Standard form and proof

Skills sheet · SL AA 1.1 · 1.6

KEY FACTS

$a \times 10^k$, $1 \leq a < 10$, $k \in \mathbb{Z}$ D1

Product: a's together, powers added; then adjust P1

Identity $\equiv$: true for every value; LHS $\rightarrow$ RHS D2

Even $2n$, odd $2n+1$, consecutive n, $n+1$ P2

12×10^3 is not standard form W1.

Never work on both sides W2.

Examples are not a proof W2.

WHAT UNLOCKS

- "in the form $a \times 10^k$" $\rightarrow$ adjust a, compensate with k.
- "show that ... $\equiv$" $\rightarrow$ expand one side until it is the other.
- "multiple of k" $\rightarrow$ factor out k, say the bracket is an integer.
- "hence" $\rightarrow$ the identity just proved, in one sentence.

WORKED EXAMPLE ①

Find $(6 \times 10^4) \times (5 \times 10^{-7})$ in standard form. no GDC

30×10^{-3} (M1)

3×10^{-2} A1

Method

Multiplying in standard form

① Multiply the numbers a.
② Add the powers of 10.
③ Adjust: $1 \leq a < 10$.

WORKED EXAMPLE ②

Show that $(n+1)^2 - (n-1)^2 \equiv 4n$. no GDC

$n^2 + 2n + 1 - (n^2 - 2n + 1)$ M1

$= 4n$ A1

Method

Proving an identity

① Start from the LHS.
② Expand, keep the brackets after a minus.
③ Simplify until you reach the RHS.

Do not start from what you must prove.

FLUENCY

1. Write 45 000 in standard form no GDC

2. Write 0.0071 in standard form no GDC

3. Write $3.2 \times 10^{-}3$ as an ordinary number no GDC

4. $(2 \times 10^3) \times (4 \times 10^5)$ no GDC

5. $\dfrac{9 \times 10^8}{3 \times 10^2}$ no GDC

6. Is 0.8×10^4 in standard form? no GDC

REASONING

●●● **Question 1.** Let $p = 6.4 \times 10^7$ and $q = 8 \times 10^{-3}$. [no GDC]

(a) Find pq in standard form. [2]

(b) Find $\frac{p}{q}$ in standard form. [2]

●●● **Question 2.** Let n be an integer. [no GDC]

(a) Show that $(2n+1)^2 - 1 \equiv 4n(n+1)$. [2]

●●● **Question 3.** Let n be an integer. [no GDC]

(a) Show that the sum of two consecutive even numbers is not a multiple of 4. [2]

PROBLEMS

●●● **Question 4.** Let n be an integer. [no GDC]

(a) Show that the product of two consecutive odd numbers plus 1 is a multiple of 4. [3]

●●● **Question 5.** A virus is 1.2×10^{-7} m long. [with GDC]

(a) How many such viruses, end to end, make 1 cm? [2]

ANSWERS

1 4.5×10^4

2 7.1×10^{-3}

3 0.0032

4 8×10^8

5 3×10^6

6 no: 8×10^3

Q1 (a) $51.2 \times 10^4 = 5.12 \times 10^5$ (b) $0.8 \times 10^{10} = 8 \times 10^9$

Q2 $4n^2 + 4n + 1 - 1 = 4n(n+1)$

Q3 $2n + (2n+2) = 4n + 2 = 4(n + \frac{1}{2})$: it is 2 more than a multiple of 4

Q4 $(2n+1)(2n+3) + 1 = 4n^2 + 8n + 4 = 4(n+1)^2$

Q5 $\dfrac{0.01}{1.2 \times 10^{-7}} = 8.33 \times 10^4$

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