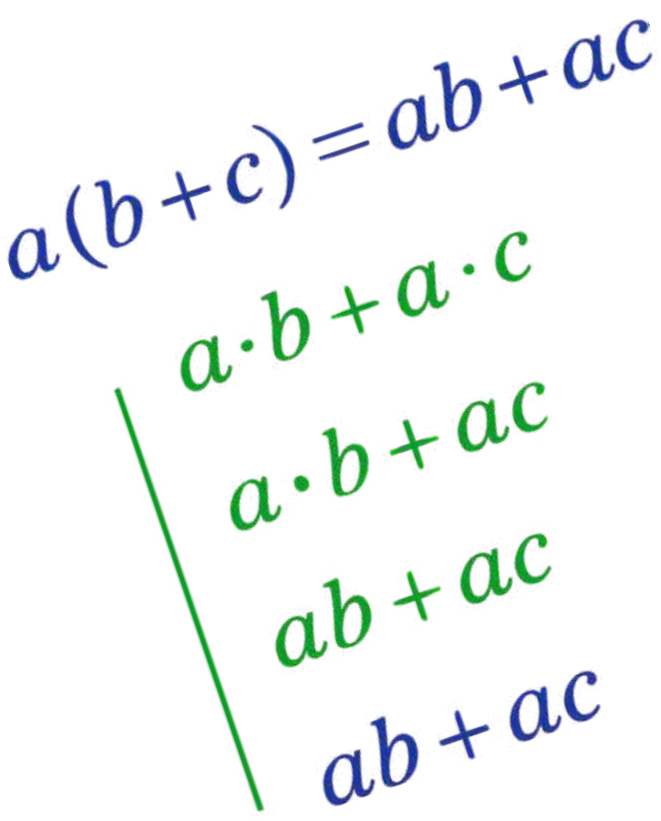
EDEXCEL IGCSE MATHEMATICS

UNIT 2 (MODULAR)

ALGEBRA – ALGEBRAIC PROOF

QP & MS (2018 - 2025)



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EDEXCEL IGCSE MATHEMATICS MODULAR FOR MAY & OCT 2026

by Sir Muhammad Abdullah Shah

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1. June 2025 1HR/Q20

Prove that, for any three numbers which are consecutive multiples of 4, the difference between the square of the largest number and the square of the smallest number is always a multiple of 64

Show clear algebraic working.

(Total for Question 17 is 3 marks)

2. Jan 2022 1HR/Q15

Using algebra, prove that, given any 3 consecutive whole numbers, the sum of the square of the smallest number and the square of the largest number is always 2 more than twice the square of the middle number.

(Total for Question 15 is 3 marks)

3. May 2021 1H/Q17

Using algebra, prove that, given any 3 consecutive even numbers, the difference between the square of the largest number and the square of the smallest number is always 8 times the middle number.

(Total for Question 17 is 3 marks)

4. May 2021 1H/Q17a

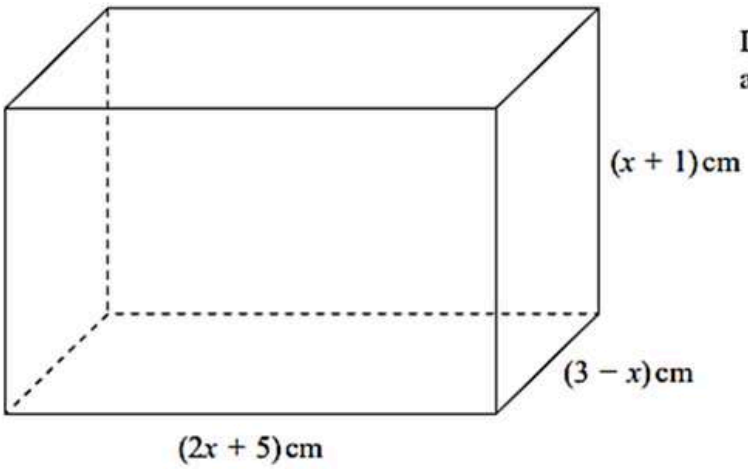


Diagram **NOT** accurately drawn

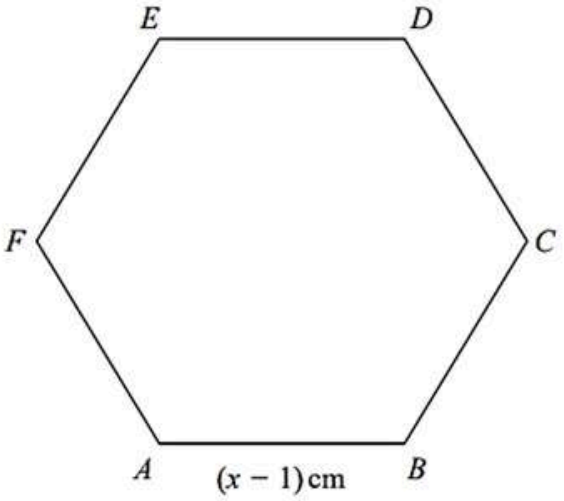
The diagram shows a cuboid of volume V cm^3

(a) Show that $V = 15 + 16x - x^2 - 2x^3$

(3)

5. Jan 2020 1HR/Q10

The diagram shows a regular hexagon, *ABCDEF*, and an isosceles triangle, *GHJ*.



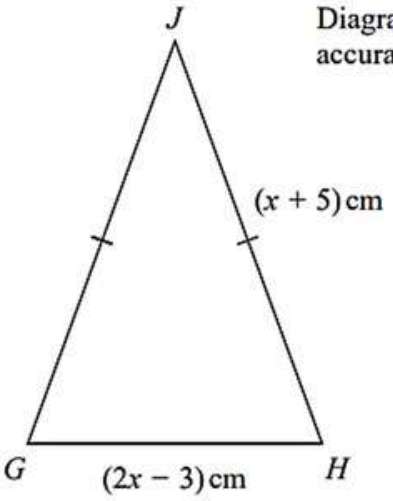


Diagram **NOT** accurately drawn

The perimeter of the hexagon is equal to the perimeter of the triangle.

Find the length of each side of the hexagon.
Show clear algebraic working.

..... cm

(Total for Question 10 is 5 marks)

6. Jan 2019 1HR/Q12

Here are the first four terms of a sequence of fractions.

$$\frac{1}{1} \quad \frac{2}{3} \quad \frac{3}{5} \quad \frac{4}{7}$$

The numerators of the fractions form the sequence of whole numbers 1 2 3 4 …
The denominators of the fractions form the sequence of odd numbers 1 3 5 7 …

(a) Write down an expression, in terms of n, for the nth term of this sequence of fractions.

(2)

(b) Using algebra, prove that when the square of any odd number is divided by 4 the remainder is 1

(3)

(Total for Question 12 is 5 marks)

7. June 2018 1HR/Q21

(a) Show that $x(x - 1)(x + 1) = x^3 - x$

(1)

(b) Prove that the difference between a whole number and the cube of this number is always a multiple of 6

(3)

(Total for Question 21 is 4 marks)

8. Specimen 1H/Q20

Prove algebraically that the difference between the squares of any two consecutive odd numbers is always a multiple of 8

(Total for Question 20 is 4 marks)

9. Sample 2018 1H/Q15a

A rectangular lawn has a length of $3x$ metres and a width of $2x$ metres.
The lawn has a path of width 1 metre on three of its sides as shown in the diagram.

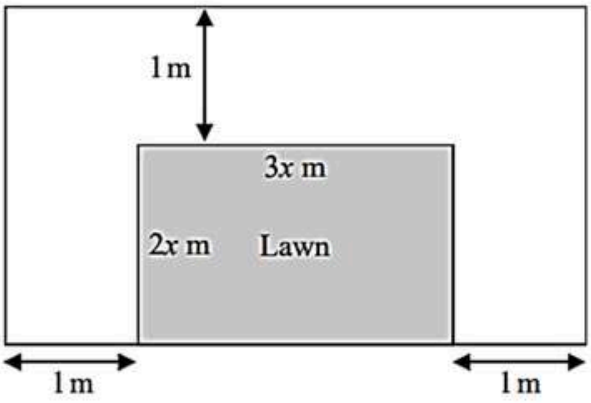


Diagram **NOT** accurately drawn

The total area of the lawn and the path is $100\,m^2$

(a) Show that $6x^2 + 7x - 98 = 0$

(2)

MARKING SCHEME

1. June 2025 1HR/Q20

17	eg $4n$, $4n + 4$, $4n + 8$ **or** $4n$, $4(n + 1)$, $4(n + 2)$ **or** $4n - 4$, $4n$, $4n + 4$ **or** $4(n - 1)$, $4n$, $4(n + 1)$		3	M1 for correct expressions for 3 consecutive multiples of 4 (any letter can be used) may just see the first and third multiple for this mark
	eg $(4n + 8)^2 - (4n)^2$ $(= 16n^2 + 64n + 64 - 16n^2)$ **or** $(4(n + 2))^2 - (4n)^2$ $(= 16n^2 + 64n + 64 - 16n^2)$ **or** $(4n + 4)^2 - (4n - 4)^2$ $(= 16n^2 + 32n + 16 - 16n^2 + 32n - 16)$ **or** $(4(n + 1))^2 - (4(n - 1))^2$ $(= 16n^2 + 32n + 16 - 16n^2 + 32n - 16)$			M1 for squaring the largest and smallest multiple of 4 and subtracting (no need to expand or simplify for this mark)
	eg $(4n + 8)^2 - (4n)^2 = 16n^2 + 64n + 64 - 16n^2 = 64n + 64$ **or** $(4n + 8)^2 - (4n)^2 = (4n + 8 + 4n)(4n + 8 - 4n) = 8(8n + 8) = 64n + 64$ **or** $(4(n + 2))^2 - (4n)^2 = 16n^2 + 64n + 64 - 16n^2 = 64n + 64$ **or** $(4(n + 2))^2 - (4n)^2 = (4(n + 2) + 4n)(4(n + 2) - 4n) = 8(8n + 8) = 64n + 64$ **or** $(4n + 4)^2 - (4n - 4)^2 = 16n^2 + 32n + 16 - 16n^2 + 32n - 16 = 64n$ **or** $(4n + 4)^2 - (4n - 4)^2 = (4n + 4 + 4n - 4)(4n + 4 - 4n + 4) = 8n \times 8 = 64n$ **or** $(4(n + 1))^2 - (4(n - 1))^2 = 16n^2 + 32n + 16 - 16n^2 + 32n - 16 = 64n$ **or** $(4(n + 1))^2 - (4(n - 1))^2 = (4(n + 1) + 4(n - 4))(4(n + 1) - 4(n - 4)) = 8n \times 8 = 64n$	correctly shown		A1 dep on M2, for use of algebra to show correct conclusion
	Working required			**Total 3 marks**

2. Jan 2022 1HR/Q15

15	E.g. n, $n + 1$, $n + 2$ $(n^2 =)n^2$ $((n+1)^2 =)n^2 + n + n + 1 = n^2 + 2n + 1$ oe $((n+2)^2 =)n^2 + 2n + 2n + 4 = n^2 + 4n + 4$ oe or E.g. $n - 1$, n, $n + 1$ $((n-1)^2 =)n^2 - n - n + 1 = n^2 - 2n + 1$ oe $(n^2 =)n^2$ $((n+1)^2 =)n^2 + n + n + 1 = n^2 + 2n + 1$ oe		3	M1 for 3 appropriate terms for their 3 numbers **and** for correctly finding the expansion of at least 2 squares (Allow 2 × middle number + 2)
	$n^2 + n^2 + 2n + 2n + 4$ $(= 2n^2 + 4n + 4)$ oe and $2(n+1)^2 = 2n^2 + 2n + 2n + 2$ $(= 2n^2 + 4n + 2)$ oe or $n^2 - 2n + 1 + n^2 + 2n + 1$ $(= 2n^2 + 2)$ oe			M1 for finding the sum of first and last square **and** double the square of the middle (Allow 2 × middle number + 2)
	E.g. $2n^2 + 4n + 4 = 2n^2 + 4n + 2 + 2$ oe or $2(x+1)^2 + 2 = 2(x+1)^2 + 2$ oe or $2n^2 + 2 = 2n^2 + 2$ oe	Complete proof		A1 for conclusion from two correct expressions e.g. $2n^2 + 4n + 4$ **and** $2n^2 + 4n + 2$
				Total 3 marks

3. May 2021 1H/Q17

17		eg $2n, 2n+2, 2n+4$ **or** $2n-2, 2n, 2n+2$ etc		3	M1	3 consecutive even numbers in algebraic form (any letter can be used)
		eg $(2n+4)^2-(2n)^2$ $(=4n^2+8n+8n+16-4n^2\ (=16n+16))$ **or** $(2n+2)^2-(2n-2)^2$ $(=4n^2+4n+4n+4-(4n^2-4n-4n+4)\ (=16n))$			M1	for squaring the largest and smallest even numbers and subtracting (no need to expand or simplify for this mark)
		eg $8(2n+2)=16n+16$ **or** eg $16n+16=8(2n+2)$ **or** eg $16n=8(2n)$ **or** eg $8n+8n=8(n+n)$ **or** eg $\frac{16n+16}{2n+2}=8$	Correctly shown		A1	dep on M2 for use of algebra to show correct conclusion (SCB1 for eg $(p+4)^2-p^2$) (SCB2 for use of eg $(p+4)^2-p^2=8p+16=8(p+2)$ If the student shows this and also says "it is true for all numbers, so it must be true for even numbers" oe then this would gain M2A1
		Alternative				**Total 3 marks**
		eg a, b, c are consecutive even numbers where $a<b<c$ **and** one of $b=\frac{a+c}{2}$ **or** $a+c=2b$ **or** $c-a=4$ oe		3	M1	3 numbers defined as consecutive even numbers with one correct equation, writing one term in terms of one or more of the others or $c-a=4$
		eg a, b, c are consecutive even numbers where $a<b<c$ **and** all of $b=\frac{a+c}{2}$ **and** $a+c=2b$ **and** $c-a=4$ oe			M1	3 numbers defined as consecutive even numbers with three correct equations that involve all letters in some place
		Now $c^2-a^2=(c-a)(c+a)=4\times 2b=8b$	Correctly shown		A1	dep on M2 for use of algebra to show correct conclusion
						Total 3 marks

4. May 2021 1H/Q17a

15	(a)	$(2x+5)(x+1)=2x^2+2x+5x+5$ $(=2x^2+7x+5)$ **or** $(x+1)(3-x)=-x^2+3x-x+3$ $(=-x^2+2x+3)$ **or** $(3-x)(2x+5)=-2x^2+6x-5x+15$ $(=-2x^2+x+15)$		3	M1 for multiplying out two brackets correctly at least 3 terms correct	M2 for at least 4 terms correct out of a maximum of 8 terms $6x^2-2x^3+6x-2x^2+15x-5x^2+15-5x$
		E.g. $[(2x^2+7x+5)(3-x)=]$ $-2x^3-7x^2-5x+6x^2+21x+15$ **or** $[(-x^2+2x+3)(2x+5)=]$ $-2x^3-5x^2+10x+4x^2+6x+15$ **or** $[(-2x^2+x+15)(x+1)=]$ $-2x^3-2x^2+15x+x^2+x+15$			M1 for at least 3 terms correct out of a maximum of 6 terms **or** for at least 4 terms correct out of a maximum of 8 terms	
			Shown		A1	

5. Jan 2020 1HR/Q10

10	e.g. $6(x-1)\ (=6x-6)$			M1	method to find expression for perimeter of hexagon
	e.g. $2(x+5)+2x-3\ (=4x+7)$			M1	method to find expression for perimeter of triangle
	"$6x-6$" = "$4x+7$"			M1	(dep on at least M1) for equating both expressions
	e.g. $6x-4x=7+6$			M1	(dep on previous M1 and equation of the form $ax+b=cx+d$)for rearranging the x terms on one side and the numerical terms on the other and all expansions correct.
		5.5	5	A1	oe (dep on M2)
					Total 5 marks

6. Jan 2019 1HR/Q12

12	(a)		$\frac{n}{2n-1}$	2	M1	for $2n \pm k$ oe as the denominator
					A1	oe
	(b)	$(2n-1)^2 = 4n^2 - 4n + 1$	Proved	3	M1	or $(2n+1)^2 = 4n^2 + 4n + 1$ ft on $2n \pm k$ (k non zero)
		$4(n^2 - n) + 1$ **or** $\frac{4n^2 - 4n + 1}{4} = n^2 - n + \frac{1}{4}$			M1	or $4(n^2 + n) + 1$ **or** $\frac{4n^2 + 4n + 1}{4} = n^2 + n + \frac{1}{4}$
					A1	Conclusion

7. June 2018 1HR/Q21

21	(a)	$x(x^2 - 1)$ or $(x^2 - x)(x + 1)$	$x^3 - x$	1	B1	for correct expansion of a pair of brackets and then $x^3 - x$ written down
	(b)	(One of the numbers) is even **or** multiple of 2 **or** 2 is a factor	Proof	3	M1	
		(One of the numbers) is a multiple of 3 **or** 3 is a factor			M1	
		Hence a multiple of 6			A1	
						Total 4 marks

8. Specimen 1H/Q20

20	eg. $2n + 1$, $2n + 3$			M1	for algebraic representation of two consecutive odd numbers
	$(2n + 3)^2 - (2n + 1)^2 =$ $(4n^2 + 6n + 6n + 9) - (4n^2 + 2n + 2n + 1)$			M1	for correct expansion of at least one bracket
	$8n + 8$			M1	for simplified answer, may be factorised
		proof	4	A1	for completion of proof
					Total 4 marks

9. Sample 2018 1H/Q15a

Question		Working	Answer	Mark	AO		Notes
15	a	$(3x + 2)(2x + 1) = 100$			AO1, AO2	M1	or $(2x \times 3x) + 2(2x + 1) + 3x = 100$ oe or $(2x \times 3x) + (2 \times 2x (\times 1)) + 1) + 3x + 1 + 1 = 100$ oe other partitions are acceptable but partitioning must go on to form a correct equation.
			$6x^2 + 7x - 98 = 0$ *	2		A1	Accept $6x^2 + 7x + 2 = 100$ if M1 awarded * Answer given