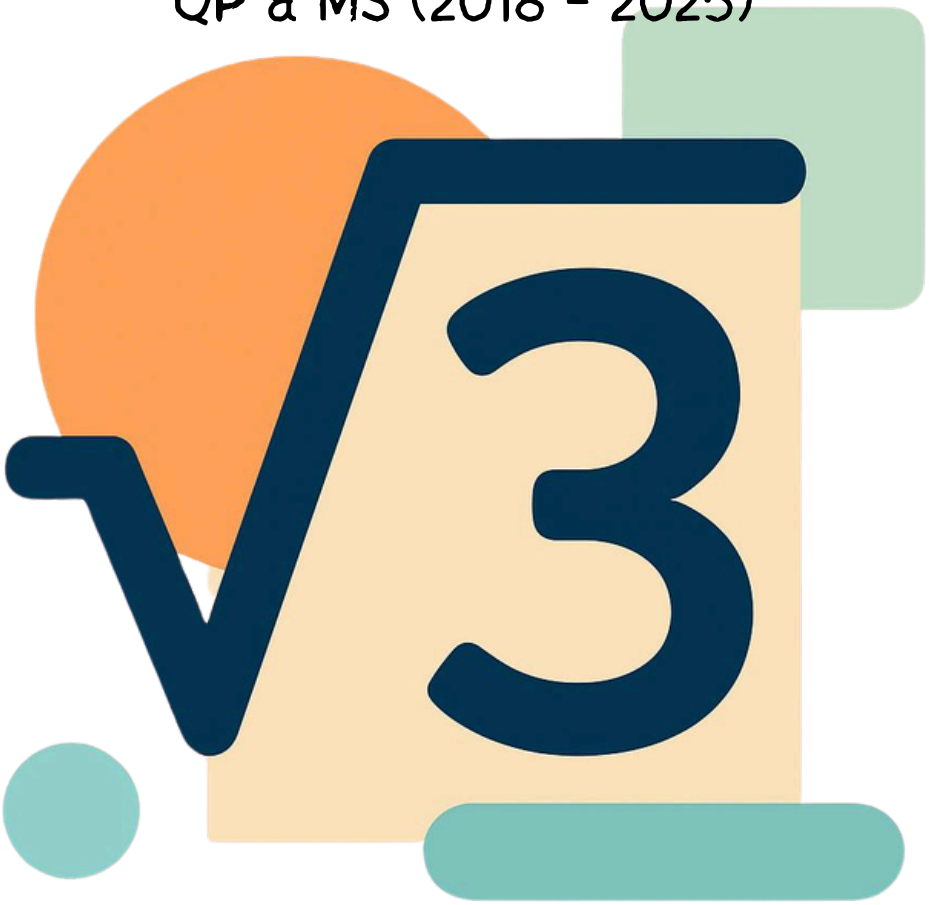
EDEXCEL IGCSE MATHEMATICS

UNIT 1 (MODULAR)

NUMBER – SURDS

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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Surds- Rationalise The Denominator

1. Nov 2025 1H/Q17

Show that $\frac{2\sqrt{7}+2}{\sqrt{7}-3}$ can be written in the form $a-\sqrt{b}$ where a and b are integers.

Show your working clearly.

(Total for Question 17 is 3 marks)

2. Nov 2024 1H/Q17(b)

(b) Show that $\frac{5-\sqrt{2}}{\sqrt{2}-1}$ can be written in the form $a+b\sqrt{2}$ where a and b are integers.

(3)

(Total for Question 17 is 4 marks)

3. June 2024 1H/Q17

Show that $\frac{1+\sqrt{5}}{3-\sqrt{5}}$ can be written in the form $a+\sqrt{b}$ where a and b are integers.

Show each stage of your working clearly.

(Total for Question 17 is 3 marks)

4. June 2024 1HR/Q17(b)

(b) Express $\frac{7}{2-\sqrt{3}}$ in the form $\sqrt{c}+d$ where c and d are integers.

Show your working clearly.

.....

(3)

(Total for Question 17 is 4 marks)

5. June 2022 1H/Q16

Without using a calculator, show that $\frac{12}{\sqrt{2}-1} - \left(\sqrt{2}\right)^5 = 2\sqrt{32} + 12$

Show your working clearly.

(Total for Question 16 is 3 marks)

6. June 2022 1HR/Q21

Express $\dfrac{3+\sqrt{8}}{\left(\sqrt{2}-1\right)^2}$ in the form $p+\sqrt{q}$ where p and q are integers.

Show each stage of your working clearly.

.....

(Total for Question 21 is 4 marks)

7. Jan 2021 1HR/Q15(b)

(b) Show that $\frac{2}{6-3\sqrt{2}}$ can be written in the form $\frac{a+\sqrt{a}}{b}$

where a and b are integers.
Show your working clearly.

(3)

(Total for Question 15 is 5 marks)

8. Nov 2020 1H/Q19

Without using a calculator, rationalise the denominator of $\frac{6}{3-\sqrt{7}}$

Simplify your answer.
You must show each stage of your working.

.....

(Total for Question 19 is 3 marks)

9. Jan 2020 1H/Q17(a)

(a) Show that $\left(6+2\sqrt{12}\right)^2 = 12\left(7+4\sqrt{3}\right)$

Show each stage of your working.

(3)

10. Jan 2020 1HR/Q13(b)

Given that y is a prime number,

(b) express $\dfrac{3}{2-\sqrt{y}}$ in the form $\dfrac{a+b\sqrt{y}}{c-y}$ where a, b and c are integers.

.....

(2)

(Total for Question 13 is 4 marks)

11. Jan 2019 1H/Q16(a)

(a) Rationalise the denominator of $\frac{a+\sqrt{4b}}{a-\sqrt{4b}}$ where a is an integer and b is a prime number.

Simplify your answer.

(3)

12. Jan 2019 1HR/Q18

Show that $\frac{\sqrt{8}}{\sqrt{8}-2}$ can be written in the form $n+\sqrt{n}$, where n is an integer.

Show your working clearly.

(Total for Question 18 is 3 marks)

Surds- Miscellaneous

13. June 2025 1H/Q15(a)

$(\sqrt{3})^5 = k\sqrt{3}$ where k is an integer.

(a) Find the value of k

$k =$ .....

(1)

14. Nov 2024 1H/Q17(a)

(a) Express $\sqrt{675}$ in the form $n\sqrt{27}$ where n is a positive integer.

.....

(1)

15. Jan 2021 1H/Q18

Given that $(8 - \sqrt{x})(5 + \sqrt{x}) = y\sqrt{x} + 21$ where x is a prime number and y is an integer,

find the value of x and the value of y.
Show each stage of your working clearly.

$x =$ .....

$y =$ .....

(Total for Question 18 is 3 marks)

MARKING SCHEME

Surds - Rationalise The Denominator

1. Nov 2025 1H/Q17

17	$\frac{2\sqrt{7}+2}{\sqrt{7}-3}\times\frac{\sqrt{7}+3}{\sqrt{7}+3}$ **or** $\frac{2\sqrt{7}+2}{\sqrt{7}-3}\times\frac{-\sqrt{7}-3}{-\sqrt{7}-3}$		3	M1	for explicitly multiplying the numerator and denominator by $\sqrt{7}+3$ or $-\sqrt{7}-3$
	$\frac{2\sqrt{7}\sqrt{7}+6\sqrt{7}+2\sqrt{7}+6}{\sqrt{7}\sqrt{7}+3\sqrt{7}-3\sqrt{7}-9}$ oe **or** $\frac{14+6\sqrt{7}+2\sqrt{7}+6}{7-9}$ oe **or** $\frac{20+8\sqrt{7}}{-2}$ **or** $\frac{20+\sqrt{448}}{-2}$ or $\frac{-2\sqrt{7}\sqrt{7}-6\sqrt{7}-2\sqrt{7}-6}{-\sqrt{7}\sqrt{7}-3\sqrt{7}+3\sqrt{7}+9}$ oe **or** $\frac{-14-6\sqrt{7}-2\sqrt{7}-6}{-7+9}$ **or** $\frac{-20-8\sqrt{7}}{2}$ **or** $\frac{-20-\sqrt{448}}{2}$			M1	numerator correctly expanded and may be simplified to at least 2 terms and denominator correctly expanded and may be simplified to one term, this mark implies previous M1 $\frac{2\sqrt{7}+2}{\sqrt{7}-3}\times\frac{\sqrt{7}+3}{\sqrt{7}+3}=-10-4\sqrt{7}$ scores M1M0
	Working required	$-10-\sqrt{112}$		A1	dep on M2 SCB1 for $-10-\sqrt{112}$ gained with no method marks awarded SCB2 for $-10-\sqrt{112}$ gained if you would award 1st M1 but not second M1 (total 2 marks)
					Total 3 marks

2. Nov 2024 1H/Q17(b)

(b)	$\frac{5-\sqrt{2}}{\sqrt{2}-1}\times\frac{\sqrt{2}+1}{\sqrt{2}+1}$ or $\frac{5-\sqrt{2}}{\sqrt{2}-1}\times\frac{-\sqrt{2}-1}{-\sqrt{2}-1}$		3	M1 for rationalising the denominator by multiplying numerator and denominator by $\sqrt{2}+1$ or $-\sqrt{2}-1$
	eg $\frac{5\sqrt{2}+5-2-\sqrt{2}}{2-1}$ oe or $\frac{5\sqrt{2}+5-2-\sqrt{2}}{\sqrt{4}+\sqrt{2}-\sqrt{2}-1}$ oe or $5\sqrt{2}+5-2-\sqrt{2}$			M1 (numerator must be expanded to 4 terms, denominator may be 4 terms which need to be all correct) Accept 1 in the denominator without working
	Working required	$3+4\sqrt{2}$		A1 or for stating $a=3$ and $b=4$ dep on M2
				Total 4 marks

3. June 2024 1H/Q17

17	$\frac{1+\sqrt{5}}{3-\sqrt{5}}\times\frac{3+\sqrt{5}}{3+\sqrt{5}}$ oe or $\frac{1+\sqrt{5}}{3-\sqrt{5}}\times\frac{-3-\sqrt{5}}{-3-\sqrt{5}}$ oe		3	M1 for rationalising the denominator by multiplying numerator and denominator by $3+\sqrt{5}$ (or $-3-\sqrt{5}$)
	$\frac{3+\sqrt{5}+3\sqrt{5}+\sqrt{5}\sqrt{5}}{9+3\sqrt{5}-3\sqrt{5}-\sqrt{5}\sqrt{5}}$ oe or $\frac{3+\sqrt{5}+3\sqrt{5}+\sqrt{5}\sqrt{5}}{9-\sqrt{5}\sqrt{5}}$ oe or $\frac{3+\sqrt{5}+3\sqrt{5}+5}{9+3\sqrt{5}-3\sqrt{5}-5}$ oe or $\frac{8+\sqrt{5}+3\sqrt{5}}{9-5}$ oe or $\frac{3+4\sqrt{5}+5}{9-5}$ oe or $\frac{8+4\sqrt{5}}{4}$			M1 numerator correctly expanded and may be simplified to at least 2 terms and denominator correctly expanded and may be simplified to 1 term
	Working required	$2+\sqrt{5}$		A1 for $2+\sqrt{5}$ from correct working dep on M2
				Total 3 marks

4. June 2024 1HR/Q17(b)

(b)	eg $\frac{7(2+\sqrt{3})}{(2-\sqrt{3})(2+\sqrt{3})}$ **or** $\frac{7(-2-\sqrt{3})}{(2-\sqrt{3})(-2-\sqrt{3})}$		3	M1 for multiplying the numerator and denominator of the fraction by $2+\sqrt{3}$ or $-2-\sqrt{3}$
	eg $\frac{14+7\sqrt{3}}{4+2\sqrt{3}-2\sqrt{3}-3}$ **or** $\frac{14+7\sqrt{3}}{4-3}$ **or** $\frac{14+7\sqrt{3}}{1}$ **or** $\frac{-14-7\sqrt{3}}{-4-2\sqrt{3}+2\sqrt{3}+3}$ **or** $\frac{-14-7\sqrt{3}}{-4+3}$ **or** $\frac{-14-7\sqrt{3}}{-1}$			M1 dep on previous M1
	Working required	$\sqrt{147}+14$		A1 dep on M2 SCB1 for $\sqrt{147}+14$ gained with no method marks awarded SCB2 for $\sqrt{147}+14$ gained with 1st M1 awarded
				Total 4 marks

5. June 2022 1H/Q16

16	$\frac{12}{\sqrt{2}-1}\times\frac{\sqrt{2}+1}{\sqrt{2}+1}$ or $\frac{12}{\sqrt{2}-1}\times\frac{-\sqrt{2}-1}{-\sqrt{2}-1}$ **and** $4\sqrt{2}$ or $2\sqrt{8}$ or $\sqrt{32}$ oe		3	M1 for showing a correct method for rationalising the denominator **and** dealing with $(\sqrt{2})^5$
	E.g. $12\sqrt{2}+12-4\sqrt{2}$ or $8\sqrt{2}+12$ $12\sqrt{2}+12-2\sqrt{8}$ or $12\sqrt{2}+12-\sqrt{32}$ oe			M1 dep expression must be in surd form
	E.g. $12\sqrt{2}(+12)-4\sqrt{2}=8\sqrt{2}(+12)=2\sqrt{4^2\times2}(+12)=2\sqrt{32}(+12)$ or $12\sqrt{2}(+12)-2\sqrt{8}=6\sqrt{8}(+12)-2\sqrt{8}=4\sqrt{8}(+12)=2\sqrt{4\times8}(+12)=2\sqrt{32}(+12)$ or $12\sqrt{2}(+12)-\sqrt{32}=3\sqrt{4^2\times2}(+12)-\sqrt{32}=2\sqrt{32}(+12)$ oe Note $8\sqrt{2}=2\sqrt{4^2\times2}$ or $2\sqrt{16\times2}$ or $\sqrt{32\times4}$ or $\sqrt{64\times2}$ $12\sqrt{2}=3\sqrt{4^2\times2}$ or $3\sqrt{16\times2}$ or $\sqrt{32\times9}$	Shown		A1 dep on M2 for showing working to given answer (they may dismiss the +12 and just deal with the surd part for this stage)
				Total 3 marks

6. June 2022 1HR/Q21

21	$(\sqrt{2}-1)^2=2-\sqrt{2}-\sqrt{2}+1\left(=3-2\sqrt{2}\right)$	$\frac{(3+\sqrt{8})}{(\sqrt{2}-1)^2}\times\frac{(\sqrt{2}+1)^2}{(\sqrt{2}+1)^2}$		4	M1 expand the denominator (accept $2-2\sqrt{2}+1$ - must see expansion) **OR** method to rationalise using $(\sqrt{2}+1)^2$
	$\frac{(3+\sqrt{8})}{"(3-2\sqrt{2})"}\times\frac{(3+2\sqrt{2})}{(3+2\sqrt{2})}$	$(\sqrt{2}-1)^2=2-\sqrt{2}-\sqrt{2}+1\left(=3-2\sqrt{2}\right)$ **or** $(\sqrt{2}+1)^2=2+\sqrt{2}+\sqrt{2}+1\left(=3+2\sqrt{2}\right)$ **or** $(\sqrt{2}-1)(\sqrt{2}+1)=2-\sqrt{2}+\sqrt{2}-1(=1)$			M1 oe ft $3-2\sqrt{2}$ method to rationalise **OR** expansion of $(\sqrt{2}-1)^2$ (accept $2-2\sqrt{2}+1$) **or** $(\sqrt{2}+1)^2$ (accept $2+2\sqrt{2}+1$) **or** $(\sqrt{2}-1)(\sqrt{2}+1)$
	eg $\frac{9+6\sqrt{2}+3\sqrt{8}+8}{9-6\sqrt{2}+6\sqrt{2}-8}$ **or** $\frac{9+12\sqrt{2}+8}{9-8}$ **or** $\frac{9+6\sqrt{2}+3\sqrt{8}+8}{1}$ **or** $\frac{9+12\sqrt{2}+8}{1}$				M1 dep on 2nd M1 correct expansion of brackets
			$17+\sqrt{288}$		A1 or $p=17$, $q=288$ answer from fully correct working with intermediate steps of working seen
					Total 4 marks

7. Jan 2021 1HR/Q15(b)

15 b	E.g. $\frac{2}{6-3\sqrt{2}}\times\frac{6+3\sqrt{2}}{6+3\sqrt{2}}$ or $\frac{2}{6-3\sqrt{2}}\times\frac{-6-3\sqrt{2}}{-6-3\sqrt{2}}$		3	M1	for rationalising the denominator by multiplying numerator and denominator by $6+3\sqrt{2}$ (or $-6-3\sqrt{2}$)
	$\frac{12+6\sqrt{2}}{36-18\sqrt{2}+18\sqrt{2}-18}$ or $\frac{12+6\sqrt{2}}{18}$ or $\frac{12+6\sqrt{2}}{6^2-\left(3\sqrt{2}\right)^2}$ or $\frac{12+6\sqrt{2}}{6^2-9\times2}$			M1	(numerator may be expanded or denominator may be 4 terms which need to be all correct)
		$\frac{2+\sqrt{2}}{3}$		A1	or for stating $a=2$ and $b=3$ for $\frac{2+\sqrt{2}}{3}$ from correct working dep on M2
					Total 5 marks

8. Nov 2020 1H/Q19

19	$\frac{6}{3-\sqrt{7}}\times\frac{3+\sqrt{7}}{3+\sqrt{7}}$ or $\frac{6}{3-\sqrt{7}}\times\frac{-3-\sqrt{7}}{-3-\sqrt{7}}$			M1
	$\frac{6(3+\sqrt{7})}{3^2-7}$ **or** $\frac{6(3+\sqrt{7})}{2}$ **or** $\frac{6(-3-\sqrt{7})}{-3^2+7}$ **or** $\frac{6(-3-\sqrt{7})}{-2}$			M1 (numerator may be expanded or denominator may be 4 terms which need to be all correct)
		$9+3\sqrt{7}$	3	A1 dep on M2 for $9+3\sqrt{7}$ **or** $3(3+\sqrt{7})$ from correct working
				Total 3 marks

9. Jan 2020 1H/Q17(a)

17	(a)	$6\times6+6\times2\sqrt{12}+6\times2\sqrt{12}+\left(2\times\sqrt{12}\right)^2$ or $36+12\sqrt{12}+12\sqrt{12}+4\sqrt{12}\sqrt{12}$ or $36+12\sqrt{12}+12\sqrt{12}+(4\times12)$ or $36+24\sqrt{3}+24\sqrt{3}+48$ or $36+2\times24\sqrt{3}+48$ or $36+6\times2\times2\sqrt{12}+48$		3	M1 for correct expansion of brackets showing **four** terms (need not be simplified) **or** for the use of $(a+b)^2=a^2+2ab+b^2$ **or** for showing or stating $\sqrt{12}=2\sqrt{3}$ oe
		$84+48\sqrt{3}$			M1 (dep on M1)
			Shown		A1 for fully correct working leading to given expression

10. Jan 2020 1HR/Q13(b)

b	$\frac{3}{2-\sqrt{y}}\times\frac{2+\sqrt{y}}{2+\sqrt{y}}$ **or** $6+3\sqrt{y}$ **or** $4-y$			M1 for multiplying numerator and denominator by $(2+\sqrt{y})$ **or** a correct expression for the numerator or denominator
		$\frac{6+3\sqrt{y}}{4-y}$	2	A1
				Total 4 marks

11. Jan 2019 1H/Q16(a)

Question	Working	Answer	Mark	Notes
16 (a)	Eg $\frac{a+\sqrt{4b}}{a-\sqrt{4b}}\times\frac{a+\sqrt{4b}}{a+\sqrt{4b}}$ **or** $\frac{a+2\sqrt{b}}{a-2\sqrt{b}}\times\frac{a+2\sqrt{b}}{a+2\sqrt{b}}$ **or** $\frac{\left(a+2\sqrt{b}\right)^2}{\left(a+2\sqrt{b}\right)\left(a-2\sqrt{b}\right)}$			M1 For multiplying the numerator and denominator by $a+\sqrt{4b}$ or $a+2\sqrt{b}$
	Eg $\frac{(a+\sqrt{4b})(a+\sqrt{4b})}{a^2-4b}$			M1 dep on M1 for correctly simplified denominator
		$\frac{a^2+4a\sqrt{b}+4b}{a^2-4b}$	3	A1 for $\frac{a^2+4a\sqrt{b}+4b}{a^2-4b}$ **or** $\frac{\left(a+2\sqrt{b}\right)^2}{a^2-4b}$

12. Jan 2019 1HR/Q18

Question	Working	Answer	Mark	Notes
18	$\frac{\sqrt{8}}{\sqrt{8}-2}\times\frac{\sqrt{8}+2}{\sqrt{8}+2}$ $\frac{\sqrt{8}(\sqrt{8}+2)}{8-4}=\frac{8+2\sqrt{8}}{4}=\frac{8+4\sqrt{2}}{4}$ $=2+\sqrt{2}$	Shown	3	M1 or $\frac{2\sqrt{2}}{2\sqrt{2}-2}$ or $\frac{\sqrt{2}}{\sqrt{2}-1}$ M1 or $\frac{\sqrt{2}}{\sqrt{2}-1}\times\frac{\sqrt{2}+1}{\sqrt{2}+1}$ A1 (dep on M2) Conclusion - need not state the value of n

Surds- Miscellaneous

13. June 2025 1H/Q15(a)

15	(a)		9	1	B1 allow $9\sqrt{3}$

14. Nov 2024 1H/Q17(a)

17	(a)		$5\sqrt{27}$	1	B1 Allow $n = 5$ Do not accept 5 by itself

15. Jan 2021 1H/Q18

18	e.g. $40+8\sqrt{x}-5\sqrt{x}-\sqrt{x}\sqrt{x}$ **or** $40+8\sqrt{x}-5\sqrt{x}-(\sqrt{x})^2$ **or** $40+8\sqrt{x}-5\sqrt{x}-x$ **or** $40+3\sqrt{x}-x$		3	M1	for a correct expansion with at least 3 out of 4 terms correct oe or all 3 terms correct
		$x = 19$		A1	(dep on M1) for $x = 19$
		$y = 3$		B1	for $y = 3$
					Total 3 marks