Surds - Lesson 1

Simplifying Surds 1 - Multiplication Rule

LI

- Know what a Surd is.
- Simplify a single surd.
- Add and subtract surds.

SC

- 1st Rule of Surds.
- Factorising numbers.
- Prime numbers.
- Square numbers.
- Collecting like terms.

A surd is a root of a number that cannot be written as a fraction

Examples

$\sqrt{2}$ $\sqrt[3]{7}$

$\sqrt{3}$ $\sqrt[5]{2}$

Non-Examples

$\sqrt{4}$

$\sqrt[3]{8}$

Guide to Simplifying a Single Surd

Simplifying a single surd involves factorisation; important facts :

- The square root of any prime number is a surd.
- The square root of any whole square number is a whole number.

When factorising a single surd, look for square or whole numbers

Simplifying a Single Surd

1st Rule of Surds

$$\sqrt{a \times b} = \sqrt{a} \times \sqrt{b}$$

Why factorise ? Why not add or subtract ?

$$\sqrt{9 + 16} = \sqrt{25} = 5$$

$$\sqrt{9} + \sqrt{16} = 3 + 4 = 7$$

Common Mistake 1

$$\sqrt{a + b} = \sqrt{a} + \sqrt{b}$$

Similarly,

Common Mistake 2

$$\sqrt{a - b} = \sqrt{a} - \sqrt{b}$$

Example 1

Simplify fully :

$$\sqrt{20} = \sqrt{4 \times 5}$$

$$= \sqrt{4} \times \sqrt{5}$$

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

$$= \boxed{2\sqrt{5}}$$

Example 2

Simplify fully :

$$\sqrt{98} = \sqrt{2 \times 49}$$

$$= \sqrt{2} \times \sqrt{49}$$

$$= \sqrt{2} \times 7$$

$$= \boxed{7\sqrt{2}}$$

Example 3

Simplify fully :

$$\sqrt{48} = \sqrt{4 \times 12}$$

$$= \sqrt{4} \times \sqrt{12}$$

$$= 2 \times \sqrt{4 \times 3}$$

$$= 2 \times \sqrt{4} \times \sqrt{3}$$

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

$$= \boxed{4\sqrt{3}}$$

Find a quicker way of doing this question by factorising 48 differently

Adding and Subtracting Surds

Surds are added and subtracted just like collecting like terms in algebra

<u>Reminders</u>

- $6x + 3x - x = 8x$.
- $5x + 8y - 9x - y = -4x + 7y$.

Example 4

Simplify fully :

$$9\sqrt{2} + 7\sqrt{2} - \sqrt{2}$$

$$= \boxed{15\sqrt{2}}$$

Example 5

Simplify fully :

$$3\sqrt{5} + \sqrt{20} - \sqrt{5}$$

$$= 3\sqrt{5} + 2\sqrt{5} - \sqrt{5}$$

$$= \boxed{4\sqrt{5}}$$

Example 6

Simplify fully :

$$4\sqrt{6} - \sqrt{2} - 2\sqrt{6} + 8\sqrt{2}$$

$$= \boxed{2\sqrt{6} + 7\sqrt{2}}$$

'Collect like surds'

Questions

1) Simplify each of the following.

a $3\sqrt{5} + 7\sqrt{5}$ b $6\sqrt{2} - 5\sqrt{2}$ c $9\sqrt{7} - 4\sqrt{7}$

d $\sqrt{3} + 8\sqrt{3}$ e $3\sqrt{11} - 5\sqrt{11}$ f $\sqrt{2} + 4\sqrt{3} - 5\sqrt{2}$

g $16\sqrt{5} - 3\sqrt{10} - 7\sqrt{5}$ h $4\sqrt{3} + \sqrt{3} - 6\sqrt{3}$ i $5\sqrt{2} + 3\sqrt{3} - 3\sqrt{2} + 8\sqrt{3}$

2) Express each of the following in its simplest form.

a $\sqrt{24}$ b $\sqrt{500}$ c $\sqrt{32}$ d $\sqrt{75}$

e $\sqrt{1000}$ f $3\sqrt{8}$ g $6\sqrt{12}$ h $5\sqrt{50}$

3) Simplify each of the following.

a $5\sqrt{2} + \sqrt{12}$ b $\sqrt{50} - 6\sqrt{2}$ c $3\sqrt{7} + \sqrt{98}$

d $\sqrt{27} - 4\sqrt{3}$ e $\sqrt{125} + 3\sqrt{5}$ f $\sqrt{112} - \sqrt{28}$

g $\sqrt{8} - 3\sqrt{32}$ h $3\sqrt{48} + 2\sqrt{75}$ i $6\sqrt{4} - 4\sqrt{9}$

Answers

1)	a	$10\sqrt{5}$	2)	a	$2\sqrt{6}$	3)	a	$5\sqrt{2} + 2\sqrt{3}$
	b	$\sqrt{2}$		b	$10\sqrt{5}$		b	$-\sqrt{2}$
	c	$5\sqrt{7}$		c	$4\sqrt{2}$		c	$3\sqrt{7} + 7\sqrt{2}$
	d	$9\sqrt{3}$		d	$5\sqrt{3}$		d	$-\sqrt{3}$
	e	$-2\sqrt{11}$		e	$10\sqrt{10}$		e	$8\sqrt{5}$
	f	$4\sqrt{3} - 4\sqrt{2}$		f	$6\sqrt{2}$		f	$2\sqrt{7}$
	g	$9\sqrt{5} - 3\sqrt{10}$		g	$12\sqrt{3}$		g	$-10\sqrt{2}$
	h	$-\sqrt{3}$		h	$25\sqrt{2}$		h	$22\sqrt{3}$
	i	$2\sqrt{2} + 11\sqrt{3}$					i	0