

## LESSON PLAN

**Subject:** Mathematics

**Topic:** Power properties

**Age of students:** 16

**Language level:** B1, B2

**Time:** 45 min

**Contents aims:**

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

Describe power properties.

Identify different power properties.

Simplify different expressions.

Apply skills to solve practical tasks.

**Language aims:**

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

Use new vocabulary within the topic.

Interpret and communicate mathematics.

Discuss his or hers point of view on different mathematic problems.

**Pre-requisites:**

- Power properties;
- Simplifying expressions.

**Key words:** Power, base, exponent, product, sum, to raise to a power.

**Materials:** Worksheet “Power properties”.

**Procedure steps:**

1. Students do the exercise 1 in pairs.
2. Students read, listen, compare and discuss their point of view.
3. Students do the exercise 2 in pairs.
4. Students read, listen, compare and discuss their point of view.
5. Students do the exercise 3 in pairs.
6. Students read, listen, compare the results.
7. Students do exercises 4 to 8 in pairs.
8. Students read, listen, compare and discuss their point of view

**Attachment:**

**Power properties**

1. Make a sentence using the following words:

*the, reciprocal, exponent, is, exponent, positive, negative, of, the*

2. Match the name of the property with the formulae:

1. Zero exponent property	<b>A</b> $(a^n)^m = a^{n \cdot m}$
2. Negative exponent property	<b>B</b> $\frac{a^n}{b^n} = \left(\frac{a}{b}\right)^n$
3. Product of powers property	<b>C</b> $a^n \cdot a^m = a^{n+m}$
4. Quotient of a powers property	<b>D</b> $a^{\frac{m}{n}} = \sqrt[n]{a^m} = (\sqrt[n]{a})^m$
5. Power of a product property	<b>E</b> $a^{-n} = \frac{1}{a^n}$
6. Power of a quotient property	<b>F</b> $a^0 = 1$
7. Power of a power property	<b>G</b> $a^n \cdot b^n = (a \cdot b)^n$
8. Rational exponent property	<b>H</b> $\frac{a^n}{a^m} = a^{n-m}$

3. Work out the value of expression:

a)  $(3a)^4$ ;

c)  $\left(\frac{4}{7}\right)^{-2}$  ;

b)  $32^{0.8}$ ;

d)  $\left(3\frac{3}{8}\right)^{-\frac{2}{3}}$  .

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4. The weight of the sun is  $1,99 \cdot 10^{30}$  kg, but the weight of the earth is  $5,98 \cdot 10^{24}$  kg. How many times the weight of the sun is greater than the weight of the earth? Approximate the result to thousands!
5. The blue whale weighs 15000 kg, but a humming bird weighs 1,7 g. How many times the humming bird is lighter than the blue whale? Write the result in standart form!
6. A small nail ( $\approx 1$  g weight) contains  $1,077 \cdot 10^{22}$  iron atoms. How many iron atoms does 0,5 kg of nails contain?
7. The weight of an air column forcing the land surface per square meter is 1,033 kg. What is the weight of the air column forcing the land surface per 1 km<sup>2</sup>? What is the weight of the air column forcing the Lubana lake, if its area is 82 km<sup>2</sup>?
8. Simplify the expressions:

a)  $\left( a^{\frac{2}{3}} b^{-\frac{1}{3}} \right)^6$  ;

b)  $\frac{(a^2)^5 \cdot k^{-4^2}}{a^{(5+m) \cdot 2} \cdot k^{-12}}$  .

**Hometask:**



## Properties of Exponents

1. In each of the following questions write the missing exponents on the dotted lines.  
Show your reasoning in the spaces provided on the right.

a)  $2 \times 2 \times 2 = 2^{\dots}$

b)  $3 + 3 + 3 = 3^{\dots}$

c)  $6^{\dots} \times 6^4 = 6^6$

d)  $3^3 \times 4^3 = 12^{\dots}$

e)  $4^5 = 2^{\dots}$

f)  $(6^{\dots})^4 = 6^8$

g)  $10^6 \div 10^3 = 10^{\dots}$

h)  $10^2 - 6^2 = 4^{\dots}$

i)  $4^5 \div 4^{\dots} = 4^{\dots} = \frac{1}{16}$


2. Write these five numbers in order of size, from greatest to smallest:

$11^{-1}$

$10^0$

$0^{10}$

$5^2$

$2^5$

Greatest

Smallest

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Show your reasoning here:

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### Power properties (answers)

1. Make a sentence using the following words:

*the, reciprocal, exponent, is, exponent, positive, negative, of, the*

**Negative exponent is the reciprocal of the positive exponent.**



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2. Match the name of the property with the formulae:

1. Zero exponent property <span style="float: right; color: red;">F</span>	A $(a^n)^m = a^{n \cdot m}$
2. Negative exponent property <span style="float: right; color: red;">E</span>	B $\frac{a^n}{b^n} = \left(\frac{a}{b}\right)^n$
3. Product of powers property <span style="float: right; color: red;">C</span>	C $a^n \cdot a^m = a^{n+m}$
4. Quotient of a powers property <span style="float: right; color: red;">H</span>	D $a^{\frac{m}{n}} = \sqrt[n]{a^m} = (\sqrt[n]{a})^m$
5. Power of a product property <span style="float: right; color: red;">G</span>	E $a^{-n} = \frac{1}{a^n}$
6. Power of a quotient property <span style="float: right; color: red;">B</span>	F $a^0 = 1$
7. Power of a power property <span style="float: right; color: red;">A</span>	G $a^n \cdot b^n = (a \cdot b)^n$
8. Rational exponent property <span style="float: right; color: red;">D</span>	H $\frac{a^n}{a^m} = a^{n-m}$

3. Work out the value of expression:

a)  $(3a)^4 = 81a^4$

b)  $32^{0.8} = 32^{\frac{4}{5}} = \sqrt[5]{32^4} = 2^4 = 16$

c)  $\left(\frac{4}{7}\right)^{-2} \left(\frac{7}{4}\right)^2 = \frac{49}{16} = 3\frac{1}{16}$

d)  $\left(3\frac{3}{8}\right)^{\frac{2}{3}} = \left(\frac{27}{8}\right)^{\frac{2}{3}} = \left(\frac{8}{27}\right)^{\frac{2}{3}} = \sqrt[3]{\left(\frac{8}{27}\right)^2} = \left(\frac{2}{3}\right)^2 = \frac{4}{9}$

4. The weight of the sun is  $1,99 \cdot 10^{30}$  kg, but the weight of the earth is  $5,98 \cdot 10^{24}$  kg. How many times the weight of the sun is greater than the weight of the earth? Approximate the result to thousands!

$$\frac{1,99 \cdot 10^{30}}{5,98 \cdot 10^{24}} \approx 0,33277 \cdot 10^6 \approx 332000$$



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5. The blue whale weighs 15000 kg, but a humming bird weighs 1,7 g. How many times the humming bird is lighter than the blue whale? Write the result in standart form!

$$\frac{15000000}{1,7} \approx 8823529 \approx 8,8 \cdot 10^6$$

6. A small nail ( $\approx 1$  g weight) contains  $1,077 \cdot 10^{22}$  iron atoms. How many iron atoms does 0,5 kg of nails contain?

$$0,5 \cdot 10^3 \cdot 1,077 \cdot 10^{22} = 5,385 \cdot 10^{24}$$

9. The weight of an air column forcing the land surface per square meter is 1,033 kg. What is the weight of the air column forcing the land surface per 1 km<sup>2</sup>? What is the weight of the air column forcing the Lubana lake, if its area is 82 km<sup>2</sup>?

$$1,033 \cdot 10^6 \text{ kg}$$

$$82 \cdot 1,033 \cdot 10^6 = 8,4706 \cdot 10^7 \text{ kg}$$

8. Simplify the expressions:

$$\text{a) } \left( a^{\frac{2}{3}} b^{-\frac{1}{3}} \right)^6 = a^4 b^{-2} = \frac{a^4}{b^2}$$

$$\text{b) } \frac{(a^2)^5 \cdot k^{-4^2}}{a^{(5+m)2} \cdot k^{-12}} = \frac{a^{10} k^{-16}}{a^{10+2m} k^{-12}} = a^{10-(10+2m)} k^{-16-(-12)} = a^{-2m} k^{-4}$$