

Re: How do I do this problem without a calculator?

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- *From:* "Chip Eastham" <[hardmath@xxxxxxxxxx](mailto:hardmath@xxxxxxxxxx)>
  - *Date:* 5 Mar 2006 20:15:38 -0800
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bell3774@xxxxxxxxxx wrote:

I don't understand.

in response to what Chip Eastham wrote:

bell3774@xxxxxxxxxx wrote:

$$6^{19} \bmod 22$$

19 is prime, but Fermat's Little Theorem requires  $p+1$  to work...

You might want Euler's generalization of Fermat's Little Thm.

It doesn't matter that 19 is prime. You need to consider the modulus 22.

Fermat's Little Theorem says that if  $p$  is prime:

$$x^{(p-1)} = 1 \bmod p$$

for any  $x$  not divisible by  $p$ .

In your problem, calculating  $6^{19} \bmod 22$  (presumably asking to find the reduced nonnegative residue mod 22), the modulus 22 is not prime! And furthermore the base  $x = 6$  that is being raised to a power has a factor 2 in common with modulus 22.

One approach, not discussed by other notes in this thread so far, would be to consider the computation modulo 2 and again modulo 11. You can then piece together the answer modulo 22 from the separate answers for 2 and 11.

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However I don't want you to get bogged down trying to follow every different approach being suggested here. Pick one and work it through!

Later you may have time to come back and verify that all the suggested approaches lead to the same answer.

regards, chip

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