



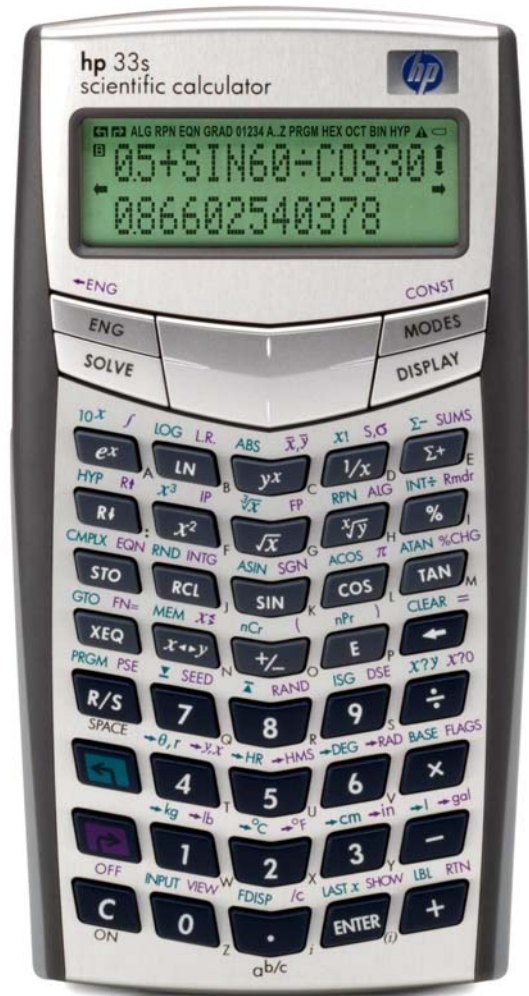
# hp calculators

HP 33S Angular conversions and arithmetic

Angular measurements

Time measurements

Practice solving problems involving angles and times



## Angular measurements

There are two primary ways of measuring angles, radians and degrees (there is a third way, Grads, which is not used as often). Radians measures the span of an angle in terms of the unit circle, where a full revolution involves an angle of  $2\pi$ . Degrees measures the span of an angle where a full revolution involves an angle of 360 degrees. The HP 33S calculator can work with angles in either measurement system and provides the  $\boxed{\rightarrow\text{RAD}}$  and  $\boxed{\rightarrow\text{DEG}}$  functions to convert between them.

Angles are also sometimes measured in degrees using two different formats: decimal degrees and degrees, minutes, and seconds. In decimal degrees, an angle might simply be 33.5 degrees. In the degrees, minutes, seconds (or DMS) format, an angle might be 30 degrees, 15 minutes, 10 seconds. An angle in the DMS format has a degree broken down into 60 minutes and each minute broken down into 60 seconds. The HP 33S calculator can convert between these two formats of angles in degrees using the  $\boxed{\rightarrow\text{HMS}}$  and  $\boxed{\rightarrow\text{HR}}$  functions. Note that these functions are actually Hours Minutes Seconds and Hours conversions, but work for angle conversions between decimal degrees and DMS.

## Time measurements

A useful application of the conversion between decimal degrees and DMS angles is that the exact same conversion can also work for time. A measurement of 10.5 hours can be converted into 10 hours and 30 minutes by the same process an angle of 10.5 degrees can be converted into 10 degrees, 30 minutes.

## Practice solving problems involving angles and times

**Example 1:** Convert an angle of 100 degrees into radians.

**Solution:** In RPN or algebraic mode:  $\boxed{1}\boxed{0}\boxed{0}\boxed{\rightarrow\text{RAD}}$



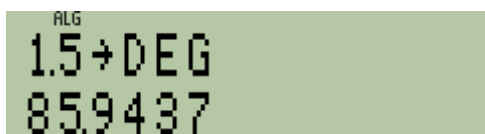
The calculator display shows 'ALG' at the top, '100→RAD' on the first line, and '1.7453' on the second line.

Figure 1

**Answer:** 1.7453 radians. Figure 1 shows the display assuming algebraic mode.

**Example 2:** Convert an angle of 1.5 radians into decimal degrees.

**Solution:** In RPN or algebraic mode:  $\boxed{1}\boxed{\cdot}\boxed{5}\boxed{\rightarrow\text{DEG}}$



The calculator display shows 'ALG' at the top, '1.5→DEG' on the first line, and '85.9437' on the second line.

Figure 2

**Answer:** 85.94 degrees. Figure 2 shows the display assuming algebraic mode.

**Example 3:** Add an angle of 30.5 degrees to an angle of  $\pi/4$  radians and express the answer in radians.

**Solution:** In RPN mode:  $\boxed{3}\boxed{0}\boxed{\cdot}\boxed{5}\boxed{\rightarrow\text{RAD}}\boxed{\rightarrow\text{RAD}}\boxed{\pi}\boxed{4}\boxed{\div}\boxed{+}$

In algebraic mode:  $\boxed{3}\boxed{0}\boxed{\cdot}\boxed{5}\boxed{\rightarrow\text{RAD}}\boxed{+}\boxed{\rightarrow\text{RAD}}\boxed{\pi}\boxed{\div}\boxed{4}\boxed{\text{ENTER}}$



Figure 3

Answer: 1.3177 radians. Figure 3 shows the display assuming RPN mode.

Example 4: Convert an angle of 20.67 decimal degrees to an angle format of DMS.

Solution: In RPN or algebraic mode: **2** **0** **.** **6** **7** **[ $\rightarrow$ DEG]** **[ $\rightarrow$ HMS]**



Figure 4

Answer: The equivalent measurement in DMS is 20 degrees, 40 minutes and 12 seconds. Figure 4 shows the display assuming RPN mode.

Example 5: Add 5 hours 33 minutes to 3 hours 58 minutes.

Solution: Each measurement of time will need to be converted from the Hours Minutes Seconds format into an equivalent "decimal hours" format and then added together.

In RPN mode: **5** **.** **3** **3** **[ $\rightarrow$ HR]** **3** **.** **5** **8** **[ $\rightarrow$ HR]** **+** **[ $\rightarrow$ DEG]** **[ $\rightarrow$ HMS]**

In algebraic mode: **5** **.** **3** **3** **[ $\rightarrow$ HR]** **+** **3** **.** **5** **8** **[ $\rightarrow$ HR]** **ENTER** **[ $\rightarrow$ DEG]** **[ $\rightarrow$ HMS]**

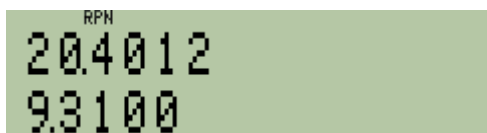


Figure 5

Answer: The answer is 9 hours, 31 minutes.

Example 6: What is the size of the angle formed by joining an angle of  $\pi/5$  radians and an angle of 40.62 degrees. Express the answer in DMS format.

Solution: In RPN mode: **[ $\rightarrow$ DEG]** **[ $\pi$ ]** **5** **[ $\div$ ]** **[ $\rightarrow$ DEG]** **4** **0** **.** **6** **2** **+** **[ $\rightarrow$ DEG]** **[ $\rightarrow$ HMS]**

In algebraic mode: **[ $\rightarrow$ DEG]** **[ $\pi$ ]** **[ $\div$ ]** **5** **ENTER** **[ $\rightarrow$ DEG]** **+** **4** **0** **.** **6** **2** **ENTER** **[ $\rightarrow$ DEG]** **[ $\rightarrow$ HMS]**

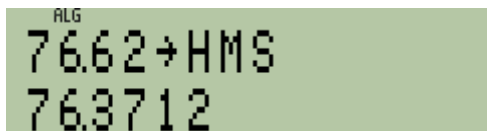


Figure 6

Answer: The resulting angle is 76 degrees, 37 minutes and 12 seconds. Figure 6 shows the display assuming algebraic mode.