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GCSE MATHEMATICS • ALGEBRA

Notation & Substitution

Worked Solutions

Pearson Edexcel GCSE (1MA1) & International GCSE (4MA1) • No calculator

Full worked solutions for the free Notation and Substitution worksheet, GCSE and iGCSE Maths



Tap a section to jump straight to it

Full worked solutions for every question on the Notation & Substitution worksheet, in the same order and with the same question numbers.

How to mark your work. Tick each step you got right, not just the final answer. In the exam, method marks are given for correct working even when the final answer is wrong. If you lost marks, find the *first* line where your working is different from ours. That is the thing to fix.

In Section E: **M** = method mark, **P** = process mark, **A** = accuracy mark, **B** = independent mark, **C** = communication mark.

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A**Your turn answers**

Compare each line of your working with the solution.

FOUNDATION

A1 $y \div 5$ is $\frac{y}{5}$. Number first, then letters in order: $\frac{3xy}{5}$

A2 $q^3 = 2^3 = 8$ $4p = 4 \times (-3) = -12$ $8 - (-12) = 20$

A3 $T = 8a + 4b$

HIGHER

A4 $8x - 4 - 3x + 9 = 5x + 5$ LHS = RHS, so $4(2x - 1) - 3(x - 3) \equiv 5x + 5$

A5 $3x + 3a + bx - 2b$ x terms: $3 + b = 7$, so $b = 4$ Numbers: $3a - 2b = -2$, so $3a = 6$ $a = 2$, $b = 4$

A6 $P = 5(2m) - 2(3m - 1) = 10m - 6m + 2 = 4m + 2$

A7 Try $x = \frac{1}{2}$: $x^2 = \frac{1}{4}$, which is smaller than $\frac{1}{2}$ $x = \frac{1}{2}$ shows it is false

$x = 1$ or $x = 0$ also work, because then x^2 equals x

B**Fluency solutions**

One mark for each correct part. The notes in italics explain why each sequence was chosen.

FOUNDATION

B1 (a) $3ab$ (b) m^3 (c) $\frac{x}{4}$ (d) $2p^2q^2$

B2 (a) $n + 5$ (b) $10n$ (c) $\frac{n}{2} - 3$ (d) $(n - 3)^2$

In (b), "multiplied by 10" is $10n$, not $\frac{n}{10}$. In (d) the brackets show that you subtract before squaring.



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B3 (a) 14 (b) $-12 + 2 = -10$ (c) $(-4)^2 = 16$ (d) $-(16) = -16$

Squaring a negative gives a positive. In (d) you square first, then make it negative.

B4 (a) -6 (b) $4 \times 3 = 12$ (c) $1^2 = 1$ (d) $4 + 9 = 13$ $(a + b)^2$ is not $a^2 + b^2$

B5 (a) **expression** (b) **equation** (c) **formula**

B6 (a) -2 (b) $\frac{15}{3} = 5$ (c) $\frac{25}{10} = \frac{5}{2}$ (d) $5^3 = 125$

HIGHER

B7 (a) **identity** (b) **equation**, $x = 4$ (c) **equation**, $x = 0$ or $x = 2$ (d) **identity**

An identity is true for every value of x . An equation is true only for particular values.

B8 (a) $a = 3$ (b) $4b = -12$: $b = -3$ (c) $2a = 10$: $a = 5, b = -5$ (d) $3x + 3a - x + 4$: $b = 2$, $3a + 4 = 10$:
 $a = 2$

B9 (a) $6t - 5$ (b) $3t + 3 - 5 = 3t - 2$ (c) $-3t - 5$ (d) $t - 5$

B10 (a) $x = \frac{1}{2}$: $\frac{1}{4} < \frac{1}{2}$ (b) $n = 4$: $9 = 3 \times 3$ (c) $b = -1$: $a - (-1) = a + 1 > a$ (d) $a = b = 1$: $4 \neq 2$

Other correct counterexamples are fine. One is enough to show a statement is false.

C

Reasoning solutions

Your wording can be different. Check that your reason makes the same point.

FOUNDATION

C1 Ali wrote a statement with units instead of an expression. $1 \text{ cm} = 10 \text{ mm}$, so $x \text{ cm}$ is $10x$ mm

C2 Tom squared $2x$ instead of just x . Square first: $2 \times (-3)^2 = 2 \times 9 = 18$

C3 (a) When $n = 1$: $3n = 3$ and $n + 3 = 4$, so $3n$ is smaller.

(b) $3n = n + 3$ gives $2n = 3$ $n = \frac{3}{2}$



C4 $a^2 - b^2 = 9 - 4 = \boxed{5}$ $(a+b)(a-b) = 1 \times 5 = 5$ The same, as required

HIGHER

C5 When $x = 1$: $2(1+4) = 10$ but $2 \times 1 + 4 = 6$, so they are not equal. Correct: $\boxed{2(x+4) \equiv 2x+8}$

C6 x^2 is never negative, so $x^2 + 1 \geq 1$ is always positive. But $x^2 - 1$ is negative when, for example, $x = 0$: $0 - 1 = -1$

C7 $a(x+2) = ax + 2a$. Matching x terms gives $a = 3$, but then the number is $2a = 6$, not 5. No value works for both.

C8 (a) $E = 2(3+t)^2 - 12(3+t) + 23 = 2(9+6t+t^2) - 36 - 12t + 23$
 $= 18 + 12t + 2t^2 - 36 - 12t + 23 = 2t^2 + 5$ as required

(b) $2t^2 \geq 0$, so $E \geq \boxed{5}$. $E = 5$ when $t = 0$, which is when $\boxed{x = 3}$

D

Problem solving solutions

There is often more than one correct method. Any complete, correct method scores full marks.

FOUNDATION

D1 Perimeter $= 2(2x+3) + 2(x-1) = 6x+4$ When $x = 5$: $30+4 = \boxed{34 \text{ cm}}$

D2 (a) $\boxed{T = 2a + 3c - 5}$ (b) $25 + 22.50 - 5 = \boxed{\text{£}42.50}$

D3 Output $= (3n-4)^2$ $n = -1$: $(-3-4)^2 = (-7)^2 = \boxed{49}$

D4 $h = 7$: $12 + 28 = 40$, which he can afford. $h = 8$: $12 + 32 = 44$, too much. 7 hours

HIGHER

D5 Area $= \frac{1}{2}(x+2+3x) \times 4 = 2(4x+2) = 8x+4$ as required

When $x = 4$: $32+4 = \boxed{36} \text{ cm}^2$, as required



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D6 $4x + 4k - 2x + 6 = 2x + 4k + 6$ This must equal $2x + 20$, so $4k + 6 = 20$ $k = 3.5$

- D7 (a) $n = 1$: 41, $n = 2$: 43, $n = 3$: 47. All three are prime.
 (b) $n = 41$: $41^2 - 41 + 41 = 41^2$, which is 41×41 , so it has a factor of 41 and is not prime.

D8 (a) $a^2 - (10 - a)^2 = a^2 - (100 - 20a + a^2) = 20a - 100$ as required
 (b) $20a - 100$ is largest when a is largest. $b \geq 1$, so $a = 9$ $180 - 100 = 80$

E

Exam practice solutions

Marks are shown on the right of each line.

FOUNDATION

Foundation and Higher crossover

- E1 (a) term B1
 (b) equation B1
 (c) formula B1
- E2 (a) a^3 B1
 (b) $3p^2q$ B1
- E3 (a) $2 \times (-3) + 3 \times 4 = -6 + 12$ M1
 6 A1
 (b) $9 - 4 = 5$ B1
- E4 Tom: $x + 5$ Uma: $2(x + 5)$ M1
 $x + (x + 5) + 2(x + 5)$ M1
 $4x + 15$ A1
- E5 (a) $C = 3 + 2m$ B2
 B1 for $3 + 2m$ without " $C =$ "
 (b) $3 + 2 \times 7.5 = \pounds 18$ B1



E6 (a) $3 \times 4 - 5 \times (-2) = 12 + 10$

M1

22

A1

(b) $-x^2 = -9$, because you square 3 then make it negative, but $(-x)^2 = (-3)^2 = 9$

C1

HIGHER

E7 LHS = $6x + 12 - 2x + 2$

M1

= $4x + 14$

M1

RHS = $4x + 14$, so LHS $\equiv$ RHS

as required

A1

E8 $ax + ab + 3x - 6$

M1

$a + 3 = 7$, so $a = 4$

A1

$ab - 6 = 10$, so $4b = 16$ and $b = 4$

A1

E9 Try $n = 2$: $2 \times 4 + 1 = 9$

M1

$9 = 3 \times 3$

M1

9 is not prime, so Aisha is wrong

C1

E10 (a) $\frac{40 \times 41}{2} = 820$

B1

(b) Sum from 1 to $2n$ minus sum from 1 to n : $\frac{2n(2n+1)}{2} - \frac{n(n+1)}{2}$

M1

= $\frac{4n^2 + 2n - n^2 - n}{2}$

M1

= $\frac{3n^2 + n}{2} = \frac{n(3n+1)}{2}$

as required

A1

(c) $n = 50$: $\frac{50 \times 151}{2} = 3775$

B1

