

Sums. They're Math Magic

13 – Is It A Prime Number

Please go through each slide stopping until you have understood the concept described

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Prime Numbers

Prime numbers are not exactly divisible by any number except one and the number. That is when divided by any another number the result is not a whole number.

Here are the first prime numbers:

1, 2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, 37, 41, 43, 47, 53, 59, 61, 67, 71, 73, 79, 83, 89, 97

The question, is 1000003 a prime number?

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The question, is 100003 a prime number?

Firstly find the square root of $100003 = \sqrt{100003} = 1000.0014999989....$

Test to see if the result is a whole number.

The “Integer” of this number is the part without the decimals = 1000.

If the integer (= 1000) = 1000.0014999989 then 1000.0014999989.... is whole number.

It is clearly not.

Now if 100003 is divisible by a number greater than 1000 it will also be divisible by a number less than 1000.

So we only need to try to divide by a number less than the square root.

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So we only need to try to divide by a number less than the square root.

Start with 2 and the answer is 500001.5 which is not a whole number (use the whole number test above)

Now use 3 and the result is 333334.3. Again not whole number.

We do not need to try any more even numbers so we can jump from 3 to 5, then to 7, etc.

Divide by 5 = 200000.6. Again not whole number.

Divide by 7 = 142857.6. Again not whole number.

We simply carry on until we reach $\sqrt{1000003} = 1000.0014999989....$

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On this page is a program in Basic that can do this.

Download “Just Basic” and use the program opposite.

<https://www.justbasic.com/>

After you have loaded Basic just open a new file and paste the programme opposite.

Run it to see if it works.

You may need to make some changes.

```
rem A programme to discover if a number is a prime number
print "Please input the number to be tested"
input a
rem test to see if it is a whole number
if int(a)<>a then
  print "Your number is not a whole number, try again"
  print a, int(a)
  z$=""
  print "Press Any Key"
  while z$=""
    z$=inkey$
  wend
end
end if
q=0
rem we use q to identify which answer to print
rem divide by 2
b=a/2
if b=int(b) then q=1
rem use the square root of the number because if the number is divisible by a number higher than
its square root the other number will be less than the square root
c=sqr(a)
rem add 1 to be sure
c=int(c)+1
for x=3 to c
  d=a/x
  if int(d)=d then
    q=1
    print q, x, a, d, a/x
    goto [ABC]
  end if
  rem jump one number to avoid even numbers
  x=x+1
next x
if q<>1 then Ans$="Your number is a Prime Number. "+str$(a)
[ABC]
if q=1 then Ans$="Your number is NOT a Prime Number. "+str$(a)
print Ans$, q
end
```

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The Program Looks Like This

```
Just BASIC v1.01 - untitled.bas
File Edit Run Setup Help
[Icons]

rem A programme to discover if a number is a prime number
print "Please input the number to be tested"
input a
rem test to see if it is a whole number
if int(a)<>a then
  print "Your number is not a whole number, try again"
  print a, int(a)
  z$=""
  print "Press Any Key"
  while z$=""
    z$=inkey$
  wend
end
end if
j=0
rem we use q to identify which answer to print
rem divide by 2
b=a/2
if b=int(b) then q=1
rem use the square root of the number because if the number is divisible by a number higher that its square root the other number will be less that the square root
c=sqr(a)
rem add 1 to be sure
c=int(c)+1
for x=3 to c
  d=a/x
  if int(d)=d then
    q=1
    print q, x, a, d, a/x
    goto [ABC]
  end if
  rem jump one number to avoid even numbers
  x=x+1
next x
if q<>1 then Ans$="Your number is a Prime Number. "+str$(a)
[ABC]
if q=1 then Ans$="Your number is NOT a Prime Number. "+str$(a)
print Ans$, q
end
```

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When you run the program it looks like this

For 1000003

```
Execution of: untitled.bas complete.
File Edit
Please input the number to be tested
?1000003
Your number is a Prime Number. 1000003  0
```

For 1000007

```
Execution of: untitled.bas complete.
File Edit
Please input the number to be tested
?1000007
1          29          1000007          34483          34483
Your number is NOT a Prime Number. 1000007          1
```

1000007 can be divided by 1, 29, 34, 483

As soon as we find it is divisible by 29 it cannot be a prime number so we can stop testing for numbers above 29

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Please go to the next lesson.

Palindrome Numbers