EaD Comprehensive Lesson Plans

Strand:	Number	Sub-Strand:	Number Operations

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BASIC 8

WEEKLY LESSON PLAN – WEEK 4

Content Standard:	B8.1.2.3 Demonstrate understanding and the use of the laws of indices in solving problems (including real life problems) involving powers of natural numbers	
Indicator (s)	B8.1.2.3.1 Identify and explain the laws of indices B8.1.2.3.2 Apply the laws of indices to simplify and evaluate numbers involving powers of numbers. (PEDMAS) B8.1.2.3.3 Solve exponential equations B8.1.2.3.4 Solve real life problems involving powers of natural numbers.	**Performance Indicator:** Learners can apply the laws of indices to solve exponential equations.
Week Ending	02-02-2024	

Class	B.S.8	**Class Size:**		**Duration:**	
Subject	Mathematics				
Reference	Mathematics Curriculum, Teachers Resource Pack, Learners Resource Pack, Textbook.				

Teaching / Learning Resources	Poster, Pictures, Chart, video.	**Core Competencies:**	• Ability to reflect on approaches to creative task and evaluate the effectiveness of tools used • Ability to select the most effective creative tools for working and preparedness to give explanations

DAY/DATE	**PHASE 1 : STARTER**	**PHASE 2: MAIN**	**PHASE 3: REFLECTION**
MONDAY	Using a Poster, assist Learners to identify the 6 laws of indices.	1. Discuss with the Learners about the properties of indices. 2. Explain to the Learners on how to use the laws of indices. 3. Assist Learners to apply the laws of indices to simplify expressions involving powers of the same base. 4. Learners brainstorm to use the laws of indices to solve problems involving powers of number. **Index Definition** A number or a variable may have an index. Index of a	Through questions and answers, conclude the lesson. **Exercise;** Solve the following by applying the laws of indices; i. Simplify $5 \times 8^{2/3}$ ii. Simplify $-2x^0$ iii. Simplify $\frac{6(y^4)^5}{12y^4y^5}$ iv. Simplify $(-243)^{-2/5}$ v. Simplify $5(8x^4 \div 2x^6)$

		variable (or a constant) is a value that is raised to the power of the variable. The indices are also known as **powers or exponents**. It shows the number of times a given number has to be multiplied. It is represented in the form: **$a^m = a \times a \times a \times \ldots\ldots \times a$ (m times)** Here, a is the base and m is the index. The index says that a particular number (or base) is to be multiplied by itself, the number of times equal to the index raised to it. It is a compressed method of writing big numbers and calculations. **Example:** $2^3 = 2 \times 2 \times 2 = 8$ In the example, 2 is the base and 3 is the index. Laws of Indices There are some fundamental rules or laws of indices which are necessary to understand before we start dealing with indices. These laws are used while performing algebraic operations on indices and while solving the algebraic expressions, including it. **Rule 1:** If a constant or variable has index as '0', then the result will be equal to one, regardless of any base value. **$a^0 = 1$** **Example:** $5^0 = 1$, $12^0 = 1$, $y^0 = 1$ **Rule 2:** If the index is a negative value, then it can be shown as the reciprocal of the positive index raised to the same variable. **$a^{-p} = 1/a^p$**	

		Example: $5^{-1} = ⅕$, $8^{-3} = 1/8^3$ **Rule 3:** To multiply two variables with the same base, we need to add its powers and raise them to that base. $a^p.a^q = a^{p+q}$ **Example**: $5^2.5^3 = 5^{2+3} = 5^5$ **Rule 4:** To divide two variables with the same base, we need to subtract the power of denominator from the power of numerator and raise it to that base. $a^p/a^q = a^{p-q}$ **Example:** $10^4/10^2 = 10^{4-2} = 10^2$ **Rule 5:** When a variable with some index is again raised with different index, then both the indices are multiplied together raised to the power of the same base. $(a^p)^q = a^{pq}$ **Example:** $(8^2)^3 = 8^{2.3} = 8^6$ **Rule 6:** When two variables with different bases, but same indices are multiplied together, we have to multiply its base and raise the same index to multiplied variables. $a^p.b^p = (ab)^p$ **Example**: $3^2.5^2 = (3 \times 5)^2 = 15^2$ **Rule 7:** When two variables with different bases, but same indices are divided, we are required to divide the bases and raise the same index to it. $a^p/b^p = (a/b)^p$	

Example: $3^2/5^2 = (3/5)^2$

Rule 8: An index in the form of a fraction can be represented as the radical form.

$$a^{p/q} = \sqrt[q]{a^p}$$

Example: $6^{1/2} = \sqrt{6}$

Indices Maths Problems

Q.1: Multiply $x^4y^3z^2$ and xy^5z^{-1}

Solution: $x^4y^3z^2$ and xy^5z^{-1}

$= x^4.x\ .y^3.y^5.z^2.z^{-1}$

$= x^{4+1}.y^{3+5}.z^{2-1}$

$= x^5.y^8.z$

Q.2: Solve a^3b^2/a^2b^4

Solution: a^3b^2/a^2b^4

$= a^{3-2}b^{2-4}$

$= a^1b^{-2}$

$= a\ b^{-2}$

$= a/b^2$

Q.3: Find the value of $27^{2/3}$.

Solution: $27^{2/3}$

$= \sqrt[3]{27^2}$

$= 3^2$

$= 9$

TUESDAY	Assist Learners to explain the meaning of "exponential equation".	1. Learners brainstorm to identify examples of exponential equations. 2. Demonstrate on how to solve exponential equation. 3. Assist Learners to solve exponential equations. 4. Discuss with the Learners about the types of exponential equations. **Solving Exponential Equations With Different Bases** Sometimes, the bases on both sides of an exponential equation may not be the same (or) cannot be made the same. We solve the exponential equations using logarithms when the bases are not the same on both sides of the equation. For example, $5^x = 3$ neither has the same bases on both sides nor the bases can be made the same. In such cases, we can do one of the following things. • Convert the exponential equation into the logarithmic form using the formula $b^x = a \Leftrightarrow \log_b a = x$ and solve for the variable. • Apply logarithm (log) on both sides of the equation and solve for the variable. In this case, we will have to use a property of logarithm, $\log a^m = m \log a$. We will solve the equation $5^x = 3$ in each of these methods. **Method 1:** We will convert $5^x = 3$ into logarithmic form. Then we get, $\log_5 3 = x$ Using the change of base property, x = (log 3) / (log 5) **Method 2:** We will apply log on both sides of $5^x = 3$. Then we get, $\log 5^x = \log 3$. Using the property $\log a^m = m \log a$ on the left side of the equation, we get, x log 5 = log 3. Dividing both sides by log 5, x = (log 3) / (log 5) **Important Notes on Exponential Equations:**	Learners in small groups to discuss and report to the class about the properties of equality for exponential equations. **Exercise;** Solve the following i. $27 / (3^{-x}) = 3^6$ ii. $7^{3x+7} = 490$. iii. $(-5)^x = 625$ iv. $7^{y+1} = 343^y$. v. $3^{x+4} = 81$

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Here are some important notes with respect to the exponential equations.

To solve the exponential equations of the same bases, just set the exponents equal.
To solve the exponential equations of different bases, apply logarithm on both sides.
The exponential equations with the same bases also can be solved using logarithms.
If an exponential equation has 1 on any one side, then we can write it as $1 = a^0$, for any 'a'. For example, to solve $5^x = 1$, we can write it as $5^x = 5^0$, then we get x = 0.
To solve an exponential equation using logarithms, we can either apply "log" or apply "ln" on both sides.

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<td>THURSDAY</td>
<td>Assist Learners to identify examples of real life problems involving powers of natural numbers.</td>
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Demonstrate on solving real life problems involving powers of natural numbers.
Assist Learners to use tables and graph to solve exponential equations.
Learners brainstorm to write equations for real life problems involving powers of natural numbers.

EXPONENTIAL GRAPHS

We can use the calculator to find approximate values of for various rational values of 2^x. We place these in a table and we can then plot the ordered pairs (x, 2^x)to produce a graph of $y = 2^x$.

EXAMPLE

Produce a table of values for the function $y = 2^x$ and use it to draw its graph.

SOLUTION

A table of approximate values follows:
<table>
<tr><td>x</td><td>-3</td><td>−2.5</td><td>−2</td><td>−1.5</td><td>−1</td><td>−0.5</td><td>0</td><td>0.5</td></tr>
<tr><td>y</td><td>0.125</td><td>0.177</td><td>0.25</td><td>0.354</td><td>0.5</td><td>0.707</td><td>1</td><td>1.414</td></tr>
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Reflect on representing exponential equations on tables and graphs.

Exercise

The product of 5 and a number is 160.Find that number.
The selling price of a certain DVD is $7 more than the price the store paid. If the selling price is $24, what did the store pay?
Suppose you drive 630 miles in 10.5 hours. What was your average speed?

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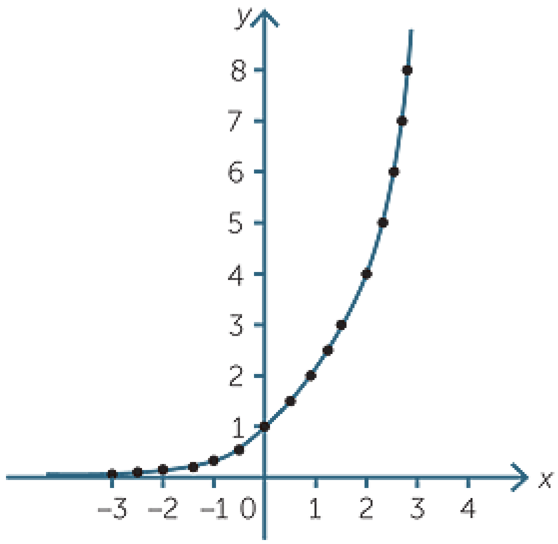


Note that although we have 'joined the dots' to form a smooth curve, we have not given any meaning at this stage to 2^x when is an irrational number. We cannot deal with this problem at this stage.

We note the following features of the graph.

- the graph is increasing.
- the values increase quite rapidly as we move along the axis.
- on the left hand-side, the graph approaches, but never reaches, the axis.

EXERCISE 6

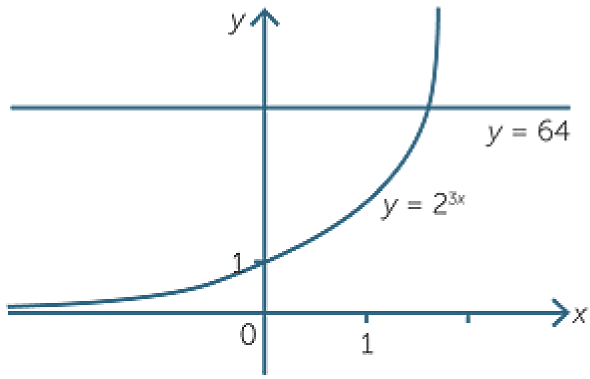
Draw the graphs of $y = 3^x$ and $y = 3^{-x}$ on the set of axes.

EXPONENTIAL EQUATIONS

An exponential equation is an equation in which the pronumeral appears as an index.
For example, $2^{3x} = 64$ is an exponential equation.

We can see from the graph that the curve $y = 2^{3x}$ and $y = 64$ the line only meet once,
so there is one unique solution to the exponential

equation.



We can solve the equation as follows:

$2^{3x} = 64$

Hence $3x = 6$, giving $x = 2$.

EXAMPLE

a $2^x = \frac{1}{8}$ **b** $7^x = \frac{1}{343}$ **c** 7^{x}

SOLUTION

a $2^x = \frac{1}{8}$ **b** $7^x = \frac{1}{343}$ **c** $7^x =$

since, $\frac{1}{8} = 2^{-3}$ since, $\frac{1}{343} = 7^{-3}$ since

$2^x = 2^{-3}$ $7^x = 7^{-3}$

$x = -3$ $x = -3$

$\frac{5}{4}$

EXERCISE 7

Solve $3^{3-x} = 27^{x-1}$.

How do we solve $2^x = 7$? The method used above does not work in quite the same way, since we do not know how to express 7 as a power of 2.

Name of Teacher: **School:** **District:**