Surds & Rationalising Denominators Worksheet

Simplifying Surds, Conjugates & Rationalisation

Reference: Edexcel GCSE 1MA1 / Higher Tier / Paper 1 / Q16

I Do

(a) Rationalise the denominator of $\frac{35}{\sqrt{7}}$. Give your answer in its simplest form.

(b) $\frac{\sqrt{27}-1}{2-\sqrt{3}}$ can be written in the form $a + b\sqrt{3}$ where a and b are integers.
Work out the value of a and the value of b.

(Total for Question 1 is 4 marks)

We Do

(a) Rationalise the denominator of $\frac{24}{\sqrt{6}}$. Give your answer in its simplest form.

(b) $\frac{\sqrt{48}-3}{2-\sqrt{3}}$ can be written in the form $a+b\sqrt{3}$ where a and b are integers.
Work out the value of a and the value of b.

(Total for Question 2 is 4 marks)

You Do

(a) Rationalise the denominator of $\frac{28}{\sqrt{7}}$. Give your answer in its simplest form.

(b) $\frac{\sqrt{75}-2}{2-\sqrt{3}}$ can be written in the form $a+b\sqrt{3}$ where a and b are integers.
Work out the value of a and the value of b.

(Total for Question 3 is 4 marks)

Challenge

Show that $\dfrac{\sqrt{50}+\sqrt{18}}{\sqrt{32}-\sqrt{8}} = 4$. Show clear algebraic working.

(Total for Question 4 is 4 marks)

Answers & Worked Solutions

• **I Do:**

(a) Multiply numerator and denominator by $\sqrt{7}$:

$\frac{35}{\sqrt{7}} \times \frac{\sqrt{7}}{\sqrt{7}} = \frac{35\sqrt{7}}{7} = 5\sqrt{7}$

(b) Simplify $\sqrt{27} = \sqrt{9 \times 3} = 3\sqrt{3}$

Multiply numerator and denominator by conjugate $(2+\sqrt{3})$***:***

$\frac{3\sqrt{3}-1}{2-\sqrt{3}} \times \frac{2+\sqrt{3}}{2+\sqrt{3}} = \frac{(3\sqrt{3}-1)(2+\sqrt{3})}{(2-\sqrt{3})(2+\sqrt{3})}$

Numerator: $6\sqrt{3} + 3(3) - 2 - \sqrt{3} = 7 + 5\sqrt{3}$

Denominator: $2^2 - (\sqrt{3})^2 = 4 - 3 = 1$

Result: $7 + 5\sqrt{3} \implies a = 7,\ b = 5$

• **We Do:**

(a) Multiply numerator and denominator by $\sqrt{6}$:

$\frac{24}{\sqrt{6}} \times \frac{\sqrt{6}}{\sqrt{6}} = \frac{24\sqrt{6}}{6} = 4\sqrt{6}$

(b) Simplify $\sqrt{48} = \sqrt{16 \times 3} = 4\sqrt{3}$

Multiply numerator and denominator by conjugate $(2+\sqrt{3})$***:***

$\frac{4\sqrt{3}-3}{2-\sqrt{3}} \times \frac{2+\sqrt{3}}{2+\sqrt{3}} = \frac{(4\sqrt{3}-3)(2+\sqrt{3})}{4-3}$

Numerator: $8\sqrt{3} + 4(3) - 6 - 3\sqrt{3} = 6 + 5\sqrt{3}$

Result: $6 + 5\sqrt{3} \implies a = 6,\ b = 5$

• **You Do:**

(a) Multiply numerator and denominator by $\sqrt{7}$:

$\frac{28}{\sqrt{7}} \times \frac{\sqrt{7}}{\sqrt{7}} = \frac{28\sqrt{7}}{7} = 4\sqrt{7}$

(b) Simplify $\sqrt{75} = \sqrt{25 \times 3} = 5\sqrt{3}$

Multiply numerator and denominator by conjugate $(2+\sqrt{3})$***:***

$\frac{5\sqrt{3}-2}{2-\sqrt{3}} \times \frac{2+\sqrt{3}}{2+\sqrt{3}} = \frac{(5\sqrt{3}-2)(2+\sqrt{3})}{4-3}$

Numerator: $10\sqrt{3} + 5(3) - 4 - 2\sqrt{3} = 11 + 8\sqrt{3}$

Result: $11 + 8\sqrt{3} \implies a = 11,\ b = 8$

• **Challenge:**

1. Simplify each surd:

$\sqrt{50} = \sqrt{25 \times 2} = 5\sqrt{2}$

$\sqrt{18} = \sqrt{9 \times 2} = 3\sqrt{2}$

$\sqrt{32} = \sqrt{16 \times 2} = 4\sqrt{2}$

$\sqrt{8} = \sqrt{4 \times 2} = 2\sqrt{2}$

2. Substitute into expression:

$\frac{\sqrt{50}+\sqrt{18}}{\sqrt{32}-\sqrt{8}} = \frac{5\sqrt{2}+3\sqrt{2}}{4\sqrt{2}-2\sqrt{2}} = \frac{8\sqrt{2}}{2\sqrt{2}} = 4$ ■