Proofs.

1). Think of a number multiply it by 2 and add 10. Divide the result by 2 and take away 5.
- a). Record your answer.
- b). Try other starting numbers and record your results.
- c). Use algebra to prove your results.

2). Think of a number add 8 and multiply by 4. Take away 12 and halve it. Halve it again and take away the number you first thought of.
- a). Record your answer.
- b). Try other starting numbers and record your results.
- c). Use algebra to prove your results.

3). Here is a calendar.
- a). A 2 x 2 square is highlighted.
  The sum of the numbers in the square is
  (The smallest date + 4) x 4.
  - i). Check this works for different 2 x 2 squares
  - ii). Prove it.
- b). Repeat this for a 3 x 3 square.
  The sum of the numbers in the square is
  (The smallest date + 8) x 9.
  - i). Check this works for different 3 x 3 squares
  - ii). Prove it.

Sun	Mon	Tue	Wed	Thu	Fri	Sat
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30				

4).
- a). Prove that the sum of three consecutive integers is always a multiple of 3.
  Hint: Let the first number be x.
- b). Prove that the sum of four consecutive integers is always an even number.
- c). Prove that the sum of five consecutive integers is always a multiple of 5.

5). Here is a 2 x 2 square taken from a multiplication grid.

28	32
35	40

- a). Which part of the multiplication grid is it taken from ?
- b). Write the multiplication from which each number is calculated.
- c). Multiply opposite corners together, what do you notice ?
- d). Repeat this for different 2 x 2 squares on a multiplication grid.
  Write your findings.
- e). Prove that for all 2 x 2 squares on a multiplication grid the products of the numbers in opposite corners is equal.

6).
- a). Write any two digit number.
  Reverse the order of the digits and take it away from the first number.
  i.e. 81 - 18.
- b). Investigate this for different starting numbers.
- c). Prove that the difference is always a multiple of 9.

7).
- a). Write any two digit number which has the digits the same i.e. 66.
  Can this be divided exactly by 11 ?
- b). Try it with other numbers and record your results.
- c). Prove that these two digit numbers will always divide by 11.

8). a). Write a four digit number in which the thousands digit and the units digit are the same and the hundreds digit and the tens digit are the same
i.e. 3773. Is it a multiple of 11 ?

b). Try generating other four digit numbers using this rule.
Are they multiples of 11 ? Record your results.

c). Prove that these four digit numbers will always divide by 11.

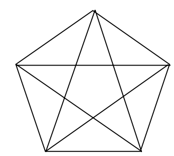
9). a). Write down any three digit number xyz.
Repeat the number to form the 6 digit number xyzxyz.
Divide the number by 13. Write down the remainder.
Divide the answer by 11. Write down the remainder.
Divide this answer by 7. Write down the remainder.
What do you notice about the remainders ?

b). Try this with different sets of digits. Again what do you notice about the remainders ?

c). Prove it.

10). a). Draw a square and join all the diagonals.

b). Copy and complete the table below for regular polygons.



5 sides
5 diagonals

No. of sides (regular polygon)	4	5	6	7
No. of diagonals	2	5		

c). For any regular polygons with **n** sides answer the questions below.

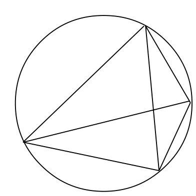
i). How many diagonals can be drawn from **one** vertex ?

ii). How many vertices can a diagonal be drawn from ?

iii). Hence prove the number of diagonals, d is given by the formula

$$d = {}^{1}/_{2}n\,(n-3)\ .$$

11). Jim and Joan investigate cutting a circle into sections by drawing lines from points on the circumference.
These are the results so far.



4 points
8 sections

Points on the Circumference	2	3	4	5
No. of sections	2	4	8	16

Jim says the number of sections will always double.
Joan disagrees.

a). Copy the table and draw the diagrams that go with the results.

b). Extend the investigation.

c). Prove who is right.

12). Here is a sequence of prime numbers:

Primes	11		13		17		23		31
Differences		2		4		6		8	

Anne finds the formula $n^2 + n + 11$ to generate this sequence.
She tells Andy this will always generate prime numbers, Andy disagrees.

a). Use the formula to generate more prime numbers.

b). Prove who is right.

c). Andy says $n^2 + n + 41$ will only generate prime numbers.
Prove if he's right.

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