

GCSE MATHEMATICS

Algebraic Notation and Substitution

OCR-style Topic Practice

Based on OCR GCSE (9–1) Mathematics (J560)

Tier: Foundation and Higher

Name _____

Date _____

You may use:

- geometrical instruments
- tracing paper

INSTRUCTIONS

- Use black ink. You may use an HB pencil for graphs and diagrams.
- Answer all the questions.
- Read each question carefully before you start to write your answer.
- Where appropriate, your answers should be supported with working. Marks may be given for a correct method even if the answer is incorrect.
- Write your answer to each question in the space provided.
- Section A: you must not use a calculator.
- Section B: you may use a scientific or graphical calculator.

INFORMATION

- The total mark for this paper is **48**.
- The marks for each question are shown in brackets [].
- The questions suit both Foundation and Higher tier students.
- Diagrams are not drawn accurately unless the question says they are.
- Graphs drawn on a grid are accurate.

These are original, independent practice questions written in the style of OCR GCSE Mathematics. They are not official OCR examination questions and are not endorsed by OCR.

Section A

You must not use a calculator in this section.

1 Simplify.

(a) $y \times y \times y \times y$

..... [1]

(b) $b \times 7 \times a \times a$

..... [1]

(c) $2w \times 9w$

..... [1]

(d) $10m^2 \div 2m$

..... [1]

2 Write an expression for each of the following.

(a) 8 less than w

..... [1]

(b) k divided by 5

..... [1]

(c) the square of the sum of a and b

..... [1]

3 Here are five statements.

Letter	Statement
A	$5t - 2$
B	$5t - 2 = 18$
C	$v = 5t - 2$
D	$5t - 2 < 18$
E	$2t \times 3t \equiv 6t^2$

(a) Write down the letter of the statement that is an inequality.

..... [1]

(b) Write down the letter of the statement that is a formula.

..... [1]

(c) Write down the letter of the statement that is an identity.

..... [1]

(d) Explain why statement B is an equation and not an identity.

..... [1]

4 Here is an expression.

$$6pq - p^2 + 9q$$

(a) Write down each term in the expression that has q as a factor.

..... [1]

(b) Work out the value of the expression when $p = -3$ and $q = 2$.

..... [2]

5 $x = -4$ and $y = 3$

Work out the value of

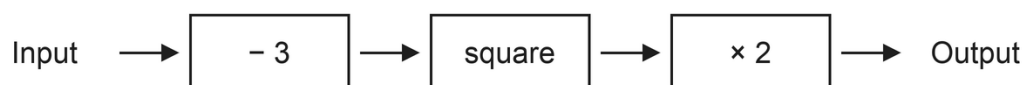
(a) $2y - 3x$

..... [2]

(b) xy^2

..... [2]

6 Here is a number machine.



(a) The input is -1 . Work out the output.

..... [1]

(b) The input is n . Write an expression, in terms of n , for the output.

..... [2]

(c) Ade says that the output is $(2n - 6)^2$.

Show that Ade's expression and the machine give different outputs when the input is 5.

..... [2]

7 Tom and Asha each work out the value of $m^3 - 4m$ when $m = -2$.

Here is their working.

Tom: $m^3 - 4m = -6 - (-8) = 2$

Asha: $m^3 - 4m = -8 - 8 = -16$

(a) Describe the mistake Tom has made.

..... [1]

- (b) Describe the mistake Asha has made.

..... [1]

- (c) Work out the correct value of $m^3 - 4m$ when $m = -2$.

..... [1]

- 8 Work out the value of

$$\frac{p^2 + q}{p - q}$$

when $p = -4$ and $q = 2$.

..... [3]

- 9 (a) Leo says, "When $x = 5$, the expressions $(-x)^2$ and $-x^2$ have the same value."
Show that Leo is wrong.

..... [2]

- (b) Leo now says, "There is no value of x for which $(-x)^2$ and $-x^2$ have the same value."
Is Leo correct? Give a reason for your answer.

..... [1]

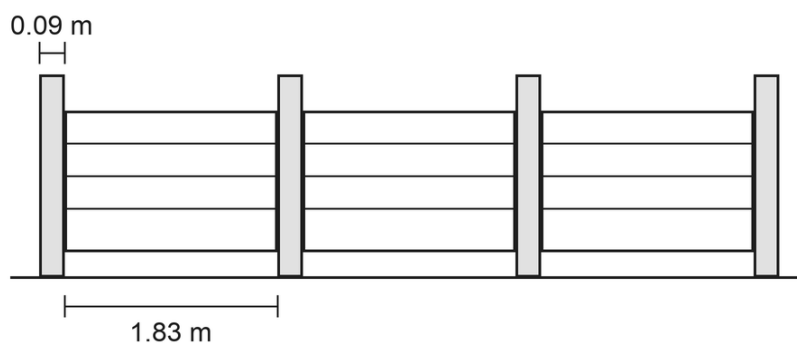
Section B

You may use a scientific or graphical calculator in this section.

- 10** A fence is made from panels and posts. Each panel is 1.83 m long. Each post is 0.09 m wide.

There is a post at each end of the fence and a post between each pair of panels.

The diagram shows a fence with 3 panels.



- (a) A fence has n panels. Write an expression, in terms of n , for the number of posts.

[1]

- (b) Write a formula for the total length, L metres, of a fence with n panels.

[3]

- (c) Work out the total length of a fence with 14 panels.

[2]

- 11 A box is in the shape of a cuboid. The length, d cm, of the longest straight rod that fits inside the box is given by the formula

$$d = \sqrt{a^2 + b^2 + c^2}$$

where a cm, b cm and c cm are the length, width and height of the box.

The box is 8.5 cm long, 4.2 cm wide and 3.6 cm high.

- (a) Work out the value of d . Give your answer correct to 1 decimal place.

..... [2]

- (b) A thin straight rod is 10.2 cm long. Can the rod fit inside the box? Give a reason for your answer.

..... [1]

- 12 Here is a formula.

$$f = \frac{uv}{u + v}$$

- (a) Work out the value of f when $u = 12.5$ and $v = -30$. Give your answer correct to 1 decimal place.

..... [2]

- (b) Kit uses his calculator to work out the value of f in part (a).

He enters $12.5 \times -30 \div 12.5 + -30$ and gets the answer -60 .

Explain the mistake Kit has made.

..... [1]

- 13 A school is planning a trip. The cost for each student, £C, is given by the formula

$$C = \frac{B + 18n}{n}$$

where £B is the cost of hiring a coach and n is the number of students on the trip.

The school can hire a small coach that costs £680 and carries 32 students, or a large coach that costs £925 and carries 47 students. Each coach will be full.

The school wants the cost for each student to be less than £38.

For which coach is the cost for each student less than £38? Show how you decide.

.....

.....

.....

.....

.....

.....

.....

[4]

END OF QUESTION PAPER

Mark scheme

Subject-Specific Marking Instructions

- M marks are for a correct method.
- A marks are for an accurate answer and depend on preceding M marks, so M0 A1 cannot be awarded.
- B marks are independent of method. SC marks are for special cases worthy of some credit.
- FT means follow through; oe means or equivalent; soi means seen or implied; isw means ignore subsequent working; nfwv means not from wrong working; dep means dependent on the marks indicated; cao means correct answer only.
- For methods not specifically provided for in the mark scheme, including valid visual representations, give as far as possible equivalent marks for equivalent correct work.

Question	Answer	Marks	Part marks and guidance	
1(a)	y^4	1		Do not accept $4y$ or $yyyy$
1(b)	$7a^2b$	1		Accept $7ba^2$ Do not accept $7aab$, a^2b7 or $7 \times a^2 \times b$
1(c)	$18w^2$	1		Do not accept $18w$, $18ww$ or $11w^2$
1(d)	$5m$	1		Do not accept $5m^2$ or $8m$

Question	Answer	Marks	Part marks and guidance	
2(a)	$w - 8$	1		Do not accept $8 - w$
2(b)	$\frac{k}{5}$ oe	1		Accept $k \div 5$, $\frac{1}{5}k$, $0.2k$ Do not accept $\frac{5}{k}$
2(c)	$(a + b)^2$	1		Accept $(a + b)(a + b)$ or $(b + a)^2$ Do not accept $a^2 + b^2$ or $a + b^2$

Question	Answer	Marks	Part marks and guidance	
3(a)	D	1		
3(b)	C	1		
3(c)	E	1		
3(d)	B is true for only one value of t ($t = 4$); an identity is true for every value of t	1	B1 for a correct explanation	Accept "B is only true when $t = 4$ " or "B is not true for all values of t " oe Do not accept "B has an $=$ sign" or "E has a $\equiv$ sign" on its own

Question	Answer	Marks	Part marks and guidance	
4(a)	6pq and 9q	1	B1 for both terms and no others	Accept 6pq, +9q B0 if $-p^2$ or any other term is also listed
4(b)	-27	2	M1 for $6 \times (-3) \times 2 - (-3)^2 + 9 \times 2$ oe, or for two of -36, -9, 18 seen as the values of the three terms A1 cao	-9 (from $-(-3)^2 = +9$) scores M1 A0 A correct answer with no working scores 2 marks

Question	Answer	Marks	Part marks and guidance	
5(a)	18	2	M1 for $2 \times 3 - 3 \times (-4)$ or $6 - (-12)$ or $6 + 12$ A1 cao	-6 (from $6 - 12$) scores M0 A0 A correct answer with no working scores 2 marks
5(b)	-36	2	M1 for -4×3^2 or -4×9 A1 cao	144 or -144 (from $(xy)^2$) scores M0 A0 36 scores M1 A0 only if -4×9 is seen A correct answer with no working scores 2 marks

Question	Answer	Marks	Part marks and guidance	
6(a)	32	1		cao
6(b)	$2(n-3)^2$ oe	2	B2 for $2(n-3)^2$ oe B1 for a correct intermediate stage showing the subtraction before the squaring, e.g. $n-3$ or $(n-3)^2$ seen	Accept for B2: $2 \times (n-3)^2$, $(n-3)^2 \times 2$, $2(n-3)(n-3)$, $2n^2 - 12n + 18$ Do not award B1 because the correct operations appear somewhere in a wrongly ordered or wrongly grouped final expression $(2n-6)^2$, $2(n^2-3)$ and $2n-3^2$ score B0, unless separate correct intermediate working earns the B1
6(c)	Machine: $5 - 3 = 2$, $2^2 = 4$, $4 \times 2 = 8$ Ade: $(2 \times 5 - 6)^2 = 4^2 = 16$, so the outputs are different	2	B1 for 8 from the machine B1 for 16 from Ade's expression, with a statement that 8 and 16 are different	Both values must be shown; "they are different" with no values scores 0

Question	Answer	Marks	Part marks and guidance	
7(a)	Tom has worked out m^3 as $3 \times m(-6)$ instead of $m \times m \times m(-8)$	1	B1 for a correct description	Accept "he did 3×-2 instead of $(-2)^3$ " or "he worked out $3m$, not m^3 " oe Do not accept "he got the cube wrong" on its own
7(b)	Asha has worked out $4m$ as 8 instead of -8 , so she subtracted 8 instead of subtracting -8 (adding 8)	1	B1 for a correct description	Accept " $4 \times -2 = -8$, not 8 " or "she should have added 8 " or "she ignored the negative sign of m in $4m$ " oe Do not accept "she got the signs wrong" on its own
7(c)	0	1		cao

Question	Answer	Marks	Part marks and guidance	
8	-3	3	M1 for $(-4)^2 + 2$ or 18 seen as the numerator M1 for $-4 - 2$ or -6 seen as the denominator A1 cao	The two M marks are independent $(-4)^2$ evaluated as -16 (numerator -14) scores M0 for the numerator Accept $18/-6$ or $-1\frac{2}{3}$ for M1 M1; the A1 requires -3 -3 nfww scores 3 marks

Question	Answer	Marks	Part marks and guidance	
9(a)	$(-5)^2 = 25$ and $-5^2 = -25$, so the values are different	2	B1 for $(-5)^2 = 25$ B1 for $-5^2 = -25$ oe, with 25 and -25 stated or shown to be different	Accept $-(5^2) = -25$ or $-(5 \times 5) = -25$ $-5^2 = 25$ scores B0 for the second mark
9(b)	No: when $x = 0$, $(-x)^2 = 0$ and $-x^2 = 0$	1	B1 for "No" with $x = 0$ given as the value that makes them equal	Accept a correct argument that both expressions equal 0 when $x = 0$ "No" with no reason scores 0 Do not accept "Yes" with any reason

Question	Answer	Marks	Part marks and guidance	
10(a)	$n + 1$	1		Accept $1 + n$
10(b)	$L = 1.83n + 0.09(n + 1)$ oe	3	B1 for $1.83n$ seen B1 for $0.09(n + 1)$ or $0.09 \times$ their (a) seen B1 for a fully correct formula with L as the subject	Accept $L = 1.92n + 0.09$ FT their (a) for the second B1 only A correct expression without "L =" scores B2 only: the answer must be a formula
10(c)	26.97 (m)	2	M1 for $1.83 \times 14 + 0.09 \times 15$ oe A1 cao	FT their formula from (b) for M1 only, provided it has a term in n Accept $1.92 \times 14 + 0.09$ for M1 A correct answer with no working scores 2 marks

Question	Answer	Marks	Part marks and guidance	
11(a)	10.1	2	M1 for $\sqrt{8.5^2 + 4.2^2 + 3.6^2}$ or $\sqrt{102.85}$ A1 cao	10.14 or better, not rounded to 10.1, scores M1 A0 $\sqrt{8.5^2 + 4.2^2 + 3.6^2}$ ($= 39.1$) scores M0 A correct answer with no working scores 2 marks
11(b)	No, because the rod (10.2 cm) is longer than d (10.1 cm)	1	B1 FT their (a)	The reason must compare 10.2 with their value of d "No" with no reason scores 0

Question	Answer	Marks	Part marks and guidance	
12(a)	21.4	2	M1 for $(12.5 \times (-30)) \div (12.5 + (-30))$ or $-375 \div -17.5$ A1 cao	21.42857... not rounded to 21.4 scores M1 A0 -21.4 scores M1 A0 if the correct method is seen A correct answer with no working scores 2 marks
12(b)	The calculator divides by 12.5 only, then adds -30; Kit needed brackets around $12.5 + -30$	1	B1 for a correct explanation	Accept "he divided by u only, not by $u + v$ " or "he has worked out $(12.5 \times -30 \div 12.5) + -30$ " oe Do not accept "he typed it in wrong" on its own

Question	Answer	Marks	Part marks and guidance	
13	Small coach: £39.25 Large coach: £37.68... Only the large coach gives a cost below £38	4	M1 for a correct method for the small coach, e.g. $(680 + 18 \times 32) \div 32$ or $680 \div 32 + 18$ M1 for a correct method for the large coach, e.g. $(925 + 18 \times 47) \div 47$ or $925 \div 47 + 18$ A1 for both 39.25 and 37.68..., dep on both M1 marks A1dep for "the large coach" as the only coach below £38, with a valid comparison	Accept 37.7, or 37.68 or better, for 37.68... Alternative method: comparing each total cost with $38n$, e.g. $1256 > 1216$ (38×32) and $1771 < 1786$ (38×47); M1 for each coach's comparison set up, A1 for all four values correct, A1dep for the large coach Alternative method: comparing $\frac{B}{n}$ with 20 ($38 - 18$), e.g. $21.25 > 20$ and $19.68... < 20$; mark as the main scheme Values from $B + 18n \div n$ (e.g. 698 or 943) score M0 "The large coach" with no supporting working scores 0

Elite Learners Specification & Assessment Objectives Summary

For teachers: this section maps the paper to OCR GCSE (9–1) Mathematics J560 content and assessment objectives. It is an Elite Learners teacher resource and is not part of the OCR-style mark scheme.

Question	OCR J560 content	AO	Marks
1(a)	6.01c Simplifying products and quotients (initial learning; the laws of indices are not assessed)	AO1	1
1(b)	6.01c Simplifying products and quotients (initial learning; the laws of indices are not assessed)	AO1	1
1(c)	6.01c Simplifying products and quotients (initial learning; the laws of indices are not assessed)	AO1	1
1(d)	6.01c Simplifying products and quotients (initial learning; the laws of indices are not assessed)	AO1	1
Question 1 total			4
2(a)	6.02a Formulate algebraic expressions	AO1	1
2(b)	6.02a Formulate algebraic expressions	AO1	1
2(c)	6.02a Formulate algebraic expressions	AO1	1
Question 2 total			3
3(a)	6.01a Algebraic terminology and proofs (vocabulary, and equation or identity; proof not assessed)	AO1	1

Question	OCR J560 content	AO	Marks
3(b)	6.01a Algebraic terminology and proofs (vocabulary, and equation or identity; proof not assessed)	AO1	1
3(c)	6.01a Algebraic terminology and proofs (vocabulary, and equation or identity; proof not assessed)	AO1	1
3(d)	6.01a Algebraic terminology and proofs (vocabulary, and equation or identity; proof not assessed)	AO2	1
Question 3 total			4
4(a)	6.01a Algebraic terminology and proofs (vocabulary, and equation or identity; proof not assessed)	AO1	1
4(b)	6.02b Substitute numerical values into formulae and expressions	AO1 ×2	2
Question 4 total			3
5(a)	6.02b Substitute numerical values into formulae and expressions	AO1 ×2	2
5(b)	6.02b Substitute numerical values into formulae and expressions	AO1 ×2	2
Question 5 total			4
6(a)	6.02b Substitute numerical values into formulae and expressions	AO1	1
6(b)	6.02a Formulate algebraic expressions	AO1 ×2	2
6(c)	6.02b Substitute numerical values into formulae and expressions	AO1, AO2	2
Question 6 total			5
7(a)	6.02b Substitute numerical values into formulae and expressions	AO2	1
7(b)	6.02b Substitute numerical values into formulae and expressions	AO2	1
7(c)	6.02b Substitute numerical values into formulae and expressions	AO1	1
Question 7 total			3
8	6.02b Substitute numerical values into formulae and expressions	AO1 ×3	3
Question 8 total			3
9(a)	6.02b Substitute numerical values into formulae and expressions	AO1, AO2	2
9(b)	6.02b Substitute numerical values into formulae and expressions	AO2	1
Question 9 total			3
10(a)	6.02a Formulate algebraic expressions	AO3	1
10(b)	6.02a Formulate algebraic expressions	AO1, AO3 ×2	3
10(c)	6.02b Substitute numerical values into formulae and expressions	AO1 ×2	2

Question	OCR J560 content	AO	Marks
Question 10 total			6
11(a)	6.02b Substitute numerical values into formulae and expressions	AO1 ×2	2
11(b)	6.02b Substitute numerical values into formulae and expressions	AO3	1
Question 11 total			3
12(a)	6.02b Substitute numerical values into formulae and expressions	AO1 ×2	2
12(b)	6.02b Substitute numerical values into formulae and expressions	AO2	1
Question 12 total			3
13	6.02b Substitute numerical values into formulae and expressions	AO1 ×2, AO3 ×2	4
Question 13 total			4
Paper total			48

Assessment objectives

Assessment objective	Marks
AO1 use and apply standard techniques	35 (73%)
AO2 reason, interpret and communicate mathematically	7 (15%)
AO3 solve problems within mathematics and in other contexts	6 (12%)
Total	48