

Review

<u>PROPERTY</u>	$(21c^6)(c^7)$	$(8y^3)(-3x^2y^2)(3/8 xy^4)$	$b^3(b)(b^5)$	$(3x^4y^3)(4x^4y)$
PRODUCT OF POWERS	$21c^{13}$ add	$-9x^3y^9$		
<u>PROPERTY</u>	$(2^3)^2$	$-4(x^3)^3$	$(5p^3)^4$	$(6x^2)(x^4)^3$
POWER OF A POWER	2^6 multiply	$-4x^9$		
<u>PROPERTY</u>	$(2a^4b^3)^3$	$(4g^2h)(-2g)^3$	$(3x^2)^2(1/3y^2)^3$	$(3x^2y^5)^3(-2xy^4z^6)^3$
POWER OF PRODUCT	$2^3(a^4)^3b^3$ $8a^{12}b^3$	$4g^2h(-2)^3g^3$ $-128g^7h$		
<u>PROPERTY</u>	$a^0b^{-2}c^{-3}$ ↓ 1	$\frac{(4x)^{-3}}{(3y)^{-3}}$	$(4xy^9z^5)^0$	$\frac{-9m^{-3}n^{-5}}{27}$
ZERO/NEGATIVE PROPERTIES	$\frac{1}{b^2c^3}$	$\frac{4^{-3}x^{-3}}{3^{-3}y^{-3}}$ $\frac{3^3y^3}{4^3x^3}$		
<u>PROPERTY</u>	$\frac{y^4z^7}{y^2z}$	$\frac{5n^5}{n^8}$ Subtract	$\frac{(-r)^5t^{-2}}{rt^8}$	$\frac{(4a^{-1})^{-2}}{(2a^4)^2}$
QUOTIENT OF POWERS	$y^{4-2}z^{7-1}$ y^2z^6	$5n^{-3}$ $\frac{5}{n^3}$		
<u>PROPERTY</u>	$\left(\frac{7m^{-2}n^3}{n^2r^{-3}}\right)^2$	$\left(\frac{3^{-1}xy^{-2}z^2}{4x^{-2}y^4}\right)^{-2}$	$\frac{(-b^{-1}c^{-2})^0}{(4a^2c^{-3})^{-2}}$	$\frac{(3a^3bc^2)^2}{18a^2b^3c^4}$
POWERS OF QUOTIENTS	$\frac{7^2m^{-4}n^6}{n^4r^{-6}}$ $\frac{7^2n^2r^6}{m^4}$	$\frac{3^{-2}x^2y^{-4}z^2}{4^2x^{-4}y^8}$ $\frac{x^2x^4z^2}{3^24^2y^4y^8} = \frac{x^6z^2}{144y^{12}}$		

ICM

$$\log a + \log b = \log(ab)$$

$$\log a - \log b = \log\left(\frac{a}{b}\right)$$

$$\log a^b = b \log a$$

Properties of Logarithms

Name KEY ID: 1

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Expand each logarithm.

1) $\log(a \cdot b) = \log_a a + \log_a b$

2) $\log u^4$

3) $\log \sqrt[3]{x} = \log x^{\frac{1}{3}} = \frac{1}{3} \cdot \log x$

4) $\log_7 \frac{x^6}{y^3}$

5) $\log_5 (a^3 \cdot b)^3 = \log_5 a^9 b^3$
 $= \log_5 a^9 + \log_5 b^3$
 $= 9 \log_5 a + 3 \log_5 b$

6) $\log_5 \left(\frac{x}{y^3}\right)^3$

7) $\log(7^6 \sqrt[3]{6}) = \log_{10} 7^6 + \log_{10} 6^{\frac{1}{3}}$
 $= 6 \log_{10} 7 + \frac{1}{3} \log_{10} 6$

8) $\log_4 (z \cdot xy^4)^5$

9) $\log_9 (8 \cdot 11^2 \sqrt{5}) = \log_9 8 + \log_9 11^2 + \log_9 5^{\frac{1}{2}}$
 $= \log_9 8 + 2 \log_9 11 + \frac{1}{2} \log_9 5$

10) $\log_2 (u^3 \cdot v \cdot w)^4$

Condense each expression to a single logarithm.

11) $\log_4 z + \frac{\log_4 x}{3} + \frac{\log_4 y}{3} = \log_4 z + \frac{1}{3} \log_4 x + \frac{1}{3} \log_4 y$
 $= \log_4 (z \cdot x^{\frac{1}{3}} \cdot y^{\frac{1}{3}})$
 $= \log_4 (z \cdot \sqrt[3]{xy})$

12) $3 \log_9 x + 18 \log_9 y$

13) $5 \log_5 z + \frac{\log_5 x}{2}$
 $= 5 \log_5 z + \frac{1}{2} \log_5 x$
 $= \log_5 z^5 + \log_5 \sqrt{x} = \log_5 (z^5 \sqrt{x})$

14) $16 \log_2 u - 4 \log_2 v$

15) $2 \log_4 x + 12 \log_4 y = \log_4 x^2 + \log_4 y^{12}$
 $= \log_4 (x^2 y^{12})$

16) $6 \log_8 u - 6 \log_8 v$

17) $12 \log_3 u - 4 \log_3 v = \log_3 u^{12} - \log_3 v^4$
 $= \log_3 \left(\frac{u^{12}}{v^4}\right)$

18) $\log_3 w + 2 \log_3 u + 5 \log_3 v$

19) $\log_6 d + \frac{\log_6 a}{3} + \frac{\log_6 b}{3} + \frac{\log_6 c}{3}$
 $= \log_6 d + \log_6 a^{\frac{1}{3}} + \log_6 b^{\frac{1}{3}} + \log_6 c^{\frac{1}{3}}$
 $= \log_6 (d \cdot (abc)^{\frac{1}{3}}) = \log_6 (d \sqrt[3]{abc})$

20) $\log_7 3 + 3 \log_7 8 - 3 \log_7 11$

Use a calculator to approximate each to the nearest thousandth.

Hint- Use Change of Base Formula

21) $\log_5 41 = \frac{\log_{10} 41}{\log_{10} 5} = 2.307$

22) $\log_6 32$

23) $\log_6 62 = \frac{\log_{10} 62}{\log_{10} 6} = 2.303$

24) $\log_7 1.3$

Simplifying Exponential Expressions

Simplify. Your answer should contain only positive exponents with no fractional exponents in the denominator.

1) $3v^3 \cdot 2v^3$ $6v^6$

2) $2m^3 \cdot 3m^2$

3) $2v^2 \cdot v^3$ $2v^5$

4) $3x \cdot x$

5) $(-x^3 y^5 \cdot x^{-5})^2 \cdot -yx^2$
 $1x^6 y^{10} x^{-10} (-y)x^2$
 $x^{-2} (-y)^{11} = \frac{-y^{11}}{x^2}$

6) $(x^{-5} y^3)^4 \cdot (-x^0 y^5)^5$

7) $(n^5 \cdot m^0 n^{-5})^2$ $n^{10} m^0 n^{-10} = 1$

8) $-x^4 y^{-5} \cdot -x^{-1} y^5 \cdot (x^{-5} y^{-4})^{-1}$

9) $(x^{-3} y^{-5})^4 \cdot x^3 y^{-4}$
 $x^{-12} y^{-20} x^3 y^{-4} = x^{-9} y^{-24} = \frac{1}{x^9 y^{24}}$

10) $(-x^5 y^{-5})^4 \cdot (x^{-3})^4$

11) $y^{-4} \cdot x^4 y^{-2} \cdot (-x^3 y^3)^2$
 $y^{-6} x^4 \cdot 1 \cdot x^6 y^6 = x^{10}$

12) $(-x^{-2} y^{-1} \cdot x^{-1} y^3)^{-3}$

13) $\frac{x^{-3} y^0 \cdot (xy^{-3})^2}{2x^0} = \frac{x^{-3} x^2 y^{-6}}{2} = \frac{x^{-1} y^{-6}}{2} = \frac{1}{2xy^6}$

14) $\frac{b}{(a^2 b^3)^2 \cdot 2b^4}$

15) $\frac{2x^4 y^2 \cdot yx^{-3}}{(2x^2 y^2 \cdot yx^{-1})^{-3}}$
 $\frac{2x^4 y^2 y^2 x^6 y^6 y^3 x^{-3}}{x^3}$
 $= \frac{16x^7 y^{12}}{x^3} = 16x^4 y^{12}$

16) $\left(\frac{yx^{-3} \cdot 2x^0 y^3}{2xy^3}\right)^2$

17) $\frac{(2xy)^0}{y^3 \cdot 2x^4 y^3}$

18) $\frac{(x^0 y^2)^3}{2xy^2 \cdot y^{-3}}$

$= \frac{1}{2x^4 y^6}$