# Outcome 2 – Rationalising the Denominator

Bronze examples…

Examples… $\sqrt{ab} = \sqrt{a} \times \sqrt{b}$

Express the following with a rational denominator.

$$\frac{1}{\sqrt{3}} \times \frac{\sqrt{3}}{\sqrt{3}} = \frac{\sqrt{3}}{3}$$

**Multiply top and bottom by the square root!**

$$\frac{2}{\sqrt{5}} \times \frac{\sqrt{5}}{\sqrt{5}} = \frac{2\sqrt{5}}{5}$$

N.B. $\sqrt{3} \times \sqrt{3} = \sqrt{9} = 3$

Silver examples

Examples…

Express the following with a rational denominator and simplify if required.

**Don't forget to simplify!**

$$\frac{3}{\sqrt{6}} \times \frac{\sqrt{6}}{\sqrt{6}} = \frac{3\sqrt{6}}{6} \div 3 = \frac{\sqrt{6}}{2}$$

$$\frac{10}{\sqrt{5}} \times \frac{\sqrt{5}}{\sqrt{5}} = \frac{10\sqrt{5}}{5} \div 5 = 2\sqrt{5}$$

Gold example

Examples… $\sqrt{a} \times \sqrt{b} = \sqrt{ab}$

Express the following with a rational denominator.

$$\frac{11}{3+\sqrt{5}} \times \frac{(3-\sqrt{5})}{(3-\sqrt{5})} = \frac{11(3-\sqrt{5})}{4}$$

**Multiply by the complex conjugate!**

$(3-\sqrt{5}) \times (3+\sqrt{5})$
$= 9 + 3\sqrt{5} - 3\sqrt{5} - 5 = 4$

## Bronze Questions

Express each of the following with rational denominators…

1. $\frac{1}{\sqrt{2}}$
2. $\frac{1}{\sqrt{7}}$
3. $\frac{1}{\sqrt{13}}$
4. $\frac{1}{\sqrt{6}}$
5. $\frac{2}{\sqrt{3}}$
6. $\frac{5}{\sqrt{11}}$
7. $\frac{3}{\sqrt{10}}$
8. $\frac{4}{\sqrt{15}}$

## Silver Questions

Express each of the following with rational denominators and simplify if required…

1. $\frac{9}{\sqrt{3}}$
2. $\frac{8}{\sqrt{6}}$
3. $\frac{5}{\sqrt{15}}$
4. $\frac{44}{\sqrt{11}}$
5. $\frac{10}{\sqrt{5}}$
6. $\frac{26}{\sqrt{13}}$
7. $\frac{6}{\sqrt{2}}$
8. $\frac{20}{\sqrt{15}}$

## Gold Questions

Express each of the following with rational denominators…

1. $\frac{5}{7+\sqrt{3}}$
2. $\frac{19}{5+\sqrt{2}}$
3. $\frac{12}{4+\sqrt{5}}$
4. $\frac{7}{3-\sqrt{3}}$
5. $\frac{13}{5-\sqrt{11}}$
6. $\frac{1}{6+\sqrt{3}}$
7. $\frac{18}{6-\sqrt{2}}$
8. $\frac{8}{10+\sqrt{3}}$

## Bronze Answers

1. $\sqrt{2}/2$
2. $\sqrt{7}/7$
3. $\sqrt{13}/13$
4. $\sqrt{6}/6$
5. $2\sqrt{3}/3$
6. $5\sqrt{11}/11$
7. $3\sqrt{10}/10$
8. $4\sqrt{15}/15$

## Silver Answers

1. $3\sqrt{3}$
2. $4\sqrt{6}/3$
3. $\sqrt{15}/3$
4. $4\sqrt{11}$
5. $2\sqrt{5}$
6. $2\sqrt{13}$
7. $3\sqrt{2}$
8. $4\sqrt{15}/3$

## Gold Answers

1. $7(5 - \sqrt{3})/46$
2. $19(5 - \sqrt{2})/23$
3. $12(4 - \sqrt{5})/11$
4. $7(3 + \sqrt{3})/6$
5. $13(5 + \sqrt{11})/14$
6. $(6 - \sqrt{3})/33$
7. $9(6 + \sqrt{2})/17$
8. $8(10 - \sqrt{3})/97$