

Chapter 8 / Example 2

Multiple solutions of trigonometric equations

Use your GDC to find all values of x , $-\pi \leq x \leq 2\pi$ for which:

a $\sin x = \frac{1}{2}$

b $\cos x = -0.2$

Press **[2nd]** **[SIN]** **[SIN⁻¹]**, type $\frac{1}{2}$ and close the parentheses

Press **[ALPHA]** **[F1]** 1:n/d to use the fraction template.

$\sin^{-1}\left(\frac{1}{2}\right)$

Press **[ENTER]**.

One solution of the equation is $x = 0.524$

$\sin^{-1}\left(\frac{1}{2}\right)$
.....5235987756

To get any remaining values of x in the given domain you must use a graph.

Press **[F1]** **[Y=]** to display the equation entry screen.

Type $\sin(x)$ and press **[ENTER]** to enter the equation as Y_1 .

Type $1 \div 2$ and press **[ENTER]** to enter the second equation as Y_2 .

Plot1 Plot2 Plot3
Y1=sin(X)
Y2=1/2
Y3=
Y4=
Y5=
Y6=
Y7=
Y8=
Y9=

Select a viewing window that shows the domain and the range of the function so that you can identify all solutions.

Press **[F2]** **[WINDOW]**

Set the axes to show $-\pi \leq x \leq 2\pi$ and $-1.5 \leq y \leq 1.5$ with an x -scale of $\pi/6$ and a y -scale of 0.5.

You can leave the last three items as they are.

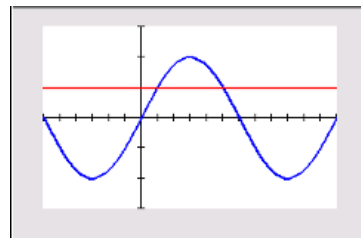
Press **[F5]** **[GRAPH]** when you have finished.

WINDOW
Xmin=-3.141592654
Xmax=6.283185307
Xscl=.5235987755983
Ymin=-1.5
Ymax=1.5
Yscl=.5
Xres=1
ΔX=.03569991651893
TraceStep=.07139983303787

Chapter 8 / Example 2

Multiple solutions of trigonometric equations

The GDC displays the graph $Y_1 = \sin x$ and $Y_2 = \frac{1}{2}$ in a suitable window.

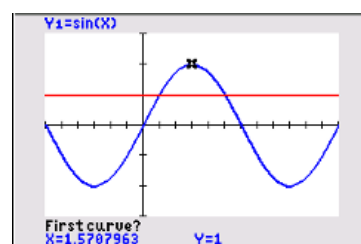


Press **[2nd]** **[F4]** **[CALC]** 5:intersect

To find the intersection you need to choose the two lines that intersect.

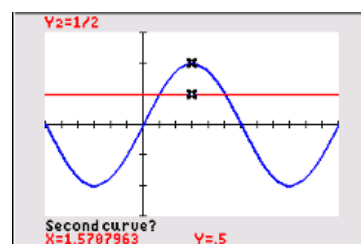
The GDC shows a cross on the curve and 'First curve?'.

Press **[ENTER]**.



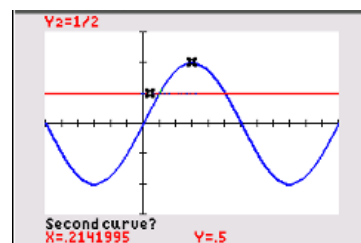
The GDC shows a cross on the line and 'Second curve?'.

Press **[ENTER]**.

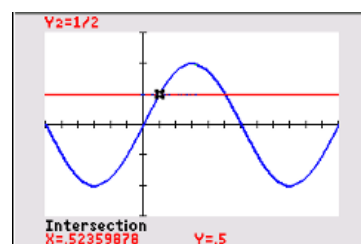


The GDC requires an initial guess for the position of the intersection. Choose a point close to the first intersection by moving the cursor with the **[◀]** **[▶]** keys.

Press **[ENTER]**.



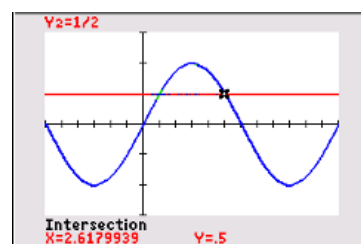
The GDC shows the first intersection at $(0.524, 0.5)$.



Repeat for the second intersection between the curve and the straight line.

The point of intersection is $(2.62, 0.5)$.

There are two values x for which $\sin x = \frac{1}{2}$: 0.524 and 2.62 correct to three significant figures.



Chapter 8 / Example 2

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Press $\boxed{2\text{nd}} \boxed{[\text{QUIT}]}$ and press $\boxed{2\text{nd}} \boxed{[\text{COS}]} \boxed{[\text{COS}^{-1}]}$, type -0.2 and close the parentheses.

Press $\boxed{\text{ENTER}}$.

The GDC displays the result $x = 1.77$.

```
sin⁻¹(½)
.....5.235987756
cos⁻¹(-0.2)
.....1.772154248
```

Press $\boxed{\text{F1}} \boxed{[\text{Y=}]}$ to display the equation entry screen.

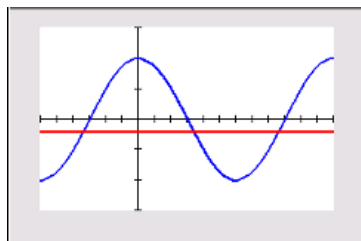
Type $\sin(x)$ and press $\boxed{\text{ENTER}}$ to enter the equation as Y_1 .

Type $1 \div 2$ and press $\boxed{\text{ENTER}}$ to enter the second equation as Y_2 .

```
Plot1 Plot2 Plot3
Y1=cos(X)
Y2=-0.2
Y3=
Y4=
Y5=
Y6=
Y7=
Y8=
Y9=
```

Press $\boxed{\text{F5}} \boxed{[\text{GRAPH}]}$.

The GDC displays the graph $Y_1 = \sin x$ and $Y_2 = \frac{1}{2}$ in a suitable window.



Find all three intersection points as before.

The points of intersection are $(-1.77, -0.2)$, $(1.77, -0.2)$ and $(4.51, -0.2)$.

There are three values x for which $\cos x = -0.2$: -1.77 , 1.77 and 4.51 correct to three significant figures

