LESSON PLAN

Subject: Mathematics

Topic: Simplifying surds

Age of students: 15-16

Language level: B1-B2

Time: 45 minutes

Content aims:

After completing the lesson, the student will be able to:

Define the square root.

Simplify expressions containing surds.

Simplify surds with and without using calculator.

Use surds properly.

Language aims:

After completing the lesson, the student will be able to:

Use new vocabulary within the topics.

Interpret and communicate mathematics in a variety of forms.

Content-obligatory language	Content-compatible language
Square root, surd, factor Whole number Square number Radicals Prime factors	To simplify To factor To break out of Product, equal As small as possible

Procedure

1. Students are working in 4-5 persons group. They are working with worksheet_1 (Problem 1) . After 5 minutes they are showing results in front of the whole class.

Put following numbers into a calculator. Find two pairs of numbers which are almost the same.

Group I	$2\sqrt{7}$; $\sqrt{2}$; $\sqrt{45}$; $\sqrt{28}$; $3\sqrt{5}$
Group II	$\sqrt{3}$; $3\sqrt{5}$; $\sqrt{45}$; $\sqrt{12}$; $2\sqrt{3}$
Group III	$2\sqrt{3}$; $\sqrt{5}$; $\sqrt{18}$; $\sqrt{12}$; $3\sqrt{2}$
Group IV	$\sqrt{7}$; $3\sqrt{2}$; $\sqrt{75}$; $\sqrt{18}$; $5\sqrt{3}$
Group V	$\sqrt{11}$; $7\sqrt{2}$; $5\sqrt{3}$; $\sqrt{75}$; $\sqrt{98}$
Group VI	$\sqrt{10}$; $7\sqrt{2}$; $\sqrt{98}$; $\sqrt{45}$; $3\sqrt{5}$

Why

$2\sqrt{7} = \sqrt{28}$; $3\sqrt{5} = \sqrt{45}$; $2\sqrt{3} = \sqrt{12}$; $3\sqrt{2} = \sqrt{18}$; $5\sqrt{3} = \sqrt{75}$; $7\sqrt{2} = \sqrt{98}$?

Volunteers write examples on board:

$\sqrt{28} = \sqrt{4 \cdot 7} = \sqrt{4} \cdot \sqrt{7} = 2\sqrt{7}$

$\sqrt{45} = \cdots$

$\sqrt{12} = \cdots$

$\sqrt{18} = \cdots$

$\sqrt{75} = \cdots$

$\sqrt{98} = \cdots$

2.. During simplifying surds we use the rule : $\sqrt{\boldsymbol{a \cdot b}} = \sqrt{\boldsymbol{a}} \cdot \sqrt{\boldsymbol{b}}$

For example: $\sqrt{72} = \sqrt{36 \cdot 2} = 6\sqrt{2}$

72 has the square factor 36. And the square root of 36 times 2 is equal to the square root of 36 times the square root of 2.

Individual work with worksheet_1 (Problem 2)

Try to fill gaps in the following rule:

The square ……. of a product is …….. to the ……. of the square roots of each …….

You should use words: product , root, equal, factor.

3.. Simplifying surds is useful when we want to add them as like terms:

$\sqrt{72}+\sqrt{18}+3\sqrt{50}$= ?

Firstly try to write all numbers as a "square number" x any integer:

Remember: An integer is just a positive or negative whole number including 0.

Here it is 2:

$\sqrt{72}+\sqrt{18}+3\sqrt{50}=\sqrt{36\cdot 2}+\sqrt{9\cdot 2}+3\sqrt{25\cdot 2}$

The square root of a square number simplifies:

$\sqrt{72}+\sqrt{18}+\sqrt{50}$=$6\sqrt{2}+3\sqrt{2}+15\sqrt{2}=24\sqrt{2}$

Therefore: $\sqrt{72}+\sqrt{18}+3\sqrt{50}=24\sqrt{2}$

4.. Pair work with worksheet_2 (Problem 3).

Express the following in the form $\sqrt{b}$, where *a* and *b* are integers and *b* as small as possible.

Remember: To add two or more surds, you will need to make sure the $\sqrt{b}$ bit is the same in each term.

a) $\sqrt{24}+\sqrt{180}-2\sqrt{54}$
b) $3\sqrt{50}-4\sqrt{18}+7\sqrt{2}$
c) $2\sqrt{27}+3\sqrt{2}-2\sqrt{3}+\sqrt{98}$
d) $\frac{1}{2}\sqrt{500}+2\sqrt{11}-\sqrt{242}+\sqrt{125}$

5. Individual work of students.

Read the text below. Do you like this method of remembering how to simplify surds ?

" Jail breaking is a method I use to remember how to simplify radicals. What do we do with radicals ? We send them to jail. What do they want to do ? Break out of jail. So the first step in breaking out of jail is to break the prison population into its cliques (prime factors),

because jailbirds only trust their own. If they are going out of jail (a square-root prison), two numbers need to work together. As one number goes over the top, it distracts the guards and gets shot. As this is happening, the other number tunnels free.

$$\sqrt{180} = \sqrt{2 \cdot 2 \cdot 3 \cdot 3 \cdot 5} = 2 \cdot 3 \cdot \sqrt{5} = 6\sqrt{5}$$

So, in our example, a 2 and 3 die as they try to go over the top, but their buddies make it through to the outside. The 5 gets left kicking its heels in jail because it has no partner to distract the guards." (Michael Willers "The Bedside Book of Algebra")

6. Homework: Worksheet_3

1) Simplify the following:

$\sqrt{108};\ \sqrt{40};\ \sqrt{150};\ \sqrt{63};\ 2\sqrt{24};\ 3\sqrt{48};\ 5\sqrt{147}$

2) Express the following in the form $\sqrt{b}$, where *a* and *b* are integers and *b* as small as possible.

a) $2\sqrt{3} + \sqrt{90} - \sqrt{10} + \sqrt{27}$

b) $3\sqrt{5} + \sqrt{125} - \sqrt{80}$

c) $\sqrt{18} + \sqrt{98} - 4\sqrt{50}$

Worksheet_1 (group I)

Problem 1

Put following numbers into a calculator. Find two pairs of numbers which are almost the same.

$2\sqrt{7}$

$\sqrt{2}$

$\sqrt{45}$

$\sqrt{28}$

$3\sqrt{5}$

Problem 2

Try to fill gaps in the following rule:

The square ……. of a product is …….. to the ……. of the square roots of each …….

You should use words: product , root, equal, factor.

Worksheet_1 (group II)

Problem 1

Put following numbers into a calculator. Find two pairs of numbers which are almost the same.

$\sqrt{3}$

$3\sqrt{5}$

$\sqrt{45}$

$\sqrt{12}$

$2\sqrt{3}$

Problem 2

Try to fill gaps in the following rule:

The square ……. of a product is …….. to the ……. of the square roots of each …….

You should use words: product , root, equal, factor.

Worksheet_1 (group III)

Problem 1

Put following numbers into a calculator. Find two pairs of numbers which are almost the same.

$2\sqrt{3}$

$\sqrt{5}$

$\sqrt{18}$

$\sqrt{12}$

$3\sqrt{2}$

Problem 2

Try to fill gaps in the following rule:

The square ……. of a product is …….. to the ……. of the square roots of each …….

You should use words: product , root, equal, factor.

Worksheet_1 (group IV)

Problem 1

Put following numbers into a calculator. Find two pairs of numbers which are almost the same.

$\sqrt{7}$

$3\sqrt{2}$

$\sqrt{75}$

$\sqrt{18}$

$5\sqrt{3}$

Problem 2

Try to fill gaps in the following rule:

The square ……. of a product is …….. to the ……. of the square roots of each …….

You should use words: product , root, equal, factor.

Worksheet_1 (group V)

Problem 1

Put following numbers into a calculator. Find two pairs of numbers which are almost the same.

$\sqrt{11}$

$7\sqrt{2}$

$5\sqrt{3}$

$\sqrt{75}$

$\sqrt{98}$

Problem 2

Try to fill gaps in the following rule:

The square ……. of a product is …….. to the ……. of the square roots of each …….

You should use words: product , root, equal, factor.

Worksheet_1 (group VI)

Problem 1

Put following numbers into a calculator. Find two pairs of numbers which are almost the same.

$\sqrt{10}$

$7\sqrt{2}$

$\sqrt{98}$

$\sqrt{45}$

$3\sqrt{5}$

Problem 2

Try to fill gaps in the following rule:

The square ……. of a product is …….. to the ……. of the square roots of each …….

You should use words: product , root, equal, factor.

Worksheet_2

Problem 3

Express the following in the form $\sqrt{b}$, where *a* and *b* are integers and *b* as small as possible.

Remember: To add two or more surds, you will need to make sure the $\sqrt{b}$ bit is the same in each term.

a) $\sqrt{24} + \sqrt{180} - 2\sqrt{54} =$

b) $3\sqrt{50} - 4\sqrt{18} + 7\sqrt{2} =$

c) $2\sqrt{27} + 3\sqrt{2} - 2\sqrt{3} + \sqrt{98} =$

d) $\frac{1}{2}\sqrt{500} + 2\sqrt{11} - \sqrt{242} + \sqrt{125} =$

Worksheet_3

Homework

1) Simplify the following:

$\sqrt{108} =$

$\sqrt{40} =$

$\sqrt{150} =$

$\sqrt{63} =$

$2\sqrt{24} =$

$3\sqrt{48} =$

$5\sqrt{147} =$

2) Express the following in the form $\sqrt{b}$, where *a* and *b* are integers and *b* as small as possible.

a) $2\sqrt{3} + \sqrt{90} - \sqrt{10} + \sqrt{27} =$

b) $3\sqrt{5} + \sqrt{125} - \sqrt{80} =$

c) $\sqrt{18} + \sqrt{98} - 4\sqrt{50} =$