

Dividing Powers with the same Base:

$$\text{Simplify } \frac{3^7}{3^5} = \frac{\cancel{3} \cdot \cancel{3} \cdot \cancel{3} \cdot \cancel{3} \cdot \cancel{3} \cdot \cancel{3} \cdot 3}{\cancel{3} \cdot \cancel{3} \cdot \cancel{3} \cdot \cancel{3} \cdot \cancel{3}}$$

$$= 3 \cdot 3$$

$$= 3^2$$

State a rule for dividing powers with the same base:

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

Ex 1: Simplify

$$\text{a) } \frac{10^7^{23}}{10^7^{10}} = 10^7^{23-10} = 10^7^{13}$$

$$\text{b) } \frac{5^{50}}{5^{20}} = 5^{30}$$

$$\text{c) } \frac{(-3)^7}{(-3)^5} = (-3)^2$$

$$\text{d) } \frac{200^{300}}{200^{299}} = 200^1 = 200$$

Power of a Power

Simplify: $(7^3)^2 = (7^3)(7^3)$
 $= 7^6$

State a rule for power of a power:

$$\Rightarrow (a^n)^m = a^{n \times m}$$

Ex 1: Simplify

a) $(3^2)^4 = 3^8$

b) $(15^2)^5 = 15^{10}$

Connecting the laws of exponents:

Power Of a Product

(notice bases are different)

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

Power of a Quotient

(notice bases are different)

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

exponent goes to each part of the base

ie:

$$(xy)^3 = x^3 y^3$$

$$\left(\frac{x}{y}\right)^3 = \frac{x^3}{y^3}$$

Putting the Exponents Laws together

Simplify:

$$\begin{aligned} \text{a) } 5(5^3) \div 5^3 & \xrightarrow{\text{Hidden exp. of 1}} \\ & = 5^{1+3-3} \\ & = 5 \end{aligned}$$

$$\begin{aligned} \text{c) } \frac{(8^4)^5}{8^2(8^6)} & = \frac{8^{20}}{8^8} \\ & = 8^{12} \end{aligned}$$

$$\begin{aligned} \text{e) } \left(\frac{4}{9}\right)^7 \left(\frac{4}{9}\right)^3 \div \left(\frac{4}{9}\right)^7 & \\ & = \left(\frac{4}{9}\right)^{7+3-7} \\ & = \left(\frac{4}{9}\right)^3 \\ & = \frac{4^3}{9^3} \end{aligned}$$

$$\begin{aligned} \text{b) } \frac{(6^8)(6^3)}{6^7} & = 6^{8+3-7} \\ & = 6^4 \\ \text{OR} \\ & = \frac{6^{11}}{6^7} \\ & = 6^4 \end{aligned}$$

$$\begin{aligned} \text{d) } \left(\frac{9(9^6)}{9^3}\right)^5 & = (9^{7-3})^5 \\ & = (9^4)^5 \\ & = 9^{20} \end{aligned}$$

$$\begin{aligned} \text{f) } \left(\frac{2}{7}\right)\left(\frac{2}{7}\right)^5 & \\ & = \left(\frac{2}{7}\right)^6 \\ & = \frac{2^6}{7^6} \end{aligned}$$

Ex 2: Simplify

$$\begin{aligned} \text{a) } (y(y^3))^4 &= (y^4)^4 \\ &= y^{16} \end{aligned}$$

$$\begin{aligned} \text{b) } \frac{c(c^{12})c^5}{c^6} &= \frac{c^{18}}{c^6} \\ &= c^{12} \end{aligned}$$

Ex 3 Now think about this one...

$$\begin{aligned} (-6)^3 \times 6^4 &= \\ (-1 \times 6)^3 \times 6^4 &= \\ (-1)^3 (6^3) (6^4) &= -6^7 \end{aligned}$$

Changing the Base

Ex 1: Write each power with the following base:

a) base of 2	b) base of 3	c) base 3	d) base of $\frac{1}{5}$
$(4)^7$	$(9)^4$	$(27)^5$	$(\frac{1}{25})^4$
$= (2^2)^7$	$= (3^2)^4$	$= (3^3)^5$	$= ((\frac{1}{5})^2)^4$
$= 2^{14}$	$= 3^8$	$= 3^{15}$	$= (\frac{1}{5})^8$

Ex 2: Simplify using the exponent laws

$$\begin{aligned} \frac{27^5}{9^4} & \quad \text{Change the base!} \\ &= \frac{(3^3)^5}{(3^2)^4} \\ &= \frac{3^{15}}{3^8} \\ &= 3^7 \end{aligned}$$

(HMWK)

P 399 # 1-3 (d), 5, 7-9(cd),
10, 11d, 13, 14