Framework reference: Page 53

Strand: Numbers and the number system.
Topic: Integers, powers and roots.
Pupils should be taught to: Recognise and use multiples, factors and primes; use tests of divisibility.
Year group: 8
Objectives: Use a calculator to explore divisibility.
Key Vocabulary: Factor, prime factor.
Resources required: Class set of calculators plus Viewscreenor TI-SmartView emulator.

Summary

In this activity students investigate prime numbers, using the calculator to check for divisibility. Shortcuts are proposed, enabling the checking process to be automated.

Instructions for the teacher

Lead a discussion exploring primeness.

E.g. Is 223 prime? Using the demonstration calculator, divide 223 by 2, 3, 4... etc.

Discuss with the class how far it is necessary to go on – as far as 221, or 110, or what? Establish that there is no point in going on beyond, say 15 (since 15 squared = 225).

Also, was it necessary to try *every* number? There was no need to try 2, since 221 is odd. In fact there was no need to try *any* even divisor. Also there was no need to try 5 since only numbers ending in 0 or 5 are divisible by five. In fact it is only really necessary to try consecutive primes.
Confirm whether or not 223 is prime.

Is 209 prime? Do this more efficiently by dividing only by known smaller primes and stopping at a suitable point – roughly the square root of 209 (15^2 = 225, so 15 would do). Students may find it difficult to understand this last point so it might better be delayed until later in the lesson.

Distribute the handouts and get students to tackle the first question.

Demonstrate a semi-programming method for testing for primes as shown in section 2 of the handout. An advantage of this approach is that the calculations are set up quickly. A disadvantage is that the method is highly inefficient as it divides by every consecutive *whole* number, not just every consecutive *prime* number. Does this matter?

Students continue working through the handouts.

The follow-up discussion could pick up the following themes:
- How exactly does the 'semi-program' in Activity 2 work?
- What other tests for divisibility do they know? (See page 52 of the Framework.)

You could also discuss writing a program for testing primes. One issue is how the calculator can register whether the division is exact. This can be done using the = command in the TEST menu. So, **iPart(A/B)=A/B** will be true if B divides A exactly.

Answers

1)

Number	Largest prime factor needed	Prime?	Factors
209	11	no	11, 19
337	17	yes	
411	3	no	3, 137
2003	43	yes	
1997	43	yes	

2) (a) Each time [ENTER] is pressed X is increased by 1. You can stop pressing [ENTER] when X divides exactly into 209 or when X exceeds the square root of 209.
(b) 223 is prime.
(c) 293, 443, 461, 367, are all prime.
207 has the factors 3, 9, 23 and 69.
341 has the factors 11 and 31.
459 has the factors 3, 9, 17, 27, 51 and 153,

3)(a) 2011 2017 2027 2029 2039
2053 2063 2069 2081 2083
2087 2089
(b) 25, 21, 14
(c) There are no known patterns in the occurrence of prime numbers.

This activity was first published in
30 Calculator Lessons for Key Stage 3 (*A+B Books*).

There is more on prime numbers in **Calculator Maths: *Number*** (p.48-51) including an efficient simple program for testing for primeness.

1) Is it prime?

(a) Starting with the number 2, write below the first 15 prime numbers.

__ __ __ __ __ __ __ __ __ __ __ __ __ __ __

(b) Use the method of dividing by consecutive prime numbers to test whether the following are prime. Write your answers in the table (one has been done for you).

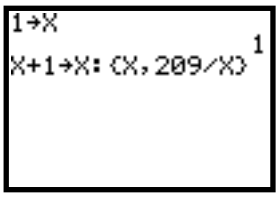
Number	**Largest prime factor tested**	**Prime? (yes/no)**	**If not prime, the factors are...**
209	11	no	11, 19
337			
411			
2003			
1997			

2) *A partial program for primes*

(a) Enter the following on the home screen of your calculator.

1 [STO▶] [X,T,Θ,*n*] [ENTER]

[X,T,Θ,*n*] [+] **1** [STO▶] [X,T,Θ,*n*] [ALPHA] **:**
[2nd] [{] [X,T,Θ,*n*] [,] **209** [÷] [X,T,Θ,*n*] [2nd] [}] [ENTER]



Keep pressing [ENTER] and watch what happens.
Then answer the following questions.

- What happens to the X value each time [ENTER] is pressed?
- How do you decide when to stop pressing [ENTER]:
  - if the number isn't prime?
  - if the number is prime?

(b) To test a different number (say 223) for primeness, edit the key sequences as follows.

Press [CLEAR] and then [2nd] [ENTRY] [2nd] [ENTRY] [ENTER] (this enters the command **1→X**)

Press [2nd] [ENTRY] [2nd] [ENTRY] and edit the value 209 to read 223.

As before, repeatedly press [ENTER] and watch the screen. Is 223 prime?

(c) Use the method of part (b) to test whether the following numbers are prime.

293 443 461 367 207 341 459

If a number is not prime, write down two of its factors.

3) Prime concerns

(a) The year 1999 was prime. What are the next twelve prime years?
Why will it be unusual to be alive in the 2080s?

(b) How many primes are there:

- between 1 and 100,
- between 100 and 200,
- between 900 and 1000.

(c) How many primes end in 1, 2, 3, 4, ... Is there a pattern?
The table below may help.

Primes to 1000

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	101	103	107	109	113
127	131	137	139	149	151	157	163	167	173
179	181	191	193	197	199	211	223	227	229
233	239	241	251	257	263	269	271	277	281
283	293	307	311	313	317	331	337	347	349
353	359	367	373	379	383	389	397	401	409
419	421	431	433	439	443	449	457	461	463
467	479	487	491	499	503	509	521	523	541
547	557	563	569	571	577	587	593	599	601
607	613	617	619	631	641	643	647	653	659
661	673	677	683	691	701	709	719	727	733
739	743	751	757	761	769	773	787	797	809
811	821	823	827	829	839	853	857	859	863
877	881	883	887	907	911	919	929	937	941
947	953	967	971	977	983	991	997		