National Mathematics Day activities for IB Maths: Beyond school: answers

IB Math Revision · Beyond school: for adults and maths fans · 22 December · Teacher answers and notes

No calculator needed. Every answer works out exactly.

Teacher notes

- A stretch set for anyone past school maths: adults, maths clubs and keen sixth-formers. Competition style, no calculator, every answer exact.

Starter

1. **1729**
   - $1729 = 1^3 + 12^3 = 9^3 + 10^3$
2. **39**
   - $7 + 13 + 19 = 39$
3. **11**
   - 6, 5+1, 4+2, 4+1+1, 3+3, 3+2+1, 3+1+1+1, 2+2+2, 2+2+1+1, 2+1+1+1+1, 1+1+1+1+1+1
4. **41**
   - Only $29^2 = 841$ matters for the last two digits.

Task A: Taxicab numbers

a. **(9, 15)**
   - $729 + 3375 = 4104$

b. **4**
   - (1, 12), (12, 1), (9, 10), (10, 9)

c. **1**
   - $1729 = 7 \times 13 \times 19$, and 6, 12 and 18 all divide 1728.
   - So 2^{1728} leaves remainder 1 modulo 7, 13 and 19, and hence modulo 1729.

Task B: Partitions

a. **42**
   - Count by the largest part: 1 + 5 + 8 + 9 + 7 + 5 + 3 + 2 + 1 + 1 = 42

b. **10**
   - List them by the number of 9s, 7s, 5s and 3s; the rest are 1s.

c. **10**
   - Euler: the number with distinct parts always equals the number with odd parts.

Extension

1. **0**
   - $1575 = 5 \times 315$
   - $24 = 5 \times 4 + 4$, as the rule says.

Every question is original and every answer was checked before publishing.