

1 LKPD 2 Matematika

Berbasis Problem Based Learning

EKSPONEN



SMA/MA/SMK

Pendidikan Matematika
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KEGIATAN 2

SIFAT-SIFAT EKSPONEN



PERMASALAHAN 2

Bagaimana menyederhanakan bentuk $2^3 \times 2^4$?

MARI RENCANAKAN



Bentuklah kelompok beranggotakan 4-5 siswa. Identifikasi masalah yang ada pada permasalahan 2 dan rencanakan bersama kelompokmu langkah apa yang dapat diambil untuk menyelesaikan masalah tersebut!

KELOMPOK :

ANGGOTA :

- 1.....
- 2.....
- 3.....
- 4.....
- 5.....



MARI SELIDIKI

Untuk menyederhanakan bentuk eksponen pada permasalahan 2 mari lengkapi penyelesaian berikut!

$$2^3 = \dots \times \dots \times \dots$$

$$2^4 = \dots \times \dots \times \dots \times \dots$$

$$2^3 \times 2^4 = \dots \times \dots \times \dots \times \dots \times \dots \times \dots \times \dots$$

$$= \dots$$

MARI KERJAKAN



Jika bilangan 2 direpresentasikan dengan "a", bilangan 3 direpresentasikan dengan "m", bilangan 4 direpresentasikan dengan "n", maka diperoleh :

$$a^m = \underbrace{\dots \times \dots \times \dots \times \dots}_{\text{faktor}}$$

$$a^n = \underbrace{\dots \times \dots \times \dots \times \dots}_{\text{faktor}}$$

$$a^m \times a^n = \underbrace{\dots \times \dots \times \dots \times \dots}_{\text{.....+..... faktor}} \times \dots \times \dots$$

$$= \dots + \dots + \dots$$



MARI SIMPULKAN

Dari permasalahan yang sudah kalian selesaikan di atas, apa yang dapat kalian simpulkan?

[illegible]

Eksplorasi di atas merupakan salah satu sifat eksponen yaitu sifat perkalian bilangan berpangkat.
mari kita bahas sifat-sifat yang terdapat pada eksponen.

SIFAT-SIFAT EKSPONEN

SIFAT - 1

$a^n a^m = a^{m+n}$ dengan $a \neq 0$ dan m, n bilangan bulat

Bukti :

$$\begin{aligned} a^m \times a^n &= \underbrace{a \times a \times a \times \dots \times a}_{m \text{ faktor}} \times \underbrace{a \times a \times a \times a \times \dots \times a}_{n \text{ faktor}} \\ &= \underbrace{a \times a \times a \times a \times a \times a}_{m+n} \\ &= a^{m+n} \quad \text{Terbukti.} \end{aligned}$$



Contoh : Sederhanakan bentuk $2^2 \times 2^5$

Penyelesaian :

$$\begin{aligned} 2^2 \times 2^5 &= \underbrace{(2 \times 2)}_{2 \text{ faktor}} \times \underbrace{(2 \times 2 \times 2 \times 2 \times 2)}_{5 \text{ faktor}} \\ &= \underbrace{2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2}_{7 \text{ faktor}} \\ &= 2^7 \end{aligned}$$

Bersama teman kelompokmu, mari sederhanakan bentuk eksponen berikut !

$$\begin{aligned}
 1. \quad y^3 \times y^5 &= (\underbrace{\dots \times \dots \times \dots}_{\dots \text{faktor}}) \times (\underbrace{\dots \times \dots \times \dots \times \dots \times \dots}_{\dots \text{faktor}}) \\
 &= \underbrace{\dots \times \dots \times \dots \times \dots \times \dots \times \dots \times \dots \times \dots}_{\dots \text{faktor}} \\
 &= \dots^{\dots}
 \end{aligned}$$

$$\begin{aligned}
 2. \quad 2p^4 \times 3p^6 &= (2(\underbrace{p \times p \times p \times p}_{\dots \text{faktor}})) \times (3(\underbrace{p \times p \times p \times p \times p \times p}_{\dots \text{faktor}})) \\
 &= 2 \times 3 (\underbrace{\dots \times \dots \times \dots \times \dots}_{\dots \text{faktor}}) (\underbrace{\dots \times \dots \times \dots \times \dots \times \dots \times \dots}_{\dots \text{faktor}}) \\
 &= \dots (\underbrace{\dots \times \dots \times \dots \times \dots \times \dots \times \dots \times \dots \times \dots \times \dots \times \dots}_{\dots \text{faktor}}) \\
 &= \dots^{\dots}
 \end{aligned}$$

$$3. \quad 2x^3 \times 7x^4 \times (3x)^2 =$$

SIFAT - 2

$\frac{a^n}{a^m} = a^{n-m}$ dengan $a \neq 0$ dan m, n bilangan bulat

Bukti :

$$\begin{aligned}\frac{a^m}{a^n} &= \frac{\overbrace{a \times a \times a \times a \times a \dots \times a}^{m \text{ faktor}}}{\underbrace{a \times a \times a \times \dots \times a}_{n \text{ faktor}}} \\ &= \underbrace{a \times \dots \times a}_{m-n \text{ faktor}} \\ &= a^{m-n}\end{aligned}$$

Contoh : Sederhanakan bentuk $\frac{3^7}{3^5}$:

Penyelesaian :

$$\begin{aligned}\frac{3^7}{3^5} &= \frac{\overbrace{3 \times 3 \times 3 \times 3 \times 3 \times 3 \times 3}^{7 \text{ faktor}}}{\underbrace{3 \times 3 \times 3 \times 3 \times 3}_{5 \text{ faktor}}} \\ &= \underbrace{3 \times 3}_{2 \text{ faktor}} \\ &= 3^2\end{aligned}$$

Bersama teman kelompokmu, mari sederhanakan bentuk eksponen berikut !

$$\begin{aligned}
 1. \quad \frac{y^7}{y^2} &= \frac{\overbrace{\dots \times \dots \times \dots \times \dots \times \dots \times \dots}^{\dots \text{faktor}}}{\underbrace{\dots \times \dots}_{\dots \text{faktor}}} \\
 &= \underbrace{\dots \times \dots \times \dots \times \dots}_{\dots \text{faktor}}
 \end{aligned}$$

$$\begin{aligned}
 2. \quad \frac{8^9}{8^5} &= \frac{\overbrace{\dots \times \dots \times \dots \times \dots \times \dots \times \dots \times \dots}^{\dots \text{faktor}}}{\underbrace{\dots \times \dots \times \dots \times \dots}_{\dots \text{faktor}}} \\
 &= \underbrace{\dots \times \dots \times \dots}_{\dots \text{faktor}} \\
 &= \dots
 \end{aligned}$$

$$3. \quad \frac{12y^8}{4y^3} =$$

SIFAT - 3

$(a^m)^n = a^{m \times n}$ dengan $a \neq 0$ dan m, n bilangan bulat

Bukti :

$$\begin{aligned}(a^m)^n &= \underbrace{a^m \times a^m \times a^m \times \dots \times a^m}_{n \text{ faktor}} \\&= \underbrace{\left(\underbrace{a \times a \times a \times \dots \times a}_{m \text{ faktor}} \right) \left(\underbrace{a \times a \times a \times \dots \times a}_{m \text{ faktor}} \right) \left(\underbrace{a \times a \times a \times \dots \times a}_{m \text{ faktor}} \right) \left(\underbrace{a \times a \times a \times \dots \times a}_{m \text{ faktor}} \right)}_{n \text{ faktor}} \\&= \underbrace{a^m \times a^m \times a^m \times \dots \times a^m}_{m \times n \text{ faktor}} \\(a^m)^n &= a^{m \times n} \text{ (terbukti)}\end{aligned}$$

Contoh : Sederhanakan bentuk $(3^4)^3$

Penyelesaian :

$$\begin{aligned}(3^4)^3 &= \underbrace{(3 \times 3 \times 3 \times 3)}_{4 \text{ faktor}} \times \underbrace{(3 \times 3 \times 3 \times 3)}_{4 \text{ faktor}} \times \underbrace{(3 \times 3 \times 3 \times 3)}_{4 \text{ faktor}} \\&\quad \underbrace{\hspace{10em}}_{3 \text{ faktor}} \\&= \underbrace{(3 \times 3 \times 3 \times 3 \times \dots \times 3)}_{4 \times 3 \text{ faktor}} \\&= 3^{12}\end{aligned}$$

Bersama teman kelompokmu, mari sederhanakan bentuk eksponen berikut !

$$\begin{aligned}
 1. \quad (6^3)^5 &= (\underbrace{\dots \times \dots \times \dots}_{\dots \text{ faktor}}) \times (\underbrace{\dots \times \dots \times \dots}_{\dots \text{ faktor}}) \times (\underbrace{\dots \times \dots \times \dots}_{\dots \text{ faktor}}) \times (\underbrace{\dots \times \dots \times \dots}_{\dots \text{ faktor}}) \times (\underbrace{\dots \times \dots \times \dots}_{\dots \text{ faktor}}) \\
 &\quad \underbrace{\hspace{10em}}_{\dots \text{ faktor}} \\
 &= (\underbrace{\dots \times \dots \times \dots \times \dots \times \dots \times \dots \times \dots \times \dots \times \dots \times \dots \times \dots \times \dots \times \dots \times \dots \times \dots \times \dots}_{\dots \times \dots \text{ faktor}}) \\
 &= \dots
 \end{aligned}$$

$$\begin{aligned}
 2. \quad (b^5)^2 &= (\underbrace{\dots \times \dots \times \dots \times \dots \times \dots}_{\dots \text{ faktor}}) \times (\underbrace{\dots \times \dots \times \dots \times \dots \times \dots}_{\dots \text{ faktor}}) \\
 &\quad \underbrace{\hspace{10em}}_{\dots \text{ faktor}} \\
 &= (\underbrace{\dots \times \dots \times \dots \times \dots \times \dots \times \dots \times \dots \times \dots \times \dots}_{\dots \times \dots \text{ faktor}}) \\
 &= \dots
 \end{aligned}$$

3. $(-9^3)^4$:

SIFAT - 4

$(ab)^n = a^n \times b^n$ dengan $a, b \neq 0$ dan n bilangan bulat

Bukti

$$\begin{aligned} a^m \times b^m &= \underbrace{a \times a \times a \dots \times a}_{m \text{ faktor}} \times \underbrace{b \times b \times b \dots \times b}_{m \text{ faktor}} \\ &= \underbrace{(ab) \times (ab) \times (ab) \times \dots \times (ab)}_{m \text{ faktor}} \end{aligned}$$

$$a^m \times b^m = (ab)^m$$

Contoh : Sederhanakanlah bentuk $(2 \times 4)^3$

Penyelesaian : $(2 \times 4)^3 = \underbrace{(2 \times 4)(2 \times 4)(2 \times 4)}_{3 \text{ faktor}}$

$$= \underbrace{(2 \times 2 \times 2)}_{3 \text{ faktor}} \underbrace{(4 \times 4 \times 4)}_{3 \text{ faktor}}$$

$$= 2^3 \times 4^3$$

Bersama teman kelompokmu, mari sederhanakan bentuk eksponen berikut !

$$\begin{aligned}
 1. \quad (6 \times 3)^4 &= \underbrace{(\dots \times \dots)(\dots \times \dots)(\dots \times \dots)(\dots \times \dots)}_{\dots \text{ faktor}} \\
 &= \underbrace{(\dots \times \dots \times \dots \times \dots)}_{\dots \text{ faktor}} \underbrace{(\dots \times \dots \times \dots \times \dots)}_{\dots \text{ faktor}} \\
 &= \dots^{\dots} \times \dots^{\dots}
 \end{aligned}$$

$$\begin{aligned}
 2. \quad (i \times j)^3 &= \underbrace{(\dots \times \dots)(\dots \times \dots)(\dots \times \dots)}_{\dots \text{ faktor}} \\
 &= \underbrace{(\dots \times \dots \times \dots)}_{\dots \text{ faktor}} \underbrace{(\dots \times \dots \times \dots)}_{\dots \text{ faktor}} \\
 &= \dots^{\dots} \times \dots^{\dots}
 \end{aligned}$$

$$3. \quad (u \times 5v)^2$$

SIFAT - 5

$$\left(\frac{a}{b}\right)^n = \frac{a^n}{b^n} \text{ dengan } b \neq 0 \text{ dan } n \text{ bilangan bulat}$$

Bukti

$$\frac{a^m}{b^m} = \frac{\overbrace{a \times a \times a \times \dots \times a}^{m \text{ faktor}}}{\overbrace{b \times b \times b \times \dots \times b}^{m \text{ faktor}}}$$

$$\frac{a^m}{b^m} = \underbrace{\frac{a}{b} \times \frac{a}{b} \times \frac{a}{b} \times \dots \times \frac{a}{b}}_{m \text{ faktor}}$$

$$\frac{a^m}{b^m} = \left(\frac{a}{b}\right)^m$$

Contoh : Sederhanakan bentuk berikut $\left(\frac{4}{5}\right)^3$

Penyelesaian :

$$\left(\frac{4}{5}\right)^3 = \underbrace{\left(\frac{4}{5}\right) \times \left(\frac{4}{5}\right) \times \left(\frac{4}{5}\right)}_{3 \text{ faktor}}$$

$$= \frac{\overbrace{(4 \times 4 \times 4)}^{3 \text{ faktor}}}{\underbrace{(5 \times 5 \times 5)}_{3 \text{ faktor}}}$$

$$= \frac{4^3}{5^3}$$

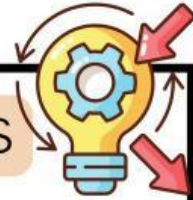
Bersama teman kelompokmu, mari sederhanakan bentuk eksponen berikut !

$$\begin{aligned}
 1. \left(\frac{2}{6}\right)^4 &= \underbrace{\left(\frac{\dots}{\dots}\right) \times \left(\frac{\dots}{\dots}\right) \times \left(\frac{\dots}{\dots}\right) \times \left(\frac{\dots}{\dots}\right)}_{\dots \text{ faktor}} \\
 &\quad \dots \text{ faktor} \\
 &= \frac{(\dots \times \dots \times \dots \times \dots)}{(\dots \times \dots \times \dots \times \dots)} \\
 &\quad \dots \text{ faktor} \\
 &= \frac{\dots}{\dots}
 \end{aligned}$$

$$\begin{aligned}
 2. \left(\frac{p}{q}\right)^6 &= \underbrace{\left(\frac{\dots}{\dots}\right) \times \left(\frac{\dots}{\dots}\right) \times \left(\frac{\dots}{\dots}\right) \times \left(\frac{\dots}{\dots}\right) \times \left(\frac{\dots}{\dots}\right) \times \left(\frac{\dots}{\dots}\right)}_{\dots \text{ faktor}} \\
 &\quad \dots \text{ faktor} \\
 &= \frac{(\dots \times \dots \times \dots \times \dots \times \dots \times \dots)}{(\dots \times \dots \times \dots \times \dots \times \dots \times \dots)} \\
 &\quad \dots \text{ faktor} \\
 &= \frac{\dots}{\dots}
 \end{aligned}$$

$$3. \left(\frac{p}{4q}\right)^2$$

MARI BERPIKIR KRITIS



Bersama kelompokmu, carilah masing-masing satu contoh bentuk eksponen yang penyederhanaannya menggunakan sifat ke-4 dan ke-5 !

HASIL DISKUSI

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