A***, the opposite is 6 and the hypotenuse is 10, so we get **sin *A*** = 6/10 = 3/5 = $\frac{3}{5}$.

Next, the cosine is the adjacent over the hypotenuse. Thus, in Fig. 2, for cos ***A***. the adjacent is 8, and the hypotenuse is 10, so we get **cos *A* =** $\frac{8}{10} = \frac{4}{5}$.

Next, the tangent is the slope of the hypotenuse, and is the opposite over the adjacent. Thus, in Fig. 2, for **tan *A***, the opposite is 6, and the adjacent is 8,

so we get **tan *A*** = 6/8 = 3/4 = $\frac{3}{4}$.

Fig. 2



Next, the sine is the opposite over the hypotenuse. So in Fig. 2, for sin ***B***, the opposite is 8 and the hypotenuse is 10, so we get **sin *B*** = 8/10 = 4/5 = $\frac{4}{5}$.

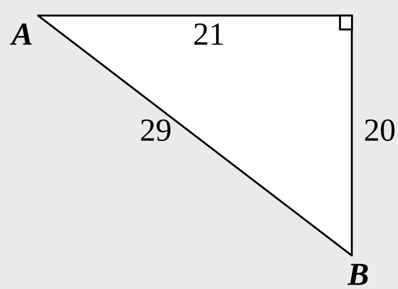
Next, the cosine is the adjacent over the hypotenuse. Thus, in Fig. 2, for cos ***B***. the adjacent is 6, and the hypotenuse is 10, so we get **cos *B* =** 6/10 = 3/5 = $\frac{3}{5}$.

Next, the tangent is the slope of the hypotenuse, and is the opposite over the adjacent. Thus, in Fig. 2, for **tan *B***, the opposite is 8, and the adjacent is 6,

so we get **tan *B* =** 8/6 = 4/3 = $\frac{4}{3}$.

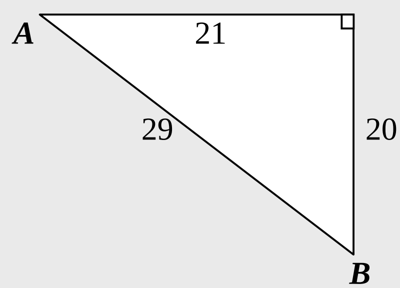
Now, moving on to Fig. 3, we have this:

Fig. 3



First, the sine is the opposite over the hypotenuse. So in Fig. 3, for sin ***A***, the opposite is 20 and the hypotenuse is 29, so we get **sin *A*** = 20/29 = $\frac{20}{29}$.

Fig. 3



Next, the cosine is the adjacent over the hypotenuse. Thus, in Fig. 3, for cos ***A***. the adjacent is 21, and the hypotenuse is 29, so we get **cos *A* =** $\frac{21}{29}$.

Next, the tangent is the slope of the hypotenuse, and is the opposite over the adjacent. Thus, in Fig. 3, for **tan *A***, the opposite is 20, and the adjacent is 21,

so we get **tan *A* =** 20/21 = $\frac{20}{21}$.

Next, the sine is the opposite over the hypotenuse. So in Fig. 3, for sin ***B***, the opposite is 21 and the hypotenuse is 29, so we get **sin *B*** = 21/29 = $\frac{21}{29}$.

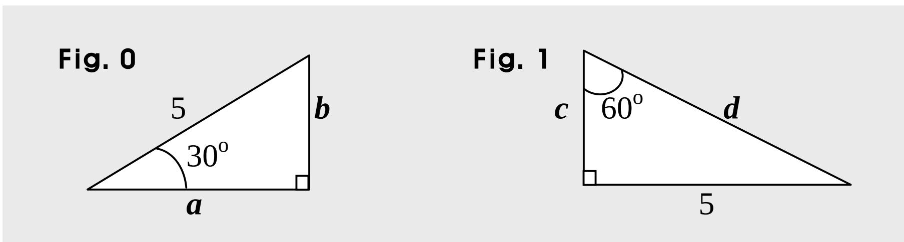
Next, the cosine is the adjacent over the hypotenuse. Thus, in Fig. 3, for cos ***B***. the adjacent is 20, and the hypotenuse is 29, so we get **cos *B*** = 20/29 = $\frac{20}{29}$.

Next, the tangent is the slope of the hypotenuse, and is the opposite over the adjacent. Thus, in Fig. 3, for **tan *B***, the opposite is 21, and the adjacent is 20,

so we get **tan *B* =** 21/20 = $\frac{21}{20}$.

Suggestions or Solutions
To the Problem 1

1. Assuming $\mathbf{sin\ 30^o = 0.5}$, $\mathbf{cos\ 30^o = 0.866}$, $\mathbf{sin\ 60^o = 0.866}$, and $\mathbf{cos\ 60 = 0.5}$, find the values of $\boldsymbol{a}$, $\boldsymbol{b}$, $\boldsymbol{c}$, and $\boldsymbol{d}$ below.



We have $\mathbf{sin\ 30^o = 0.5}$ and the sine is the opposite over the hypotenuse.
And in Fig. 0, for $\mathbf{sin\ 30^o}$, the opposite is $\boldsymbol{b}$ and the hypotenuse is 5, so we get this:

$$\mathbf{sin\ 30^o = 0.5} = \frac{\boldsymbol{b}}{5} \Rightarrow \boldsymbol{b} = 0.5 \cdot 5 = 2.5 \Rightarrow \boldsymbol{b} = 2.5.$$

We have $\mathbf{cos\ 30^o = 0.866}$ and the cosine is the adjacent over the hypotenuse.
And in Fig. 0, for $\mathbf{cos\ 60^o}$, the adjacent is $\boldsymbol{a}$ and the hypotenuse is 5, so we get this:

$$\mathbf{cos\ 30^o = 0.866} = \frac{\boldsymbol{a}}{5} \Rightarrow \boldsymbol{a} = 0.866 \cdot 5 = 4.33 \Rightarrow \boldsymbol{a} = 4.33$$

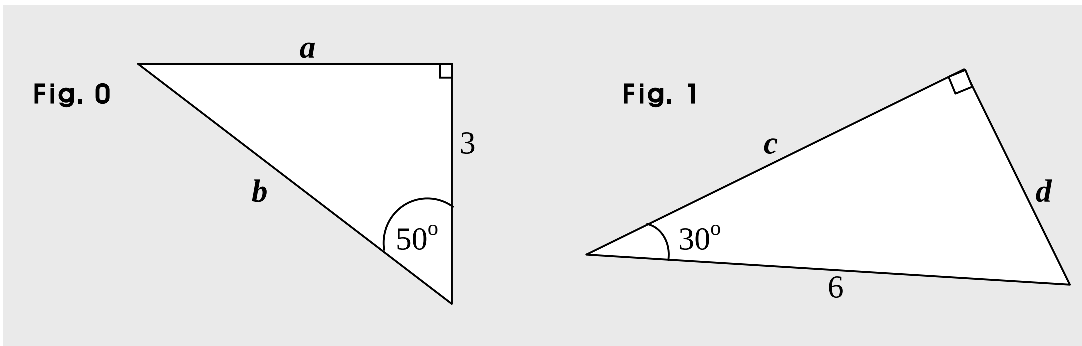
We have $\mathbf{sin\ 60^o = 0.866}$ and the sine is the opposite over the hypotenuse.
And in Fig. 1, for $\mathbf{sin\ 60^o}$, the opposite is 5 and the hypotenuse is $\boldsymbol{d}$, so we get this:

$$\mathbf{sin\ 60^o = 0.866} = \frac{5}{\boldsymbol{d}} \Rightarrow 5 = 0.866 \cdot \boldsymbol{d} \Rightarrow \boldsymbol{d} = \frac{5}{0.866} = \frac{5000}{866} = \frac{2500}{433} \Rightarrow \boldsymbol{d} = \frac{2500}{433}.$$

We have $\mathbf{cos\ 60^o = 0.5}$ and the cosine is the adjacent over the hypotenuse.
And in Fig. 1, for $\mathbf{cos\ 60^o}$, the adjacent is $\boldsymbol{c}$ and the hypotenuse is $\boldsymbol{d}$, which is $\frac{2500}{433}$, so we get this: $\mathbf{cos\ 60^o = 0.5} = \frac{\boldsymbol{c}}{\boldsymbol{d}} \Rightarrow \boldsymbol{c} = 0.5 \cdot \boldsymbol{d} = 0.5 \cdot \frac{2500}{433} = \frac{1250}{433} \Rightarrow \boldsymbol{c} = \frac{1250}{433}$.

Suggestions or Solutions
To the Problem 2

2. Assuming **sin 50^o = 0.766**, **cos 50^o = 0.643**, **sin 30^o = 0.5**, **cos 30^o = 0.866**, **sin 60^o = 0.866**, and **cos 60 = 0.5**, find the values of ***a***, ***b***, ***c***, and ***d*** below.



We have **cos 50^o = 0.643** and the cosine is the adjacent over the hypotenuse.
And in Fig. 0, for **cos 50^o**, the adjacent is 3 and the hypotenuse is ***b***, so we get this:

$$\mathbf{\cos 50^o = 0.643} = \frac{3}{\boldsymbol{b}} \Rightarrow \boldsymbol{b} = \frac{3}{0.643} = \frac{3000}{643} \approx 4.6656 \Rightarrow \boldsymbol{b} = \frac{3000}{643}.$$

We have **sin 50^o = 0.766** and the sine is the opposite over the hypotenuse.
And in Fig. 0, for **sin 50^o**, the opposite is ***a***, the hypotenuse is ***b***, and $\boldsymbol{b} = \frac{3000}{643}$, so we get this: $\mathbf{\sin 50^o = 0.766} = \frac{\boldsymbol{a}}{\boldsymbol{b}} \Rightarrow \boldsymbol{a} = 0.766 \cdot \boldsymbol{b} = 0.766 \cdot \frac{3000}{643} = \frac{2298}{643} \approx 3.57 \Rightarrow \boldsymbol{a} = \frac{2298}{643}$.

We have **sin 30^o = 0.5** and the sine is the opposite over the hypotenuse.
And in Fig. 1, for **sin 30^o**, the opposite is ***d*** and the hypotenuse is 6, so we get this:

$$\mathbf{\sin 60^o = 0.5} = \frac{\boldsymbol{d}}{6} \Rightarrow \boldsymbol{d} \Rightarrow \boldsymbol{d} = 0.5 \cdot 6 \Rightarrow \boldsymbol{d} = 3.$$

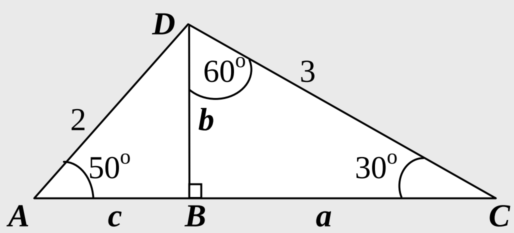
We have **cos 30^o = 0.866** and the cosine is the adjacent over the hypotenuse.
And in Fig. 1, for **cos 30^o**, the adjacent is ***c*** and the hypotenuse is 6,

so we get this: $\mathbf{\cos 30^o = 0.866} = \frac{\boldsymbol{c}}{6} \Rightarrow \boldsymbol{c} = 0.866 \cdot 6 = 5.196 \Rightarrow \boldsymbol{c} = 5.196.$

Suggestions or Solutions
To the Problem 3

3. Assuming **sin 50^o = 0.766**, **cos 50^o = 0.643**, **sin 30^o = 0.5**, **cos 30^o = 0.866**, **sin 60^o = 0.866**, and **cos 60 = 0.5**, find the values of ***a***, ***b***, and ***c*** below.

Fig. 0



We have **sin 50^o = 0.766**, and the sine is the opposite over the hypotenuse.
And in Fig. 0, for **sin 50^o**, the opposite is ***b***, the hypotenuse is 2,

so we get this: **sin 50^o = 0.766** = $\frac{\boldsymbol{b}}{2} \Rightarrow \boldsymbol{b} = 0.766 \cdot 2 = 1.532 \Rightarrow \boldsymbol{b} = 1.532$.

We have **cos 50^o = 0.643**, and the cosine is the adjacent over the hypotenuse.
And in Fig. 0, for **cos 50^o**, the adjacent is ***c*** and the hypotenuse is 2, so we get this:

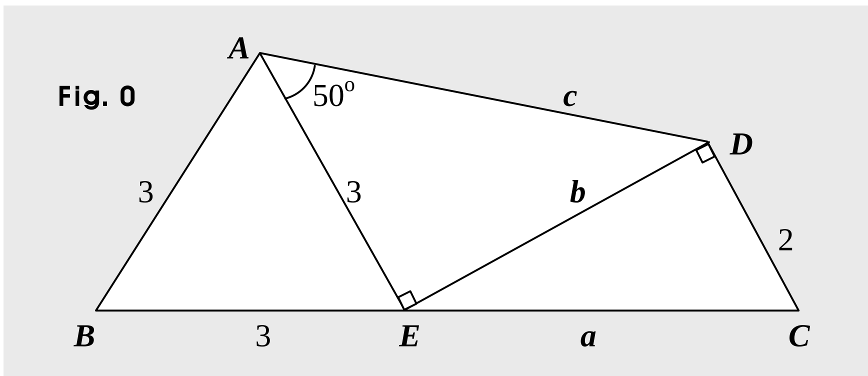
cos 50^o = 0.643 = $\frac{\boldsymbol{c}}{2} \Rightarrow \boldsymbol{c} = 0.643 \cdot 2 = 1.286 \Rightarrow \boldsymbol{c} = 1.286$.

We have **cos 30^o = 0.866**, and the cosine is the adjacent over the hypotenuse.
And in Fig. 1, for **cos 30^o**, the adjacent is ***a*** and the hypotenuse is 3,

so we get this: **cos 30^o = 0.866** = $\frac{\boldsymbol{a}}{3} \Rightarrow \boldsymbol{a} = 0.866 \cdot 3 = 2.598 \Rightarrow \boldsymbol{a} = 2.598$.

Suggestions or Solutions
To the Problem 4

4. Find $\boldsymbol{a}$, $\boldsymbol{b}$, $\boldsymbol{c}$, assuming $\mathbf{\sin 50^o = 0.766}$, $\mathbf{\cos 50^o = 0.643}$, $\mathbf{\sin 30^o = 0.5}$, $\mathbf{\cos 30^o = 0.866}$, $\mathbf{\sin 60^o = 0.866}$, and $\mathbf{\cos 60 = 0.5}$.



We have $\mathbf{\cos 50^o = 0.643}$, and the cosine is the adjacent over the hypotenuse.
And in Fig. 0, for $\mathbf{\cos 50^o}$, the adjacent is 3, and the hypotenuse is $\boldsymbol{c}$, so we get this:

$$\mathbf{\cos 50^o = 0.643} = \frac{3}{\boldsymbol{c}} \Rightarrow \boldsymbol{c} = \frac{3}{0.643} = \frac{3000}{643} \approx 4.6656 \Rightarrow \boldsymbol{c} = \frac{3000}{643}.$$

Since the three sides are equal, the triangle ***ABE*** is a regular triangle, so the angle ***AEB*** is 60^o. And the angle ***CED*** + the angle ***DEA*** + the angle ***AEB*** = 180^o, where the angle ***DEA*** = 90^o, and the angle ***AEB*** = 60^o. So the angle ***CED*** + 90^o + 60^o = 180^o, and we get the angle ***CED*** = 30^o.

We have $\mathbf{\sin 30^o = 0.5}$, and the sine is the opposite over the hypotenuse.
And in the triangle ***DEC***, for $\mathbf{\sin 30^o}$, the opposite is 2, the hypotenuse is $\boldsymbol{a}$,
so we get this: $\mathbf{\sin 30^o = 0.5} = \frac{2}{\boldsymbol{a}} \Rightarrow \boldsymbol{a} = \frac{2}{0.5} = \frac{20}{5} = 4 \Rightarrow \boldsymbol{a} = 4$.

We have $\mathbf{\cos 30^o = 0.866}$, and the cosine is the adjacent over the hypotenuse.
And in the triangle ***DEC***, for $\mathbf{\cos 30^o}$, the adjacent is $\boldsymbol{b}$, and the hypotenuse is $\boldsymbol{a}$, which is 4, so we get this: $\mathbf{\cos 30^o = 0.866} = \frac{\boldsymbol{b}}{\boldsymbol{a}} = \frac{\boldsymbol{b}}{4} \Rightarrow \boldsymbol{b} = 0.866 \cdot 4 = 3.464 \Rightarrow \boldsymbol{b} = 3.464$.