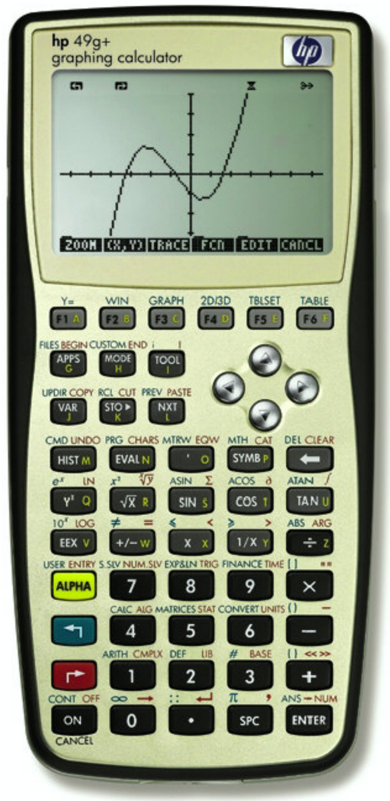
hp calculators

HP 49G+ Hyperbolic functions

The MTH (MATH) menu

Hyperbolic trigonometric functions

Practice using hyperbolic trigonometric functions



The MTH (MATH) menu

The Math menu is accessed from the GREEN shifted function of the SYMB key by pressing ← MTH . When pressed, a CHOOSE box is displayed with a number of choices allowing problems to be solved with different math functions on the HP 49G+ calculator.

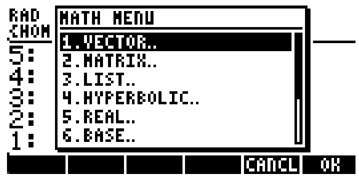


Figure 1

The first choice allows for calculations dealing with vectors. The second choice provides access to many functions for working with matrices. The third choice allows for the manipulation of lists and for using lists to apply mathematical functions to a list of numbers, all at the same time. The fourth function provides access to the hyperbolic trigonometric functions. The fifth selection provides a list of many functions that can be applied to real numbers. The sixth choice displays functions dealing with numbers in different bases. Choices seven through eleven are not displayed in the screen above, but deal with probability, fast fourier transformations, complex numbers, constants and a choice dealing with several special functions.

To display the hyperbolic trig function menu, press 4 ENTER . The screen displays the three basic hyperbolic trig functions and their inverses.

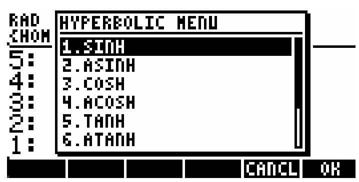


Figure 2

In RPN mode, if the argument is already on level 1 of the stack, choosing the appropriate hyperbolic trig function will cause it to be applied to the value in the stack. In Algebraic mode, choosing one of the hyperbolic trig functions will cause that function to be copied to the command line with the cursor positioned where the argument for the function may be entered.

Figure 3

Hyperbolic trigonometric functions

Trigonometric functions are often called "circular" functions, because the value for the cosine and sine of an angle lie on the unit circle defined by $X^2 + Y^2 = 1$ (points on the unit circle will have the X and Y coordinate of (Cosine(theta),Sine(theta))). Hyperbolic trigonometric functions have a similar relationship, but with the hyperbola defined by $X^2 – Y^2 = 1$.

Given a value for Z, the hyperbolic sine is calculated by evaluating the following:

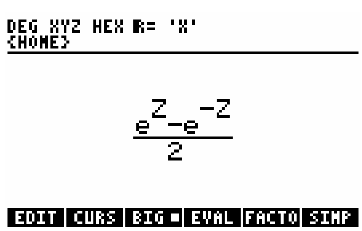


Figure 4

The hyperbolic cosine is calculated by evaluating the following:

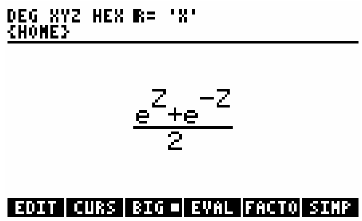


Figure 5

Assume that Z is 3. The position on the unit hyperbola $X^2 - Y^2 = 1$ is defined by the point (COSH(Z),SINH(Z)), where COSH is the hyperbolic cosine and SINH is the hyperbolic sine. The value for the SINH(3) is equal to 10.0179 and the value of COSH(3) is 10.0677. When 10.0677 x 10.0677 – 10.0179 x 10.0179 is evaluated, the value is 1, so the point falls on the unit hyperbola. The hyperbolic tangent is defined as the hyperbolic sine divided by the hyperbolic cosine.

Hyperbolic functions have applications in many areas of engineering. For example, the shape formed by a wire freely hanging between two points (a catenary curve) is described by the hyperbolic cosine (COSH). Hyperbolic functions are also used in electrical engineering applications.

Practice using hyperbolic trigonometric functions

Example 1: Find the Hyperbolic Sine of 2.

Solution: 2 ← MTH 4 ENTER 2 ENTER - Press → →NUM if a numerical answer is not displayed.

Answer: 3.62686.

Example 2: A tram carries tourists between two peaks that are the same height and 437 meters apart. Before the tram latches onto the cable, the angle from the horizontal to the cable at its point of attachment is 63 degrees. How long does it take the tram to travel from one peak to the other, if the tram moves at 135 meters per minute?

Solution: The travel time is given by the following formula:

$$t = \frac{437 \times \tan(63\ \text{degrees})}{135 \times \text{ASINH}(\tan(63\ \text{degrees}))}$$

Assuming the 49G+ is in Radians mode, it will need to be changed to Degrees mode to calculate the tangent function value. We will use the EquationWriter to solve for the answer.

MODE

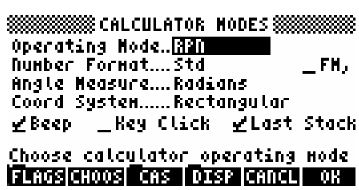


Figure 6

▼ ▼ CHOOS ▲

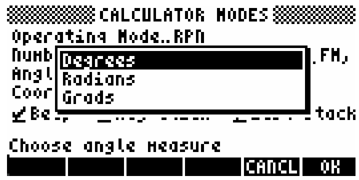


Figure 7

[ENTER] [OK] [↱] EQW [4] [7] [×] [TAN] [6] [3] [▲] [▲] [▲] [÷] [1] [3] [5] [×]
[↰] MTH [4] [ENTER] [2] [ENTER] [TAN] [6] [3]

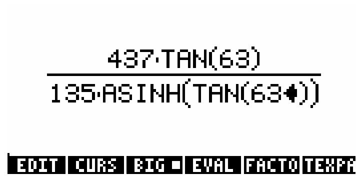


Figure 8

[ENTER]

Figure 9

Press [↱] →NUM if a fraction is displayed.

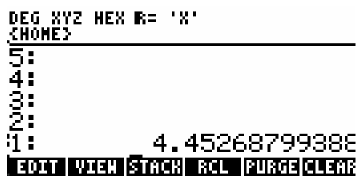


Figure 10

Answer: The travel time between the peaks is just under four and one half minutes.

Example 3: A cable is strung between two poles that are 40 feet apart, with the cable attached to each pole at a height of 30.436 feet above the level ground. At the midpoint between the poles, the cable is 18.63 feet above the level ground. What is the length of the cable required between the two poles?

Solution: The length of the cable is described by the formula:

L = 2 a SINH ((D/2) / a)

Where a is the lowest height of the cable and D is the distance between the two poles.

Assuming the 49G+ is in RPN mode.

[2] [ENTER] [1] [8] [•] [6] [3] [×] [4] [0] [ENTER] [2] [÷] [1] [8] [•] [6] [3] [÷] [↰] MTH
[4] [ENTER] [ENTER] [×]

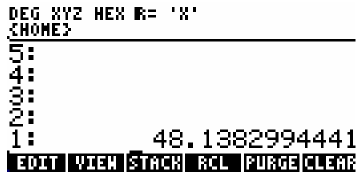


Figure 11

<u>Answer:</u> The length of the cable will be 48.14 feet.