Number & Algebra: Surds & Rationalising Denominators

Practice Worksheet (Edexcel GCSE 1MA1 Nov 2024 1H Style)

I Do

(a) Rationalise the denominator of $\dfrac{15}{\sqrt{5}}$

Give your answer in its simplest form.

(b) Write $\dfrac{\sqrt{75}-2}{1+2\sqrt{3}}$ in the form $\dfrac{a-b\sqrt{3}}{c}$ where a, b and c are integers.

We Do

(a) Rationalise the denominator of $\dfrac{12}{\sqrt{3}}$

Give your answer in its simplest form.

(b) Write $\dfrac{\sqrt{48}-3}{1+3\sqrt{3}}$ in the form $\dfrac{a-b\sqrt{3}}{c}$ where a, b and c are integers.

You Do

(a) Rationalise the denominator of $\frac{18}{\sqrt{6}}$

Give your answer in its simplest form.

(b) Write $\frac{\sqrt{108}-4}{1+2\sqrt{3}}$ in the form $\frac{a-b\sqrt{3}}{c}$ where a, b and c are integers.

Challenge

(a) Rationalise and simplify $\dfrac{24}{\sqrt{8}}$

(b) Write $\dfrac{2\sqrt{50}-3}{2-3\sqrt{2}}$ in the form $\dfrac{a+b\sqrt{2}}{c}$ where a, b and c are integers.

Answers & Worked Solutions

- **I Do:**
  (a) $\frac{15}{\sqrt{5}} \times \frac{\sqrt{5}}{\sqrt{5}} = \frac{15\sqrt{5}}{5} = \mathbf{3\sqrt{5}}$.
  (b) Simplify $\sqrt{75} = \sqrt{25 \times 3} = 5\sqrt{3}$.
  Multiply numerator and denominator by conjugate $(1 - 2\sqrt{3})$:

$$\text{Denominator} = (1 + 2\sqrt{3})(1 - 2\sqrt{3}) = 1 - 4(3) = -11$$

$$\text{Numerator} = (5\sqrt{3} - 2)(1 - 2\sqrt{3}) = 5\sqrt{3} - 30 - 2 + 4\sqrt{3} = -32 + 9\sqrt{3}$$

$$\text{Fraction} = \frac{-32 + 9\sqrt{3}}{-11} = \frac{\mathbf{32 - 9\sqrt{3}}}{\mathbf{11}} \quad (a = 32, b = 9, c = 11)$$

- **We Do:**
  (a) $\frac{12}{\sqrt{3}} \times \frac{\sqrt{3}}{\sqrt{3}} = \frac{12\sqrt{3}}{3} = \mathbf{4\sqrt{3}}$.
  (b) $\sqrt{48} = 4\sqrt{3}$.
  Multiply by $(1 - 3\sqrt{3})$:

$$\text{Denominator} = (1 + 3\sqrt{3})(1 - 3\sqrt{3}) = 1 - 27 = -26$$

$$\text{Numerator} = (4\sqrt{3} - 3)(1 - 3\sqrt{3}) = 4\sqrt{3} - 36 - 3 + 9\sqrt{3} = -39 + 13\sqrt{3}$$

$$\text{Fraction} = \frac{-39 + 13\sqrt{3}}{-26} = \frac{\mathbf{39 - 13\sqrt{3}}}{\mathbf{26}} \quad \left(\text{or } \frac{\mathbf{3 - \sqrt{3}}}{\mathbf{2}}\right)$$

- **You Do:**
  (a) $\frac{18}{\sqrt{6}} \times \frac{\sqrt{6}}{\sqrt{6}} = \frac{18\sqrt{6}}{6} = \mathbf{3\sqrt{6}}$.
  (b) $\sqrt{108} = 6\sqrt{3}$.
  Multiply by $(1 - 2\sqrt{3})$:

$$\text{Denominator} = (1 + 2\sqrt{3})(1 - 2\sqrt{3}) = 1 - 12 = -11$$

$$\text{Numerator} = (6\sqrt{3} - 4)(1 - 2\sqrt{3}) = 6\sqrt{3} - 36 - 4 + 8\sqrt{3} = -40 + 14\sqrt{3}$$

$$\text{Fraction} = \frac{-40 + 14\sqrt{3}}{-11} = \frac{\mathbf{40 - 14\sqrt{3}}}{\mathbf{11}} \quad (a = 40, b = 14, c = 11)$$

- **Challenge:**
  (a) $\frac{24}{\sqrt{8}} = \frac{24}{2\sqrt{2}} = \frac{12}{\sqrt{2}} \times \frac{\sqrt{2}}{\sqrt{2}} = \frac{12\sqrt{2}}{2} = \mathbf{6\sqrt{2}}$.
  (b) $2\sqrt{50} = 2(5\sqrt{2}) = 10\sqrt{2}$.
  Multiply by conjugate $(2 + 3\sqrt{2})$:

$$\text{Denominator} = (2 - 3\sqrt{2})(2 + 3\sqrt{2}) = 4 - 18 = -14$$

$$\text{Numerator} = (10\sqrt{2} - 3)(2 + 3\sqrt{2}) = 20\sqrt{2} + 60 - 6 - 9\sqrt{2} = 54 + 11\sqrt{2}$$

$$\text{Fraction} = \frac{54 + 11\sqrt{2}}{-14} = \frac{\mathbf{-54 - 11\sqrt{2}}}{\mathbf{14}}$$