1506. Crossed ladders

Along a narrow street, there are two houses – one on the left and the other on the right.

A ladder of length *x* feet is placed at the base of the right house and leans against the house on the left. Another ladder of length *y* feet stands at the base of the left house and leans against the right house. The ladders cross at a height of  feet above the ground. Find the width of the street.



**Input.** Each line represents a separate test case and contains three positive real numbers: *x*, *y* and *c*.

**Output.** For each test case, print one real number – the width of the street, rounded to three decimal places.

|  |  |
| --- | --- |
| **Sampe input** | **Sample output** |
| 30 40 1012.619429 8.163332 310 10 310 10 1 | 26.0337.0008.0009.798 |

## SOLUTION

**geometry – binary search**

# Algorithm analysis



The tiangles AOP and ADC are similar: .

The triangles COP and CBA are also similar: .



Whence

, .

We’ll find the width of the street *d* = AC using the binary search method.

Initially, let 0 ≤ *d* ≤ min(*x*, *y*). Given the values of *d*, *x* and *y*, we can compute *a*, *b* and *c*. For fixed *x* and *y*, as *d* increases, the value of *c* decreases.

# Algorithm implementation

Read the input data for each test case.

while(scanf("%lf %lf %lf",&x,&y,&c) == 3)

{

Set the initial values: *left* = 0, *right* = min(*x*,*y*). During the execution of the loop, the inequality *left* ≤ *d* ≤ *right* always holds.

 left = 0;

 if (x < y) right = x; else right = y;

 d = (left + right) / 2;

 do

 {

Compute the values of *a*, *b*, *c*.

 a = sqrt(x\*x - d\*d); b = sqrt(y\*y - d\*d);

 c1 = 1/(1/a + 1/b);

If the computed value *c*1 is less than the given *c*, the upper bound of *d* should be decreased. Otherwise, the lower bound should be increased.

 if (c1 < c) right = (left + right) / 2;

 else left = (left + right) / 2;

 d = (left + right) / 2;

The computations are performed until the required accuracy specified in the problem statement is reached – four decimal places.

 } while (fabs(c1 - c) > 0.00001);

Print the answer.

 printf("%.3lf\n",d);

}

**Java implementation**

**import** java.util.\*;

**public** **class** Main

{

 **public** **static** **void** main(String[] args)

 {

 Scanner con = **new** Scanner(System.*in*);

 con.useLocale(**new** Locale("US"));

 **while**(con.hasNext())

 {

 **double** x = con.nextDouble();

 **double** y = con.nextDouble();

 **double** c = con.nextDouble();

 **double** Left = 0, Right, a, b, c1;

 **if** (x < y) Right = x; **else** Right = y;

 **double** d = (Left + Right) / 2;

 **do**

 {

 a = Math.*sqrt*(x\*x - d\*d);

 b = Math.*sqrt*(y\*y - d\*d);

 c1 = 1/(1/a + 1/b);

 **if** (c1 < c) Right = (Left + Right) / 2;

 **else** Left = (Left + Right) / 2;

 d = (Left + Right) / 2;

 } **while** (Math.*abs*(c1 - c) > 0.00001);

 System.*out*.format(Locale.*US*,"%.3f\n",d);

 }

 }

}