GROUP WORKSHEET

Mathematics

Exponents (Powers)

Class VIII – Junior High School

Group Members:

Learning Objectives

1. After being given a group worksheet, students can explain the meaning and general form of exponential numbers through contextual examples in everyday life with a minimum accuracy of 75%. (C2)
2. After being given a group worksheet, students can apply the properties of powers (multiplication, powers of powers, and division) to solve practice problems with a minimum accuracy of 80%. (C3)
3. Students can analyze the properties of powers (zero and negative powers) through constructivist-based exploratory activities with a minimum accuracy rate of 80%. (C4)
4. Students can demonstrate critical thinking and responsibility in solving problems in the group worksheet. (DPL 3)

Steps for Completing the Group Worksheet

1. Read and understand the learning objectives written at the beginning of the worksheet.
2. Discuss each activity (Activity 1–4) with your group members. Perform simple experiments (e.g., paper-tearing in Activity 1) and complete the provided tables based on your group's observations and calculations.
3. Write your discussion results in the given spaces (such as repeated multiplication, exponential form, and general formulas).
4. Answer the reflective questions in each section using your group's understanding.
5. Summarize what you have learned by completing the final summary table of exponent concepts.
6. Submit your group worksheet after finishing, making sure all group members' names are listed.

Exponents (Powers)

Problem Orientation

When calculating the area of a square with a side length of 3 cm, Raka wrote $3 \times 3 = 9$.
He then saw in a book the notation "$3^2 = 9$".
Raka became confused: "Why is it written 3^2, instead of 3×3?"

1. What does the symbol "^{2}" pada 3^2?

2. If the side of the square is 4 cm, how should it be written?

3. What is the relationship between exponential form and repeated multiplication?

Activity 1 (Discovering Patterns from Paper Tearing)

You have a sheet of paper.
Each time you tear every piece into two equal parts, the number of pieces becomes twice as many as before.

After 1 tear, you have 2 pieces.
After 2 tears, you have 4 pieces.

Exponents (Powers)

How many pieces will you have after tearing it 5 times?

Record your results in the table below

Number of Tears	Number of Pieces	Repeated Multiplication	Exponential Form
1	2	2	2^1
2	4	2x2	2^2

Discuss with your group

1. What pattern do you find between the number of tears and the number of pieces?

2. Can you express the relationship between the number of pieces (P) and the number of tears (n) as a general formula?

3. What do the numbers 2 and n represent in this formula?

Exponents (Powers)

4 Write what 2^5 means in your own words

Activity 2 (Investigating Multiplication Patterns in Exponents)

Write the repeated multiplication form of each operation below, then simplify it to find the pattern.

A. Multiplication Property of Exponents

Operation	Repeated Multiplication	Simplified Form
$3^5 \times 3^2$	$(3\times3\times3\times3\times3)\times(3\times3)$	$3^{5+2} = 3^7$
$12^6 \times 12$		
$(-5)^4 \times (-5)^6$		
$(0,7)^3 \times (0,7)^2$		
$(4b)^5 \times (4b)^3$		

Discuss with your group

1 What happens to the exponents when two powers with the same base are multiplied?

2 Can you express the relationship between the number of pieces (P) and the number of tears (n) as a general formula?

Exponents (Powers)

3 Write the general formula

$a^m \times a^n =$

B. Division Property of Exponents

Operation	Repeated Multiplication	Simplified Form
$3^5 \div 3^2$	$(3\times3\times3\times3\times3) \div (3\times3)$	$3^{5-2} = 3^3$
$12^6 \div 12$		
$(-5)^4 \div (-5)^6$		
$(0,7)^3 \div (0,7)^2$		
$(4b)^5 \div (4b)^3$		

Discuss with your group

1 What happens to the exponents when dividing powers with the same base?

2 Does this rule hold for all numbers (positive, negative, fractions, or algebraic forms)?

3 Write the general formula

$\frac{a^m}{a^n} =$

Exponents (Powers)

C. Power of a Power Property

Operation	Repeated Multiplication	Simplified Form
$(2^2)^2$	$2^2 \times 2^2 = (2\times2) \times (2\times2)$	2^4
$(4^3)^2$		
$(0,5^2)^2$		
$(7^5)^2$		
$(a^2)^3$		

Discuss with your group

1. What happens when a power is raised to another power?

2. Does this hold for all types of numbers (positive, fractions, variables)?

3. Write the general formula

$(a^m)^n =$

Exponents (Powers)

D. Power of a Product Property

Operation	Repeated Multiplication	Simplified Form
$(4 \times 3)^3$	$(4 \times 3) \times (4 \times 3) \times (4 \times 3)$ $= 4 \times 3 \times 4 \times 3 \times 4 \times 3$ $= (4 \times 4 \times 4) \times (3 \times 3 \times 3)$	$4^3 \times 3^3$
$(2 \times 6)^4$		
$(p \times 2)^2$		
$(5 \times m)^3$		
$(a \times b)^5$		

Discuss with your group

1. What happens to each factor inside parentheses when raised to a power?

2. What is the common feature of all examples above?

3. Write the general formula

$(a \times b)^n =$

Exponents (Powers)

Activity 3 (Exploring Zero and Negative Exponents)

Write the repeated multiplication form of each operation below, then simplify it to find the pattern.

Observe the following pattern:

$2^3 = 8,\ 2^2 = 4,\ 2^1 = 8$

Then, what is 2^0? Is it 0, or 1?

Exponent	Value	Relation to Previous
2^3	8	-
2^2	4	divided by 2
2^1		
2^0		
2^{-1}		
2^{-2}		

Discuss with your group

1. What pattern do you see?

2. Try using another number, e.g. 3^2, 3^1, 3^0 does it give the same result?

Exponents (Powers)

3 Write the general formula

4 Does a negative exponent mean the result is negative?

5 Try calculating 10^{-1}, 5^{-2}, dan $\frac{1}{2}^{-2}$, what are the results?

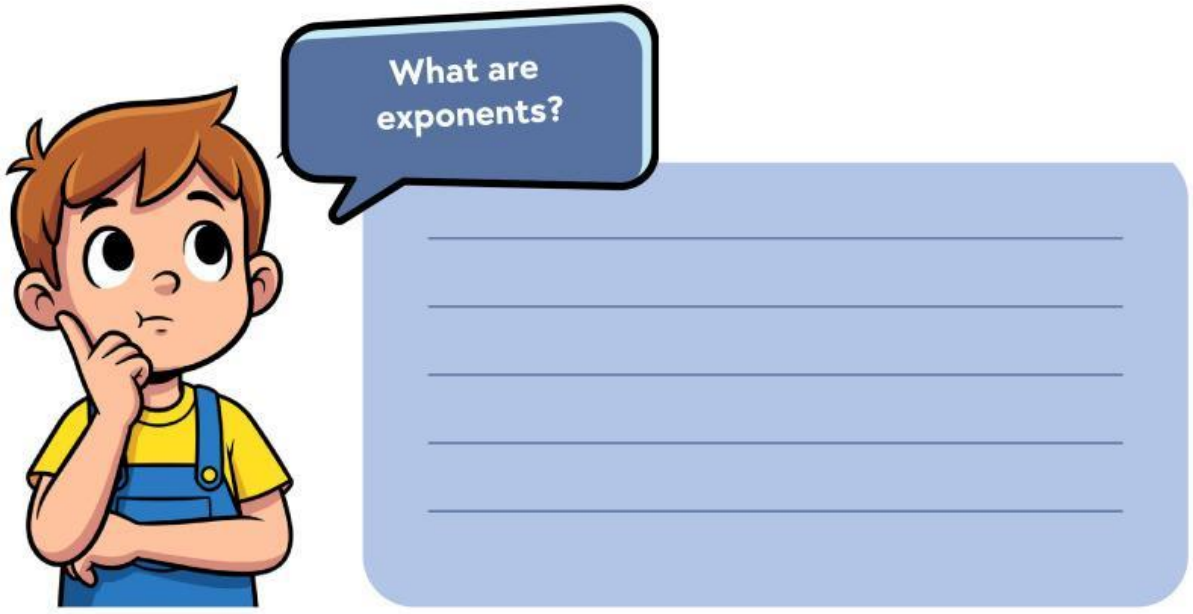
6 Write the general formula

$a^{-n} =$ $(\frac{1}{a^n}) =$

Activity 4 (Summarizing the Concept of Integer Exponents)

You have learned various activities about exponents, namely:

- Patterns of repeated multiplication through the paper-tearing activity.
- The properties of exponents (multiplication, division, power of a power, and power of a product).
- Numbers with zero and negative exponents.



Exponents (Powers)

Type of Operation	Example	General Rule	Conclusion
Multiplication of Powers			
Division of Powers			
Power of a Power			
Power of a Product			
Zero Exponent			
Negative Exponent			

What is the relationship among all these properties?

What is the relationship among all these properties?

What is the relationship among all these properties?