# Surds

**Starter**

1. **(Review of last lesson)**
   Without a calculator, evaluate: (a) $32^{\frac{2}{5}}$ (b) $64^{-\frac{5}{6}}$

2. **(Review of last lesson)** Find integers $x$ and $y$ such that $4^x \times 3^y = 24^8$.

3. **(Review of GCSE material)**
   Simplify: (a) $\sqrt{28}$ (b) $(4+\sqrt{5})(3-\sqrt{5})$
   (c) $\dfrac{4}{\sqrt{2}}$ (d) $\dfrac{4}{2+\sqrt{3}}$

**Notes**

Simplifying surds — find the highest square number that is a factor.

***E.g. 1*** Simplify $\sqrt{48}$.

***Rationalising the denominator***

Type I: $\sqrt{a}$ is in the denominator — multiply by $\dfrac{\sqrt{a}}{\sqrt{a}}$

Type II: $p \pm \sqrt{q}$ is in the denominator — multiply by $\dfrac{p \mp \sqrt{q}}{p \mp \sqrt{q}}$ ***change the sign***

Type II: $\sqrt{x} \pm \sqrt{y}$ is in the denominator — multiply by $\dfrac{\sqrt{x} \mp \sqrt{y}}{\sqrt{x} \mp \sqrt{y}}$ ***change the sign***

***N.B.*** If there is a number in front of the surd, it does not need to be included in the multiplying term

***E.g. 2*** Simplify: (a) $\dfrac{7}{\sqrt{3}}$ (b) $\dfrac{18}{5\sqrt{6}}$

***Working:*** (a) $\dfrac{7}{\sqrt{3}} = \dfrac{7}{\sqrt{3}} \times \dfrac{\sqrt{3}}{\sqrt{3}} = \dfrac{7\sqrt{3}}{3}$ $\sqrt{3} \times \sqrt{3} = 3$

***E.g. 3*** Simplify: (a) $\dfrac{1}{\sqrt{7}-2}$ (b) $\dfrac{2\sqrt{3}-1}{4-\sqrt{3}}$

***Working:*** (a)
$$\frac{1}{\sqrt{7}-2} = \frac{1}{\sqrt{7}-2} \times \frac{\sqrt{7}+2}{\sqrt{7}+2}$$
$$= \frac{\sqrt{7}+2}{7-4} \qquad \textit{the } 2\sqrt{7} \textit{ and } -2\sqrt{7} \textit{ terms cancel}$$
$$= \frac{\sqrt{7}+2}{3}$$

***E.g. 4*** Simplify: (a) $\dfrac{8}{\sqrt{21}+\sqrt{7}}$ (b)* $\dfrac{\sqrt{2}}{\sqrt{3}(\sqrt{5}-\sqrt{2})}$

Video: Multiplying surds
Video: Rationalising surds

Solutions to Starter and E.g.s

**Exercise**
p22 2B Qu 1-4ac(i), 5-12

**Summary**
Rationalising the denominator:

Type I: $\sqrt{a}$ is in the denominator — multiply by $\dfrac{\sqrt{a}}{\sqrt{a}}$

Type II: $p \pm \sqrt{q}$ is in the denominator — multiply by $\dfrac{p \mp \sqrt{q}}{p \mp \sqrt{q}}$ *change the sign*

Type II: $\sqrt{x} \pm \sqrt{y}$ is in the denominator — multiply by $\dfrac{\sqrt{x} \mp \sqrt{y}}{\sqrt{x} \mp \sqrt{y}}$ *change the sign*