Surds and Indices

You should be able to:

- simplify surds;
- rationalise denominators;
- multiply and divide using positive, negative and fractional indices;

Simplify Surds

Need to know your square numbers up to 144

a) Simplify $\sqrt{63}$

Same rules as algebra - collect like terms

b) Simplify $\sqrt{6} + 3\sqrt{6} - \sqrt{5} + 2\sqrt{5}$

Rationalise a Denominator

1) Rationalise the denominator of the following: $\frac{2}{\sqrt{14}}$

2) Rationalise the denominator of the following and simplify: $\frac{3}{2\sqrt{5}}$

Multiply/Divide using positive, negative and fractional indices

1. $a^m \times a^n = a^{m+n}$
2. $\frac{a^m}{a^n} = a^{m-n}$
3. $(a^m)^n = a^{m \times n}$
4. $a^0 = 1$
5. $a^{-m} = \frac{1}{a^m}$
6. $a^{\frac{m}{n}} = \sqrt[n]{a^m}$

☆ These must be learned!! ☆

1. Simplify:

(a) $\frac{x^5}{x^3}$ (b) $x^4 \times x^3$ (c) $\frac{x^2 \times x^5}{x^3}$ (d) $\frac{x^{-3} \times x^4}{x^5}$ (e) $5x^3 \times 4x^{\frac{1}{2}}$

2) Remove brackets and simplify

$$a^{\frac{1}{2}}(a^{\frac{1}{2}} - 2).$$

3) Evaluate

$$8^{\frac{2}{3}}.$$

Next Steps:

1. Learn Indices Rules

2. Complete practice questions

3. Try the topic exam questions

4. Past Papers!

Practice Questions - Surds

Q1: Simplify $\sqrt{45}$

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Q2: Simplify $\sqrt{\frac{50}{36}}$

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Q3: Simplify $5\sqrt{5} - 3\sqrt{5} + 2\sqrt{5}$

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Q4: Simplify $\sqrt{2}(3 + 2\sqrt{2})$

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Q5: Rationalise the denominator and simply $\frac{2}{\sqrt{10}}$

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Q6: Simplify $3\sqrt{12}$

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Q7: Simplify $\sqrt{72} - 2\sqrt{2}$

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Q8: Simplify $\frac{\sqrt{8}}{\sqrt{48}}$

.....

Q9: Simplify $(\sqrt{3} + 2)(\sqrt{3} - 1)$

.....

Q10: Rationalise the denominator and simplify $\frac{5\sqrt{2}}{2\sqrt{5}}$

.....

Q11: Rationalise the denominator and simplify $\frac{5}{\sqrt{5}+2}$

.....

Practice Questions - Indices

Q12: Simplify $\frac{a^4 \times a^5}{a^7}$

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Q13: Simplify $(3b^3)^2$

.....

Q14: Simplify, giving your answer with a positive index $\frac{2e^5}{(e^3)^2}$

.....

Q15: Simplify $\frac{6b^{\frac{1}{2}}}{3b^{\frac{1}{2}}}$

.....

Q16: Simplify $16^{\frac{3}{2}}$

.....

Q17: Multiply out the brackets and simplify $y^{\frac{1}{4}}\left(y^{-\frac{1}{4}} + y^{\frac{7}{4}}\right)$

.....

.....

Surds - Exam Questions

1. Express $\sqrt{50}$ as a surd in its simplest form.

2. Simplify $\sqrt{48}-3\sqrt{3}$

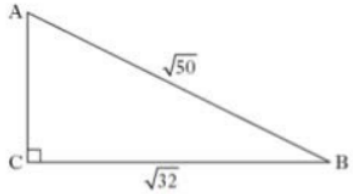
3. Express $\sqrt{32}-\sqrt{2}$ as a surd in its simplest form.

4. Express $\sqrt{72}-\sqrt{2}+\sqrt{50}$ as a surd in its simplest form

5. Simplify

$$\frac{\sqrt{24}}{\sqrt{2}}.$$

11. A right angled triangle has dimensions as shown



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Calculate the length of AC, leaving your answer as a surd **in its simplest form**.

Indices Exam Questions

1. **(a)** Simplify $\frac{7a^3b^2}{a\sqrt{b}}$

   (b) If $a=-1$ and $b=4$, find the value of the expression in part (a

2. Given that $y=2x^{-\frac{2}{3}}$, find y when $x=8$.

3. Simplify $x^{\frac{3}{2}}(x^{\frac{2}{3}}+x^{-\frac{2}{3}})$

4. **(a)** Simplify $\frac{m^5}{m^{-3}}$ **(b)** Evaluate $125^{-\frac{2}{3}}$

5. Express $\frac{p^5\times 8p}{2p^{-3}}$ in its simplest form.

6. Simplify, writing your answer with a positive index: $3a^4\times a^{-6}$

7. Simplify the fraction, giving your answer in positive index form: $\frac{x^3\times x^4}{x^9}$

8. Simplify $\frac{a^2\times a^5}{a^{-3}}$.

9. **(a)** Remove the brackets and simplify: $p^{\frac{1}{2}}(p^{\frac{5}{2}}-2)$.

   (b) Hence, or otherwise, find the value of $p^{\frac{1}{2}}(p^{\frac{5}{2}}-2)$ when $p=4$.

Answers - Surds

Q1: $3\sqrt{5}$

Q2: $\frac{5\sqrt{2}}{6}$

Q3: $4\sqrt{5}$

Q4: $3\sqrt{2} + 4$

Q5: $\frac{\sqrt{10}}{5}$

Q6: $6\sqrt{3}$

Q7: $4\sqrt{2}$

Q8: $\frac{1}{\sqrt{6}}$

Q9: $1 + \sqrt{3}$

Q10: $\frac{\sqrt{10}}{2}$

Q11:

Hint:

- Multiply the numerator and denominator by $\sqrt{5} + 2$

Answer: $5\sqrt{5} + 10$ or $5(\sqrt{5} + 2)$

Answers - Indices

Q12: a^2

Q13: $9b^6$

Q14: $\frac{2}{e}$

Q15: 2

Q16: 64

Q17: $1 + y^2$