

GCSE MATHEMATICS

Algebraic Notation and Substitution

AQA-style Topic Practice

Based on AQA GCSE Mathematics (8300)

Tier: Foundation and Higher

Name _____

Date _____

Instructions

- Use black ink or black ball-point pen. Draw diagrams in pencil.
- Answer all questions in the spaces provided.
- Do all rough work in this booklet.
- Section A: you must not use a calculator.
- Section B: you may use a calculator.

Information

- The marks for questions are shown in brackets.
- The maximum mark for this paper is 48.
- 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.

Advice

- In all calculations, show clearly how you work out your answer.

For Examiner's Use	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
16	
TOTAL	

These are original practice questions written in the style of AQA GCSE Mathematics (8300). They are not official AQA examination questions and are not endorsed by AQA.

SECTION A

You must not use a calculator in this section.

- 1** (a) Circle the expression that is the same as $a \times a \times a \times b$

Circle your answer.

[1 mark]

$3ab$

a^3b

ab^3

$3a + b$

- (b) Circle the expression for “multiply n by 3, then square the answer”.

Circle your answer.

[1 mark]

$3n^2$

$6n$

$9n$

$9n^2$

- (c) Circle the expression that is the same as $y \div 2$

Circle your answer.

[1 mark]

$2y$

$\frac{2}{y}$

$\frac{1}{2}y$

$y - 2$

- 2** Each row of the table shows an expression, an equation, a formula or an identity.

Tick one box in each row.

[2 marks]

	Expression	Equation	Formula	Identity
$5w + 3 = 23$				
$p \times p \times p \equiv p^3$				
$7p - 2q$				
$P = 2l + 2w$				

- 3** Here is an expression.

$4a^2 - 7ab + 9 - b$

- (a) How many terms are in the expression?

[1 mark]

Answer _____

- (b) Write down the coefficient of ab .

[1 mark]

Answer _____

- 3(c) Work out the value of the expression when $a = 2$ and $b = -1$

[2 marks]

Answer _____

- 4 A pencil costs p pence. An eraser costs e pence.

- (a) A ruler costs 15 pence more than a pencil. Write an expression for the cost of a ruler.

[1 mark]

Answer _____ pence

- (b) Write an expression for the total cost of 4 pencils and 3 erasers.

[1 mark]

Answer _____ pence

- (c) Mia buys some pencils and some erasers. She pays $2p + 5e$ pence. Write down what Mia buys.

[1 mark]

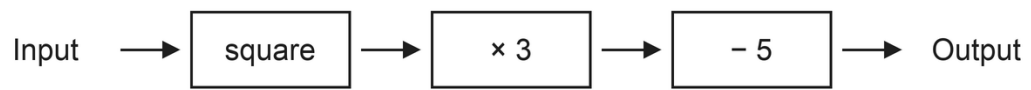
- (d) A pack of 6 pencils costs w pence. Write an expression for the cost of one pencil from the pack.

[1 mark]

Answer _____ pence

- 5 Figure 1 shows a number machine.

Figure 1



- (a) The input is -4 . Work out the output.

[1 mark]

Answer _____

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

[2 marks]

Answer _____

- 6 $a = -3$ and $b = 2$

- (a) Work out the value of $b^3 - a$

[2 marks]

Answer _____

- 6(b) Hannah says, " $2a^2$ and $(2a)^2$ have the same value." Show that Hannah is wrong.

[2 marks]

- 7 A bag of compost has a mass of 25 kg. A bag of sand has a mass of 40 kg.
A van carries c bags of compost and s bags of sand.

- (a) Write a formula for the total mass, M kg, of the bags in the van.

[2 marks]

Answer _____

- (b) The van can carry a mass of up to 1000 kg. Can the van carry 18 bags of compost and 14 bags of sand? You must show your working.

[2 marks]

- 8 Jamal works out the value of $20 - 3x^2$ when $x = -2$. Here is his working.

$$20 - 3 \times (-2)^2 = 17 \times 4 = 68$$

- (a) Explain the mistake Jamal has made.

[1 mark]

8(b) Work out the correct value of $20 - 3x^2$ when $x = -2$

[1 mark]

Answer _____

9 This formula changes a temperature of C degrees Celsius ($^{\circ}\text{C}$) into F degrees Fahrenheit ($^{\circ}\text{F}$).

$$F = \frac{9C}{5} + 32$$

One morning, it is -15°C in Oslo and 14°F in Chicago.

Which city is colder? You must show your working.

[3 marks]

10 Show that the value of $3(2x - y)^2$ is 300 when $x = 4$ and $y = -2$

[2 marks]

11 When $t = -\frac{1}{2}$, write t , t^2 , t^3 and $2t$ in order of size, starting with the smallest.

[2 marks]

Answer _____

SECTION B

You may use a calculator in this section.

- 12** A recipe uses this rule to work out the time needed to roast a chicken.

Cooking time in minutes = $45 \times \text{mass in kg} + 20$

- (a) A chicken has a mass of 2.6 kg. Use the rule to work out its cooking time.

[2 marks]

Answer _____ minutes

- (b) T is the cooking time in minutes and m is the mass in kg. Write the rule as a formula for T in terms of m.

[1 mark]

Answer _____

- 13** The kinetic energy, E joules, of a moving object is given by the formula

$$E = \frac{1}{2}mv^2$$

where m is the mass in kg and v is the velocity in m/s.

- (a) Work out the value of E when $m = 0.8$ and $v = 3.5$

[2 marks]

Answer _____ J

- 13(b)** A second object also has a mass of 0.8 kg. It moves in the opposite direction, so its velocity is -3.5 m/s. Zara says, “The kinetic energy of the second object is -4.9 joules.” Explain why Zara is wrong.

[1 mark]

- 14** Leon works out the value of $2x^2 + 5x$ when $x = -1.5$. Here is his working.

$$2 \times (-1.5)^2 + 5 \times 1.5 = 4.5 + 7.5 = 12$$

- (a) Explain the mistake Leon has made.

[1 mark]

- (b) Work out the correct value of $2x^2 + 5x$ when $x = -1.5$

[1 mark]

Answer _____

- 15** Two companies hire out minibuses. The cost, £C, of hiring a minibus for h hours is

Company A: $C = 35 + 12.5h$

Company B: $C = 18h$

A club hires a minibus for 4.5 hours. Which company is cheaper, and by how much?
You must show your working.

[3 marks]

16 A water tank is a cylinder with radius 0.45 m and height 1.2 m.

The volume, $V \text{ m}^3$, of a cylinder is given by $V = \pi r^2 h$, where r is the radius and h is the height.

$1 \text{ m}^3 = 1000 \text{ litres}$

The tank is empty. Ellie fills it using a bucket that holds 9 litres.

Work out the least number of buckets of water Ellie needs to fill the tank.

[4 marks]

Answer _____

END OF QUESTIONS

Mark scheme

Glossary: M marks are for a correct method which could lead to a correct answer. A marks are for an accurate answer and depend on the M mark before them. B marks are independent of method. M1dep is a method mark that depends on the previous method mark. ft means follow through from an earlier answer, oe or equivalent, and cao correct answer only.

Q	Answer	Mark	Comments
1(a)	a^3b	B1	
	Additional Guidance If more than one answer is circled, award no mark		
1(b)	$9n^2$	B1	
	Additional Guidance If more than one answer is circled, award no mark		
1(c)	$\frac{1}{2}y$	B1	
	Additional Guidance If more than one answer is circled, award no mark		
Total		3	

Q	Answer	Mark	Comments
2	$5w + 3 = 23$ Equation; $p \times p \times p \equiv p^3$ Identity; $7p - 2q$ Expression; $P = 2l + 2w$ Formula	B2	B1 for two or three rows correct
	Additional Guidance A row with more than one tick is wrong		
Total		2	

Q	Answer	Mark	Comments
3(a)	4	B1	
3(b)	-7	B1	do not accept 7 or -7ab
3(c)	$4 \times 2^2 - 7 \times 2 \times (-1) + 9 - (-1)$	M1	oe; or 16, 14 and 1 seen, e.g. $16 + 14 + 9 + 1$
	40	A1	
	Additional Guidance - Correct answer implies M1 $16 - 14 + 9 - 1 = 10$ scores M0 A0		
Total		4	

Q	Answer	Mark	Comments
4(a)	$p + 15$	B1	oe; do not accept 15p
4(b)	$4p + 3e$	B1	oe, e.g. $3e + 4p$; do not accept 7pe or 12pe
4(c)	2 pencils and 5 erasers	B1	both needed
4(d)	$\frac{w}{6}$	B1	oe, e.g. $w \div 6$; do not accept $\frac{6}{w}$ or 6w
Total		4	

Q	Answer	Mark	Comments
5(a)	43	B1	
	Additional Guidance • -53 (from taking $(-4)^2$ as -16) scores B0		
5(b)	$3n^2 - 5$	B2	oe, e.g. $n^2 \times 3 - 5$; B1 for $3n^2$ seen, or an answer of $3(n^2 - 5)$ or $(3n)^2 - 5$
	Additional Guidance • Do not award B2 for $(3n)^2 - 5$ or $3n - 5$		
Total		3	

Q	Answer	Mark	Comments
6(a)	$2^3 - (-3)$ or $8 + 3$	M1	
	11	A1	do not accept 5
	Additional Guidance • Correct answer implies M1		
6(b)	$2a^2 = 2 \times 9 = 18$	B1	$2 \times (-3)^2$ or 2×9 must be seen
	$(2a)^2 = (-6)^2 = 36$, and a statement that the two values are different	B1	e.g. $18 \neq 36$
	Additional Guidance • Do not award the first B1 for $2 \times (-3)^2 = -18$ • A correct explanation that only a is squared in $2a^2$ but 2a is squared in $(2a)^2$ may score the second B1 if 36 is seen		
Total		4	

Q	Answer	Mark	Comments
7(a)	$M = 25c + 40s$	B2	oe, e.g. $M = 40s + 25c$; B1 for $25c + 40s$ (not a formula), or for $M = 25c + ks$ or $M = kc + 40s$
	Additional Guidance - Answer must be a formula with M as the subject for B2 - Do not accept $M = 65cs$		
7(b)	$25 \times 18 + 40 \times 14$ or 450 and 560 seen	M1	ft their formula from (a)
	1010 and No	A1	oe, e.g. "No, it is 10 kg too heavy"
	Additional Guidance A1 needs 1010 (or 10 kg over) and a conclusion		
Total		4	

Q	Answer	Mark	Comments
8(a)	He worked out $20 - 3$ before multiplying	B1	or an equivalent explanation
	Additional Guidance - The explanation must say that $3 \times (-2)^2$ (or 3×4) must be worked out before subtracting from 20, e.g. "multiplication comes before subtraction" - Do not award for "the answer should be 8" or "he got the order wrong" without saying which operations		
8(b)	8	B1	
Total		2	

Q	Answer	Mark	Comments
9	$9 \times (-15) \div 5 + 32$	M1	oe; or -27 seen
	5	A1	
	Oslo, with 5 °F and 14 °F compared	A1	dependent on M1
	Additional Guidance - Alternative method: substituting $C = -10$ to give $F = 14$, then comparing -15 °C with -10 °C, scores M1 A1 A1 "Oslo" with no correct working scores 0		
Total		3	

Q	Answer	Mark	Comments
10	$3(2 \times 4 - (-2))^2$ or $2 \times 4 - (-2)$ or $8 + 2$	M1	a correct substitution into $2x - y$
	$3 \times 10^2 = 300$	A1	“show that” mark; oe chain from the substitution to 300
Additional Guidance - For example, $3(2 \times 4 - (-2))^2 = 3 \times 10^2 = 300$ scores M1 A1. $10^2 = 100$ need not be written as a separate step 300, or $3 \times 10^2 = 300$, with no substitution shown scores M0 A0 - Do not award A1 for $(3 \times 10)^2$ or $30^2 (= 900)$, or for working that uses $2x - y = 6$			
Total		2	

Q	Answer	Mark	Comments
11	$2t, t, t^3, t^2$	B2	B1 for at least three of $-1, -\frac{1}{2}, -\frac{1}{8}, \frac{1}{4}$ correctly matched to their expressions, or for the correct order reversed
Additional Guidance The correct order written as values $(-1, -\frac{1}{2}, -\frac{1}{8}, \frac{1}{4})$ with no expressions scores B1			
Total		2	

Q	Answer	Mark	Comments
12(a)	$45 \times 2.6 + 20$	M1	or 117 seen
	137	A1	
Additional Guidance - Correct answer implies M1 $45 \times (2.6 + 20) = 1017$ scores M0 A0			
12(b)	$T = 45m + 20$	B1	oe, e.g. $T = 20 + 45m$
Additional Guidance - Answer must be a formula with T as the subject - Do not accept $45m + 20$ on its own			
Total		3	

Q	Answer	Mark	Comments
13(a)	$\frac{1}{2} \times 0.8 \times 3.5^2$	M1	oe; or 12.25 seen, or 0.4×12.25
	4.9	A1	
	Additional Guidance - Correct answer implies M1 $(\frac{1}{2} \times 0.8 \times 3.5)^2 = 1.96$ scores M0 A0		
13(b)	$(-3.5)^2 = 12.25$, which is positive, so E is still 4.9	B1	oe
	Additional Guidance - Must refer to squaring the negative velocity giving a positive value - Do not accept "kinetic energy cannot be negative" on its own		
Total		3	

Q	Answer	Mark	Comments
14(a)	He used 1.5 instead of -1.5 for x in $5x$	B1	or an equivalent explanation
	Additional Guidance - Accept "he did not substitute -1.5 for every x" or "$5 \times -1.5 = -7.5$, not 7.5" - Do not award for "the answer should be -3" without a reason		
14(b)	-3	B1	
Total		2	

Q	Answer	Mark	Comments
15	$35 + 12.5 \times 4.5$	M1	or 91.25 seen
	18×4.5	M1	or 81 seen
	Company B, cheaper by £10.25	A1	allow 10.25
	Additional Guidance A1 needs both the company and the difference		
Total		3	

Q	Answer	Mark	Comments
16	$\pi \times 0.45^2 \times 1.2$	M1	
	0.763... (m ³) or 763... (litres)	A1	accept 0.763 to 0.764, or 763 to 764
	their volume in m ³ $\times 1000 \div 9$	M1dep	or their volume in litres $\div 9$; 84.8... seen implies M1dep
	85	A1	cao
Additional Guidance • The second M1 is dependent on the first • 84 or 84.8 after correct working scores M1 A1 M1dep A0 • $\pi \times 0.45 \times 1.2$ or $(\pi \times 0.45)^2 \times 1.2$ scores M0			
Total		4	

Elite Learners Assessment Objectives Summary

For teachers: how the marks in this paper divide between the three assessment objectives of AQA GCSE Mathematics (8300). This summary is not part of the AQA-style mark scheme.

AO1 — use and apply standard techniques	27 marks (56%)
AO2 — reason, interpret and communicate mathematically	12 marks (25%)
AO3 — solve problems within mathematics and in other contexts	9 marks (19%)
Total	48 marks