**Let ' s use Mathematica to find some prime numbers between 10 ^ 10 and 10 ^ 16.**

**First we note that by the Prime Number Theorem there are approximately x / ln x prime numbers less than or equal to x. Note that ln 10 ^ k = k ln 10, and the command for natural logarithm is Log[ ]. N[ ] gives an actual numerical value.We first find the approximate number of primes < 10 ^ 16, and then the approximate number of primes < 10 ^ 10 , and subtact them to find the approximate number of primes between 10 ^ 10 and 10 ^ 116**

In[27]:=
```
N[10 ^ 16 / (16 Log[10]) - 10 ^ 10 / ( 10 Log[10])]
```
Out[27]= $2.71434 \times 10^{14}$

**The above is the approximate number of primes between 10 ^ 10 and 10 ^ 16. So there are a LOT of primes in this range. If we choose an ODD number at random in this range, since there are (10 ^ 16 - 10 ^ 10) / 2 odd numbers in this range, we can calculate the approximate probability that an odd number in this range will be prime to be :**

In[28]:=
```
2 * (N[10 ^ 16 / (16 Log[10]) - 10 ^ 10 / ( 10 Log[10])]) / (10 ^ 16 - 10 ^ 10)
```
Out[28]= 0.0542868

**So if we choose an odd number at random in this range the chances of it being a prime are only slighly more than 5 % , i.e. on average we might have to choose 20 odd numbers at random before we found a prime. Let ' s try one to see if we are lucky by choosing a random integer between 10 ^ 10 and 10 ^ 16 (if it is even we can either try again or divide it by 2 and see if it is odd and still in range) .**

In[31]:=
```
Random[Integer, {10 ^ 10, 10 ^ 16}]
```
Out[31]= 2 055 259 494 792 511

**We can ask Mathematica whether or not and integer is prime using the Prime Q command.**

In[32]:=
```
PrimeQ[ 2 055 259 494 792 511]
```
Out[32]= False

**If we are not lucky by choosing an odd number at random, in fact we can ask Mathematica directly for a random prime in a specified range using the RandomPrime command.**

In[33]:=
```
RandomPrime[{10 ^ 10, 10 ^ 16}]
```
Out[33]= 8 914 109 010 080 107

**Just to be sure it is prime we apply the PrimeQ command.**

In[34]:=
```
PrimeQ[8 914 109 010 080 107]
```
Out[34]= True

**We choose another one :**

In[35]:=
```
RandomPrime[{10^10, 10^16}]
```
Out[35]= 7 769 020 344 007 919

In[36]:=
```
PrimeQ[7 769 020 344 007 919]
```
Out[36]= True

**Now let's label our two primes p and q (so we can just enter these letters when doing further calculations).**

In[37]:=
```
p = 8 914 109 010 080 107
```
Out[37]= 8 914 109 010 080 107

In[38]:=
```
q = 7 769 020 344 007 919
```
Out[38]= 7 769 020 344 007 919

**Finally we compute our product m = pq**

In[39]:=
```
m = p * q
```
Out[39]= 69 253 894 248 016 643 181 947 632 367 333

**We label this value m. This will be OUR m (for class directory listing)**

**Note that most hand calculators do not store this many digits,
so even if your hand calculator has enough digits for p and q,
it may not have enough digits to return the value of their product exactly.**