

Spook numbers & MCYA Challenge



The following Spook numbers problem requires a very good understanding of place value.

This problem is suitable for upper primary and junior secondary students.

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MCYA CHALLENGE school-based problem-solving program

- + Designed to help teachers motivate, stimulate, encourage and develop mathematically interested students in years 3–10
- + It can be undertaken by an individual or group, solo or preferably with some time support at school where teacher can monitor progress (e.g. 1 hour per week in class).
- + Materials provided by AMT include question booklets, teacher guide (questions, solutions, marking schemes, extension work), certificates and stats reports.

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Spook numbers



Look at the number **8161**

It is made up of four digits: **8**, **1**, **6** and **1**. It does not contain the digit **0**. The first digit from the left is **8**. We will call this the leading digit.

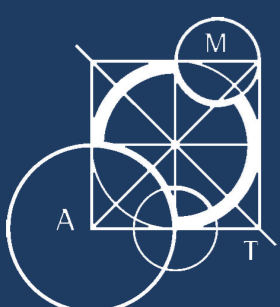
The sum of all the digits is **16**: $8 + 1 + 6 + 1 = 16$

This is twice the leading digit: $16 = 2 \times 8$

So **8161** is a 4-digit spook number.



- Find an even 5-digit spook number.
- What is the smallest 4-digit spook number? Explain why it is the smallest.
- What is the largest spook number? Explain why it is the largest.
- What is the largest spook number which has all its digits different? Explain why it is the largest.



Spook numbers Solutions

a. **82222, 71114, 81214** are examples. There are many more. The smallest is **51112** and the largest is **94212**.

b. The leading digit of a spook number is the sum of the other digits. The smallest digit which is the sum of three other non-zero digits is **$3 = 1 + 1 + 1$** . This is the only way this can be done, so the smallest 4-digit spook number is **3111**.



c. The largest possible leading digit is **9**. The more digits that follow the **9**, the greater the place value of the 9 and the larger the number. A sum of **9** using the greatest number of digits is **$9 = 1 + 1 + 1 + 1 + 1 + 1 + 1 + 1 + 1$** . Therefore, the largest spook number is **9111111111**.

d. No spook number with all its digits different can have more than four digits. This is so since the smallest set of four different non-zero digits is **1, 2, 3** and **4**. These sum to **10**, which is more than one digit.

Of the possible 4-digit spook numbers with different digits, the largest will have leading digit **9**. The sets of different digits which add to **9** are **1, 2** and **6**; **1, 3** and **5**; **2, 3** and **4**. So the largest spook number with four different digits is **9621**.

