

# Lunar New Year maths for IB Maths SL and HL: answers

IB Math Revision · IB Maths SL and HL (AA and AI) · Teacher answers and notes

No GDC needed.

## Teacher notes

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- Lunar New Year falls on a different date each year: use this pack in the weeks around it.
- Students may want to check the rule against their own year of birth: remind them that the lunar year usually begins in January or February, so a birthday early in the calendar year may belong to the previous lunar year.
- Task B (c) is the key idea: the two cycles can only meet in pairs with the same parity.

## Starter

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1. **2**
  - $12 \times 169 = 2028$ , and  $2030 - 2028 = 2$ .
2. **60**
  - $10 = 2 \times 5$ ,  $12 = 2^2 \times 3$ , so  $\text{LCM} = 2^2 \times 3 \times 5 = 60$ .
3. **111**
  - $3 + 9 \times 12 = 111$
4. **Friday**
  - $100 = 7 \times 14 + 2$ , so 2 days after Wednesday.

## Task A: The 12-year cycle

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- a. **12**
  - $2031 - 4 = 2027 = 12 \times 168 + 11$ , so the remainder is 11.
  - $11 + 1 = 12$
- b. **2008, 2092; 8 terms**
  - Animal number 1 needs  $(Y - 4) \bmod 12 = 0$ , that is  $Y = 4 + 12k$ .
  - The first after 2000 is 2008 ( $= 4 + 12 \times 167$ ); the last up to 2100 is 2092.
  - $(2092 - 2008) \div 12 + 1 = 8$  terms
- c. **16 400**
  - $S = 8/2 \times (2008 + 2092) = 4 \times 4100 = 16\,400$

## Task B: Two cycles together

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- a. **60 years**
  - We need a multiple of 10 that is also a multiple of 12:  $\text{LCM}(10, 12) = 60$ .
- b. **60**
  - The pattern repeats every 60 years, and no pair repeats inside one cycle, so 60 pairs occur.
- c. **0 years**
  - Label 1 needs the year to be a multiple of 10, which is even. Animal 2 needs the year to leave remainder 1 when divided by 12, which is odd.
  - A year cannot be both even and odd, so there are 0 such years.

## Task C: Clock and calendar arithmetic

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a. **1**

- $7^2 = 49 = 4 \times 12 + 1$ , so  $7^2$  leaves remainder 1.
- $7^{2026} = (7^2)^{1013}$  leaves remainder  $1^{1013} = 1$ .

b. **10**

- $1 + 2 + \dots + 100 = 5050$ .
- $5050 = 12 \times 420 + 10$

c. **27**

- Remainder 3 on dividing by 12: 3, 15, 27, 39, ...
- $27 = 5 \times 5 + 2$ , so 27.

## Extension

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1. **421**

- It is 1 more than a common multiple of 7, 10 and 12.  $\text{LCM}(7, 10, 12) = 420$ .
- $420 + 1 = 421$

2. **Proof**

- Such an  $n$  leaves remainder 1, 5, 7 or 11 when divided by 12.
- $1^2 = 1$ ,  $5^2 = 25 = 2 \times 12 + 1$ ,  $7^2 = 49 = 4 \times 12 + 1$ ,  $11^2 = 121 = 10 \times 12 + 1$ .
- In every case the remainder is 1.

Every question is original and every answer was recomputed by computer before publishing.