

Indices, Surds and Logarithms

Indices

- $a^m \times a^n = a^{m+n}$
- $a^m \div a^n = a^{m-n}$
- $a^{-n} = \frac{1}{a^n}$
- $\left(\frac{a}{b}\right)^n = \frac{a^n}{b^n}$
- $\left(\frac{a}{b}\right)^{-n} = \left(\frac{b}{a}\right)^n = \frac{1}{a^n/b^n}$
- $\frac{a^m}{a^n} = \frac{a^m \times a^{-n}}{a^{-n} \times a^n} = \frac{a^{m-n}}{a^0}$
- $a^0 = 1$
- $a^{\frac{1}{n}} = \sqrt[n]{a}$
- $a^{\frac{m}{n}} = \sqrt[n]{a^m}$
- $a^m \times b^m = (ab)^m$

Solving by substitution

Express the indices into its component powers before doing the substitution

Example

By using a suitable substitution, solve the following equation:

$$\begin{aligned} 3^{2x+1} + 3^{x-1} &= 1 + 3^x \\ 3^x(3^{x+1}) + 3(3^x) &= 1 + 3^x \\ 17(3^x) + 3(3^x) - 1 &= 0 \end{aligned}$$

Let $y = 3^x$

$$\begin{aligned} 17y^2 + 3y - 1 &= 0 \\ y &= 0.1589 \text{ or } -0.2130 \text{ (N.A.)} \\ \text{(Exponentials are always positive)} \\ 3^x &= 0.1589 \end{aligned}$$

Take 'lg' both sides

$$\begin{aligned} x \lg 3 &= \lg 0.1589 \\ \lg 0.1589 \\ x &= \frac{\lg 0.1589}{\lg 3} = -0.4771 \end{aligned}$$

Surds

Common Laws

$$\begin{aligned} \sqrt{a} \times \sqrt{b} &= \sqrt{ab} \\ \frac{\sqrt{a}}{\sqrt{b}} &= \sqrt{\frac{a}{b}} \\ \sqrt{a} \times \sqrt{b} &= a \\ a\sqrt{b} \times c\sqrt{b} &= ac\sqrt{b} \\ (a + \sqrt{b})(c + \sqrt{d}) &= ac + a\sqrt{d} + c\sqrt{b} + \sqrt{bd} \\ (1 + \sqrt{a})(1 - \sqrt{a}) &= 1^2 - (\sqrt{a})^2 = 1 - a \end{aligned}$$

Rationalising the denominator

To remove the surd from the denominator, multiply the entire fraction by the conjugate surd

Example:

$$\begin{aligned} \frac{3}{4 - 2\sqrt{6}} &= \frac{3}{4 - 2\sqrt{6}} \times \frac{4 + 2\sqrt{6}}{4 + 2\sqrt{6}} \\ &= \frac{12 + 6\sqrt{6}}{4^2 - (2\sqrt{6})^2} \\ &= \frac{6(2 + \sqrt{6})}{16 - 24} \\ &= -\frac{3(2 + \sqrt{6})}{4} \end{aligned}$$

Simplifying surds

Split the surd into a square root of a perfect square times another surd

Example:

$$\begin{aligned} \sqrt{100} &= \sqrt{100} \times \sqrt{1} = 10\sqrt{1} \\ \sqrt{700} &= \sqrt{100} \times \sqrt{7} = 10\sqrt{7} \\ \sqrt{125} &= \sqrt{25} \times \sqrt{5} = 5\sqrt{5} \end{aligned}$$

Logarithms

Common Laws

$$\begin{aligned} \log_a b + \log_a c &= \log_a (bc) \\ \log_a b - \log_a c &= \log_a \left(\frac{b}{c}\right) \\ \log_a b^c &= c \log_a b \\ \log_a c &= \frac{\log_b c}{\log_b a} \text{ (b can take any value)} \end{aligned}$$

Converting from log from to index Form

$$\log_a b = c \iff b = a^c$$

Example

$$\log_2 8 = 3 \iff 8 = 2^3$$

Common & Natural logarithms

$$\begin{aligned} \log_{10} a &= \lg a \\ \log_e a &= \ln a \end{aligned}$$

(Use "ln" when there is e, otherwise always use "lg")

Solving Equations

2 scenarios to watch

1. A single log on both sides with the same base

Example

$$\begin{aligned} \log_2(2x + 1) &= \log_2(x - 3) \\ 2x + 1 &= x - 3 \\ -2 - 1 \\ x &= \frac{-3 - 1}{1} = -2 \end{aligned}$$

2. A single log on one side of the equation

Example

$$\begin{aligned} \log_2(2x + 1) &= 2 \\ 2x + 1 &= 2^2 \\ x &= \frac{2^2 - 1}{1} = 4 \end{aligned}$$

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N Colangelo



Indices Surds And Logarithms Equation Mathematics Stack:

The Top Books of the Year Indices Surds And Logarithms Equation Mathematics Stack The year 2023 has witnessed a remarkable surge in literary brilliance, with numerous compelling novels captivating the hearts of readers worldwide. Lets delve into the realm of top-selling books, exploring the fascinating narratives that have enthralled audiences this year.

Indices Surds And Logarithms Equation Mathematics Stack : Colleen Hoover's "It Ends with Us" This poignant tale of love, loss, and resilience has captivated readers with its raw and emotional exploration of domestic abuse. Hoover skillfully weaves a story of hope and healing, reminding us that even in the darkest of times, the human spirit can triumph.

Uncover the Best : Taylor Jenkins Reid's "The Seven Husbands of Evelyn Hugo" This intriguing historical fiction novel unravels the life of Evelyn Hugo, a Hollywood icon who defies expectations and societal norms to pursue her dreams. Reid's compelling storytelling and compelling characters transport readers to a bygone era, immersing them in a world of glamour, ambition, and self-discovery.

Indices Surds And Logarithms Equation Mathematics Stack : Delia Owens' "Where the Crawdads Sing" This evocative coming-of-age story follows Kya Clark, a young woman who grows up alone in the marshes of North Carolina. Owens weaves a tale of resilience, survival, and the transformative power of nature, entrancing readers with its evocative prose and mesmerizing setting.

These top-selling novels represent just a fraction of the literary treasures that have emerged in 2023. Whether you seek tales of romance, adventure, or personal growth, the world of literature offers an abundance of captivating stories waiting to be discovered.

The novel begins with Richard Papen, a bright but troubled young man, arriving at Hampden College. Richard is immediately drawn to the group of students who call themselves the Classics Club. The club is led by Henry Winter, a brilliant and charismatic young man. Henry is obsessed with Greek mythology and philosophy, and he quickly draws Richard into his world. The other members of the Classics Club are equally as fascinating. Bunny Corcoran is a wealthy and spoiled young man who is always looking for a good time. Charles Tavis is a quiet and reserved young man who is deeply in love with Henry. Camilla Macaulay is a beautiful and intelligent young woman who is drawn to the power and danger of the Classics Club. The students are all deeply in love with Morrow, and they are willing to do anything to please him. Morrow is a complex and mysterious figure, and he seems to be manipulating the students for his own purposes. As the students become more involved with Morrow, they begin to commit increasingly dangerous acts.

The Secret History is a brilliant and gripping novel that will keep you guessing until the very end. The novel is a warning tale about the dangers of obsession and the power of evil.

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Table of Contents Indices Surds And Logarithms Equation Mathematics Stack

1. Understanding the eBook Indices Surds And Logarithms Equation Mathematics Stack
 - The Rise of Digital Reading Indices Surds And Logarithms Equation Mathematics Stack
 - Advantages of eBooks Over Traditional Books
2. Identifying Indices Surds And Logarithms Equation Mathematics Stack
 - Exploring Different Genres
 - Considering Fiction vs. Non-Fiction
 - Determining Your Reading Goals
3. Choosing the Right eBook Platform
 - Popular eBook Platforms
 - Features to Look for in an Indices Surds And Logarithms Equation Mathematics Stack
 - User-Friendly Interface
4. Exploring eBook Recommendations from Indices Surds And Logarithms Equation Mathematics Stack
 - Personalized Recommendations
 - Indices Surds And Logarithms Equation Mathematics Stack User Reviews and Ratings
 - Indices Surds And Logarithms Equation Mathematics Stack and Bestseller Lists
5. Accessing Indices Surds And Logarithms Equation Mathematics Stack Free and Paid eBooks
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 - Indices Surds And Logarithms Equation Mathematics Stack eBook Subscription Services
 - Indices Surds And Logarithms Equation Mathematics Stack Budget-Friendly Options
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 - ePub, PDF, MOBI, and More
 - Indices Surds And Logarithms Equation Mathematics Stack Compatibility with Devices
 - Indices Surds And Logarithms Equation Mathematics Stack Enhanced eBook Features
7. Enhancing Your Reading Experience
 - Adjustable Fonts and Text Sizes of Indices Surds And Logarithms Equation Mathematics Stack
 - Highlighting and Note-Taking Indices Surds And Logarithms Equation Mathematics Stack
 - Interactive Elements Indices Surds And Logarithms Equation Mathematics Stack
8. Staying Engaged with Indices Surds And Logarithms Equation Mathematics Stack

- Joining Online Reading Communities
 - Participating in Virtual Book Clubs
 - Following Authors and Publishers Indices Surds And Logarithms Equation Mathematics Stack
9. Balancing eBooks and Physical Books Indices Surds And Logarithms Equation Mathematics Stack
- Benefits of a Digital Library
 - Creating a Diverse Reading Collection Indices Surds And Logarithms Equation Mathematics Stack
10. Overcoming Reading Challenges
- Dealing with Digital Eye Strain
 - Minimizing Distractions
 - Managing Screen Time
11. Cultivating a Reading Routine Indices Surds And Logarithms Equation Mathematics Stack
- Setting Reading Goals Indices Surds And Logarithms Equation Mathematics Stack
 - Carving Out Dedicated Reading Time
12. Sourcing Reliable Information of Indices Surds And Logarithms Equation Mathematics Stack
- Fact-Checking eBook Content of Indices Surds And Logarithms Equation Mathematics Stack
 - Distinguishing Credible Sources
13. Promoting Lifelong Learning
- Utilizing eBooks for Skill Development
 - Exploring Educational eBooks
14. Embracing eBook Trends
- Integration of Multimedia Elements
 - Interactive and Gamified eBooks

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