

A sample set of the lesson notes on the topic of Surds

What is a surd?

A surd is a **root** that **cannot be simplified into a rational number***.

*A **rational number** is a number that can be written as a **fraction with integers**.

Examples of surds

$$\sqrt{3} \approx 1.732 \dots$$

$$\sqrt{5} \approx 2.236 \dots$$

$$\sqrt{6} \approx 2.449 \dots$$

All the answers are non-terminating, non-repeating decimals = **irrational number**

Non-examples

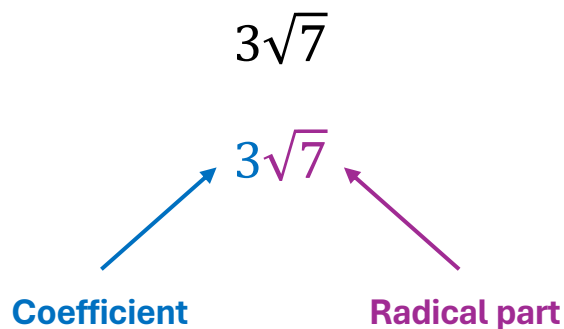
$$\sqrt{0} = 0$$

$$\sqrt{1} = 1$$

$$\sqrt{4} = 2$$

All the answers can be written as a fraction with integers = **rational number**

Parts of a root



2. Adding and subtracting surds without simplifying surds first ***

“**Like surds**” can be added and subtracted in the same way as “**like terms**” in algebra. To combine like surds, **add or subtract the coefficients** and **keep the radical part the same**.

Simplify $\sqrt{3} + \sqrt{3}$

$$\begin{aligned} & \sqrt{3} + \sqrt{3} \\ = & 2\sqrt{3} // \end{aligned}$$

Tip

To add or subtract surds, the **radical parts** must be the **same**.

Simplify $7\sqrt{7} - 2\sqrt{2} - \sqrt{2} - 5\sqrt{7} + 9$

$$\begin{aligned} & 7\sqrt{7} - 2\sqrt{2} - \sqrt{2} - 5\sqrt{7} + 9 \\ = & 7\sqrt{7} - 5\sqrt{7} - 2\sqrt{2} - \sqrt{2} + 9 \\ = & 2\sqrt{7} - 3\sqrt{2} + 9 // \end{aligned}$$

Tip

Group like surds next to each other then simplify.

7. Rationalising a denominator without simplifying surds first ****

Similar to 1HR – June 2024 (Q17 – 3 marks)

Show that $\frac{6 + 2\sqrt{3}}{3 - \sqrt{3}}$ can be written in the form $a + \sqrt{b}$ where a and b are integers.

$$\frac{6 + 2\sqrt{3}}{3 - \sqrt{3}}$$

Tip

The goal is to remove any surd in the denominator by rationalising. **Don't worry about the surd in the numerator** and **if it is in your final answer.**

$$= \frac{6 + 2\sqrt{3}}{3 - \sqrt{3}} \times \frac{3 + \sqrt{3}}{3 + \sqrt{3}}$$

$$= \frac{(6 + 2\sqrt{3})(3 + \sqrt{3})}{(3 - \sqrt{3})(3 + \sqrt{3})}$$

$$= \frac{6(3) + 6(\sqrt{3}) + 2\sqrt{3}(3) + 2\sqrt{3}(\sqrt{3})}{(3)^2 - (\sqrt{3})^2}$$

Tip

When multiplying the denominators, we can use the **rule $(a - b)(a + b) = a^2 - b^2$** to speed up the process.

$$= \frac{18 + 6\sqrt{3} + 6\sqrt{3} + 2(3)}{9 - 3}$$

$$= \frac{18 + 12\sqrt{3} + 6}{6}$$

$$= \frac{24 + 12\sqrt{3}}{6}$$

Tip

You **MUST** factorise an expression whenever possible.

$$= \frac{12(2 + \sqrt{3})}{6}$$

$$= \frac{2 \cdot 12(2 + \sqrt{3})}{6}$$

$$= 4 + 2\sqrt{3}$$

$$= 4 + \sqrt{4} \cdot \sqrt{3}$$

Tip

You **MUST** rewrite 2 as $\sqrt{4}$ because the **answer needs be in the form of $a + \sqrt{b}$.**

$$= 4 + \sqrt{12}$$

This is the hardest part of the question.

How my notes are structured

My notes are **organised by topic and skill**. At the top of each page, you'll find the **specific skill being addressed**. At the end of that skill statement, a series of asterisks indicates **how often the skill appears in the exam** – the more asterisks, the more frequently it is tested.

7. Rationalising a denominator without simplifying surds first ****

My worked examples **mirror real past paper questions**, giving your child **authentic exam practice** every time.

Similar to 1HR – June 2024 (Q17 – 3 marks)

Show that $\frac{6+2\sqrt{3}}{3-\sqrt{3}}$ can be written in the form $a + \sqrt{b}$ where a and b are integers.

$$\begin{aligned} & \frac{6+2\sqrt{3}}{3-\sqrt{3}} \\ = & \frac{6+2\sqrt{3}}{3-\sqrt{3}} \times \frac{3+\sqrt{3}}{3+\sqrt{3}} \\ = & \frac{(6+2\sqrt{3})(3+\sqrt{3})}{(3-\sqrt{3})(3+\sqrt{3})} \\ = & \frac{6(3) + 6(\sqrt{3}) + 2\sqrt{3}(3) + 2\sqrt{3}(\sqrt{3})}{(3)^2 - (\sqrt{3})^2} \\ = & \frac{18 + 6\sqrt{3} + 6\sqrt{3} + 2(3)}{9 - 3} \\ = & \frac{18 + 12\sqrt{3} + 6}{6} \\ = & \frac{24 + 12\sqrt{3}}{6} \\ = & \frac{12(2 + \sqrt{3})}{6} \\ = & \frac{2 \cdot 12(2 + \sqrt{3})}{6} \\ = & 4 + 2\sqrt{3} \\ = & 4 + \sqrt{4} \cdot \sqrt{3} \\ = & 4 + \sqrt{12} \end{aligned}$$

Note
The goal is to remove any surd in the denominator. **Don't worry about the surd in the numerator and if it is in your answer.**

Tip
When multiplying the denominators, we can use the **rule $(a-b)(a+b) = a^2 - b^2$** to speed up the process.

Tip
You **MUST** factorise an expression whenever possible.

Tip
You **MUST** rewrite 2 as $\sqrt{4}$ because the **answer needs to be in the form of $a + \sqrt{b}$** .

This is the hardest part of the question.

My working out is **easy to follow**, with each step laid out clearly.

Tips to help your child avoid common mistakes and reinforce exam techniques.

A sample set of the homework assignment on the topic of Surds

Homework
Topic: Surds

Skill: Multiplying two pairs of brackets with surds ***

1. [MUST]
Similar to 1H – January 2020 (Q17a – 3 marks)

Show that $(2 + 3\sqrt{8})^2 = 4(19 + 6\sqrt{2})$

Homework
Topic: Surds

Skill: Rationalising a denominator without simplifying surds first ****

1. [MUST]

Similar to 1HR – June 2024 (Q17b – 3 marks)

Express $\frac{5}{2 - \sqrt{3}}$ in the form $\sqrt{a} + b$ where a and b are integers.

Homework
Topic: Surds

Skill: Rationalising a denominator by simplifying surds first ***

1. [MUST]

Similar to 2H – January 2023 (Q17 – 3 marks)

Show that $\frac{13 - \sqrt{8}}{1 - \sqrt{2}}$ can be written in the form $a + b\sqrt{2}$ where “a” and “b” are integers.

How my homework is structured

My homework is **organised into sections**, each focused on **one specific skill**. At the end of each skill statement, a series of asterisks indicates **how often the skill appears in the exam** – the more asterisks, the more frequently it is tested.

Homework
Topic: Surds

Skill: Rationalising a denominator by simplifying surds first ***

1. [MUST]

Similar to 2H – January 2023 (Q17 – 3 marks)

Show that $\frac{13 - \sqrt{8}}{1 - \sqrt{2}}$ can be written in the form $a + b\sqrt{2}$ where “a” and “b” are integers.

Each question is marked as either “**MUST**” or “**OPTIONAL**”.
Optional questions are designed for students who wish to extend their learning.

Each question **mirrors real past paper questions**, giving your child **authentic exam practice** every time.

How my homework is structured

Each homework concludes with a **guided reflection**, designed to help your child **track progress, identify strengths and weaknesses** using the traffic light colour-coding system, and **create a targeted study plan** for the exam.

Homework
Topic: Surds

✔ Post Homework Reflection

Review each skill and colour-code it based on your understanding. This step is crucial for identifying weaknesses and building a focussed study plan for your exam.

- Red: You don't understand it at all or find it very challenging.
- Yellow: You struggle with certain aspects or need more practice.
- Green: You understand the skill well and feel confident about it.

Frequency Scale: How frequent the skill appears in the exam

25% of the time	50% of the time	75% of the time	100% of the time
Not frequent	Frequent	Very frequent	Certain to appear

Skill	Colour	Frequency
Writing a surd in simplest form ***		Very frequent
Adding and subtracting surds without simplifying surds first ***		Very frequent
Adding and subtracting surds by simplifying surds first ***		Very frequent
Multiplying surds ***		Very frequent
Multiplying one pair of brackets with surds ***		Very frequent
Multiplying two pairs of brackets with surds ***		Very frequent
Rationalising a denominator without simplifying surds first ****		Certain to appear
Rationalising a denominator by simplifying surds first ***		Very frequent

Tip

- Share your reflection with your friends in our community ⚡
- Harness our community's collective knowledge to support one another 💡