ADDING AND SUBTRACTING SURDS

Surds of the same kind can be added or subtracted just like pronumerals, using the distributive law to collect like terms: $ab + ac = a(b + c)$.

You can only add and subtract like-algebraic terms, such as $2a + 3a - a = 4a$

Similarly, you can only add and subtract like-surds, such as $2\sqrt{2} + 3\sqrt{2} = 5\sqrt{2}$

It may be necessary to first simplify the surd terms by removing perfect square factors.

Example 17

Simplify each expression by collecting like terms.

(a) $2\sqrt{3}+5\sqrt{3}$ **(b)** $4\sqrt{10}-\sqrt{10}$ **(c)** $3\sqrt{6}+4\sqrt{6}-\sqrt{5}$ **(d)** $3\sqrt{5}+4\sqrt{7}+2\sqrt{5}-6\sqrt{7}$

Solution

(a) $2\sqrt{3}+5\sqrt{3}=(2+5)\sqrt{3}=7\sqrt{3}$

(b) $4\sqrt{10}-\sqrt{10}=(4-1)\sqrt{10}=3\sqrt{10}$

(c) $3\sqrt{6}+4\sqrt{6}-\sqrt{5}=7\sqrt{6}-\sqrt{5}$

(d) $3\sqrt{5}+4\sqrt{7}+2\sqrt{5}-6\sqrt{7}=5\sqrt{5}-2\sqrt{7}$

In parts **(c)** and **(d)** the different surds cannot be combined into a single term.

Example 18

Simplify:

(a) $\sqrt{8}-\sqrt{18}+\sqrt{50}$ **(b)** $5\sqrt{3}+\sqrt{20}-2\sqrt{12}+\sqrt{45}$

Solution

Where possible, simplify each term before attempting to add or subtract the surds.

(a)
$\sqrt{8}-\sqrt{18}+\sqrt{50}$
$=\sqrt{4\times2}-\sqrt{9\times2}+\sqrt{25\times2}$
$=2\sqrt{2}-3\sqrt{2}+5\sqrt{2}$
$=4\sqrt{2}$

(b)
$5\sqrt{3}+\sqrt{20}-2\sqrt{12}+\sqrt{45}$
$=5\sqrt{3}+2\sqrt{5}-4\sqrt{3}+3\sqrt{5}$
$=\sqrt{3}+5\sqrt{5}$