

Surds - Lesson 1

Simplifying Surds 1 - Multiplication Rule

LI

- Know what a Surd is.
- Simplify surds using the 1st Rule of Surds.

SC

- Factorising numbers.

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

$$\sqrt{4}$$

$$\sqrt[3]{8}$$

The square root of any prime number is a surd

When simplifying surds, try to get square roots of prime numbers

This involves factorising numbers; look for square numbers

Simplifying Surds by Factorising Only

1st Rule of Surds :

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

Example 1

Simplify fully :

$$\begin{aligned} \sqrt{20} &= \sqrt{4 \times 5} \\ &= \sqrt{4} \times \sqrt{5} \\ &= 2 \times \sqrt{5} \\ &= 2\sqrt{5} \end{aligned}$$

Example 2

Simplify fully :

$$\begin{aligned} \sqrt{98} &= \sqrt{2 \times 49} \\ &= \sqrt{2} \times \sqrt{49} \\ &= \sqrt{2} \times 7 \\ &= 7\sqrt{2} \end{aligned}$$

Example 3

Simplify fully :

$$\begin{aligned} \sqrt{48} &= \sqrt{4 \times 12} \\ &= \sqrt{4} \times \sqrt{12} \\ &= 2 \times \sqrt{4 \times 3} \\ &= 2 \times \sqrt{4} \times \sqrt{3} \\ &= 2 \times 2 \times \sqrt{3} \\ &= 4\sqrt{3} \end{aligned}$$

Adding and Subtracting Surds

Example 4

Simplify fully :

$$9\sqrt{2} + 7\sqrt{2} - \sqrt{2}$$
$$= 15\sqrt{2}$$

Example 5

Simplify fully :

$$3\sqrt{5} + \sqrt{20} - \sqrt{5}$$
$$= 3\sqrt{5} + 2\sqrt{5} - \sqrt{5}$$
$$= 4\sqrt{5}$$

Example 6

Simplify fully :

$$4\sqrt{6} - \sqrt{2} - 2\sqrt{6} + 8\sqrt{2}$$
$$= 2\sqrt{6} + 7\sqrt{2}$$

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 | $10\sqrt{5}$ |
| | b | $\sqrt{2}$ |
| | c | $5\sqrt{7}$ |
| | d | $9\sqrt{3}$ |
| | e | $-2\sqrt{11}$ |
| | f | $4\sqrt{3} - 4\sqrt{2}$ |
| | g | $9\sqrt{5} - 3\sqrt{10}$ |
| | h | $-\sqrt{3}$ |
| | i | $2\sqrt{2} + 11\sqrt{3}$ |

| | | |
|-----------|----------|---------------|
| 2) | a | $2\sqrt{6}$ |
| | b | $10\sqrt{5}$ |
| | c | $4\sqrt{2}$ |
| | d | $5\sqrt{3}$ |
| | e | $10\sqrt{10}$ |
| | f | $6\sqrt{2}$ |
| | g | $12\sqrt{3}$ |
| | h | $25\sqrt{2}$ |

| | | |
|-----------|----------|-------------------------|
| 3) | a | $5\sqrt{2} + 2\sqrt{3}$ |
| | b | $-\sqrt{2}$ |
| | c | $3\sqrt{7} + 7\sqrt{2}$ |
| | d | $-\sqrt{3}$ |
| | e | $8\sqrt{5}$ |
| | f | $2\sqrt{7}$ |
| | g | $-10\sqrt{2}$ |
| | h | $22\sqrt{3}$ |
| | i | 0 |