

Unit 5 Lesson #1 Exponents Review
Pre-Calculus CP REVIEW FOR MSA

Name: Key

A. Properties of Exponents

1) Product of Powers $a^m a^n = a^{m+n}$

a) $5g^4 \cdot 4g^3 = \underline{20g^7}$

2) Powers of Powers $(a^m)^n = a^{mn}$

b) $(2x^4)^3 = \underline{8x^{12}}$

3) Power of Products $(ab)^m = a^m b^m$

c) $3x^2(2x)^4 = \underline{48x^6}$
 $3x^2 \cdot 16x^4 =$

4) Dividing Powers $\frac{a^m}{a^n} = a^{m-n}$

d) $\frac{5k^7}{15k^2} = \underline{\frac{k^5}{3}}$

5) Power of a Quotient $\left(\frac{a}{b}\right)^m = \frac{a^m}{b^m}$

e) $\left(\frac{-2m}{n}\right)^4 = \underline{\frac{-16m^4}{n^4}}$

6) Negative Exponents $a^{-n} = \frac{1}{a^n}$

f) $\left(\frac{x^2}{y^3}\right)^{-2} = \underline{\frac{y^6}{x^4}}$
 $\left(\frac{y^3}{x^2}\right)^2 =$

B. Rational Exponents $a^{\frac{m}{n}} = \sqrt[n]{a^m}$

7) $a^0 = 1$ $a^0 = 1$

Simplify each example using rational exponents:

a) $\sqrt[10]{c^{5k}} = \underline{c^{\frac{5k}{10}} = c^{\frac{k}{2}}}$

C. Radical Operation Rules. Multiply coefficients with coefficients. You may only add or subtract terms with LIKE BASES.

a) $5\sqrt{3} \cdot 6\sqrt{2} = \underline{30\sqrt{6}}$
 $30\sqrt{6}$

b) $7\sqrt{3} + 6\sqrt{2} = \underline{\text{same}}$
like
 $7x + 6y$

c) $5\sqrt{20} - 3\sqrt{45} = \underline{\sqrt{5}}$
 $5\sqrt{4} \sqrt{5} - 3\sqrt{9} \sqrt{5}$
 $10\sqrt{5} - 9\sqrt{5} = \sqrt{5}$

Simplify each expression.

1. Create like bases if possible! 2. Simplify any exponents if possible. 3. Use rules of exponents

$$1) 2^{\sqrt{3}} \cdot 2^{\sqrt{27}} = 2^{4\sqrt{3}}$$

$$= 2^{\sqrt{3}} \cdot 2^{\sqrt{9}\sqrt{3}}$$

$$= 2^{\sqrt{3}} \cdot 2^{3\sqrt{3}}$$

$$= 2^{4\sqrt{3}}$$

$$2) 3^{\sqrt{2}} \cdot 9^{\sqrt{2}} = 3^{3\sqrt{2}}$$

$$3^{\sqrt{2}} \cdot 3^{2\sqrt{2}}$$

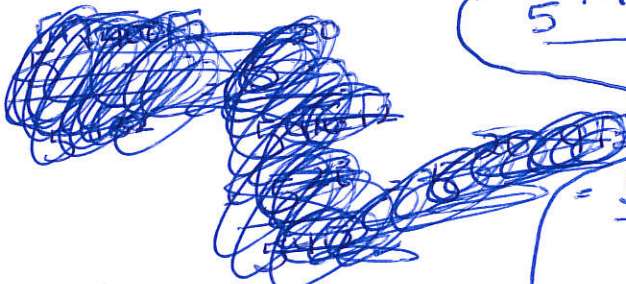
$$= 3^{3\sqrt{2}}$$

$$3) \frac{2^{\sqrt{48}}}{2^{\sqrt{27}}} = 2^{\sqrt{3}}$$

$$\frac{2^{\sqrt{16}\sqrt{3}}}{2^{\sqrt{9}\sqrt{3}}}$$

$$= \frac{2^{4\sqrt{3}}}{2^{3\sqrt{3}}} = 2^{\sqrt{3}}$$

$$4) \frac{5^{\sqrt{8}} 5^{\sqrt{50}}}{5^{\sqrt{32}}} = 5^{3\sqrt{2}}$$



$$5) 2^{4x+3} \cdot 2^{3x-7} = 2^{7x-4}$$

$$\frac{5^{\sqrt{4}\sqrt{2}} \cdot 5^{\sqrt{25}\sqrt{2}}}{5^{\sqrt{16}\sqrt{2}}}$$

$$= \frac{5^{2\sqrt{2}} \cdot 5^{5\sqrt{2}}}{5^{4\sqrt{2}}}$$

$$= 5^{3\sqrt{2}}$$

$$6) \frac{(3x^2)^3}{6x^2} = \frac{9x^4}{2}$$

$$\frac{27x^6}{6x^2}$$

$$= \frac{3 \cdot 9 \cdot x^6}{3 \cdot 2 \cdot x^2}$$

$$= \frac{9x^4}{2}$$

$$7) \frac{20m^4n}{5(mn)^3} = \frac{4m}{n^2}$$

$$\frac{20}{5} \cdot \frac{m^4}{m^3} \cdot \frac{n}{n^3}$$

$$= \frac{4m}{n^2}$$

Solve each equation. If possible, write using like bases first! Then equate the exponents!

$$7) 3^3 = 3^x$$

$$x = 3$$

$$8) 16 = 4^{x-1}$$

$$4^2 = 4^{x-1}$$

$$2 = x-1$$

$$x = 3$$

$$9) 16^{2x+3} = 64^{\frac{2}{3}}$$

$$4^{2(2x+3)} = 4^{3(\frac{2}{3})}$$

$$4x+6 = 2$$

$$4x = -4$$

$$x = -1$$

$$10) \frac{1}{25} = 5^{x+2}$$

$$5^{-2} = 5^{x+2}$$

$$-2 = x+2$$

$$-4 = x$$

16 ⁵ 16 ² 4 ¹ 4 ¹ 4

Independent Practice

Simplify each expression without using a calculator (Write all answers without negative exponents).

1) $(-3m)^4$ $81m^4$

2) $-(3m)^4$ $-81m^4$

3) $\frac{1}{4x^0 + 2y^0}$ $\frac{1}{6}$

4) $\frac{(3y^5)^2}{(3y^{-3})^3}$ $\frac{y^{19}}{3}$
 $= \frac{9y^{10}}{27y^{-9}} = \frac{y^{19}}{3}$

5) $\frac{(6a^3b^{-5}c^5)^2}{4(a^2bc^3)^3}$ $\frac{9c}{b^{13}}$
 $= \frac{36a^6b^{-10}c^{10}}{4a^6b^3c^9} = \frac{9c}{b^{13}}$

6) $7^{3\sqrt{5}} \div 7^{\sqrt{5}}$ $7^{2\sqrt{5}}$
 $\frac{7^{3\sqrt{5}}}{7^{\sqrt{5}}}$

7) $(m^{\sqrt{10}})^{\sqrt{20}}$ $m^{10\sqrt{2}}$
 $= m^{\sqrt{200}}$
 $= m^{\sqrt{100} \cdot 2}$
 $= m^{10\sqrt{2}}$

8) $\sqrt{8} \cdot \sqrt{96}$ $12\sqrt{12}$
 $\sqrt{4} \sqrt{2} \sqrt{4} \sqrt{4} \sqrt{6} = 8\sqrt{12} = 8\sqrt{4} \sqrt{3} = 16\sqrt{3}$

9) $4\sqrt{5} - \sqrt{20}$ $2\sqrt{5}$
 $4\sqrt{5} - 2\sqrt{5}$

10) $(3\sqrt{2} - 4\sqrt{6})^2$ $114 - 48\sqrt{3}$

11) $\sqrt{24} - \sqrt{8} + 13\sqrt{2} - 5\sqrt{96}$ $-18\sqrt{6} + 14\sqrt{2}$

12) $\sqrt{x^7} \cdot x^{\frac{5}{2}} \cdot x^{\frac{3}{2}}$ $x^7 \sqrt{x}$
 $x^{\frac{7}{2}} \cdot x^{\frac{5}{2}} \cdot x^{\frac{3}{2}} = x^{\frac{15}{2}} = \sqrt{x^4} \cdot x^{\frac{7}{2}} = x^2 \sqrt{x}$

$(3\sqrt{2} - 4\sqrt{6})(3\sqrt{2} - 4\sqrt{6})$
 $= 18 - 12\sqrt{12} - 12\sqrt{12} + 16 \cdot 6$
 $= 18 + 96 - 24\sqrt{4} \sqrt{3}$
 $= 114 - 48\sqrt{3}$

$\sqrt{4} \sqrt{6} - 4\sqrt{2}$
 $+ 13\sqrt{2} - \sqrt{4} \cdot \sqrt{4} \sqrt{6}$
 $= 2\sqrt{6} - 2\sqrt{2} + 13\sqrt{2}$
 $- 4\sqrt{6}$
 $= 11\sqrt{2} - 18\sqrt{6}$

13) $(c^{\sqrt{6}})^{\sqrt{63}}$ $c^{3\sqrt{42}}$
 $(c^{\sqrt{6}})^{\sqrt{7} \sqrt{9}} = c^{3\sqrt{42}}$

14) $(x^{\sqrt{2}} y^{3\sqrt{2}})^{\sqrt{2}}$ $x^2 y^6$

15) $32^{\sqrt{5}} \div 4^{\sqrt{5}}$ $2^{3\sqrt{5}}$
 $\frac{2^{5\sqrt{5}}}{2^{2\sqrt{5}}} = 2^{3\sqrt{5}}$

$$16) 25^{\sqrt{2}} \cdot 125^{\sqrt{2}} = \frac{5^{2\sqrt{2}} \cdot 5^{3\sqrt{2}}}{5^{5\sqrt{2}}}$$

$$17) 32^{\sqrt{3}} \cdot 16^{\sqrt{2}} = \frac{2^{5\sqrt{3}} \cdot 2^{4\sqrt{2}}}{2^{4\sqrt{2} + 5\sqrt{3}}}$$

$$18) (r^{\sqrt{3}} \cdot p^{\sqrt{5}})^2 = \frac{r^{2\sqrt{3}} p^{2\sqrt{5}}}{r^{2\sqrt{3}} p^{2\sqrt{5}}}$$

*** You cannot distribute an exponent over an addition or subtraction. Use binomial multiplication (FOIL)

$$19) (r^{\sqrt{3}} + p^{\sqrt{5}})^2 =$$

$$(r^{\sqrt{3}} + p^{\sqrt{5}})(r^{\sqrt{3}} + p^{\sqrt{5}}) = r^{2\sqrt{3}} + 2r^{\sqrt{3}}p^{\sqrt{5}} + p^{2\sqrt{5}}$$

$$20) (n^{\sqrt{6}} + w^{\sqrt{3}})(n^{\sqrt{6}} - w^{\sqrt{3}}) =$$

$$n^{2\sqrt{6}} - w^{2\sqrt{3}}$$

Solve each equation - See if you can rewrite using like bases and equate the exponents!

$$21) 6^y = 6^{3y+1}$$

$$y = 3y + 1$$

$$-2y = 1$$

$$y = -1/2$$

$$22) 4^{x+1} = 8^{2x+3}$$

$$2^{2(x+1)} = 2^{3(2x+3)}$$

$$2x + 2 = 6x + 9$$

$$-4x = 7$$

$$x = -7/4$$

$$23) 3^{2x-1} = \frac{1}{9}$$

$$3^{2x-1} = 3^{-2}$$

$$2x - 1 = -2$$

$$2x = -1$$

$$x = -1/2$$

$$24) 8^{2n} = 16^{n-3}$$

$$2^{6n} = 2^{4n-12}$$

$$2n = -12$$

$$n = -6$$

$$25) 9^{2x-1} = 27^{x+4}$$

$$3^{2(2x-1)} = 3^{3(x+4)}$$

$$4x - 2 = 3x + 12$$

$$x = 14$$

$$26) 5^{2x+3} = (\sqrt{5})^{x+4}$$

$$= 5^{1/2(x+4)}$$

$$2x + 3 = \frac{1}{2}x + 2$$

$$\frac{3}{2}x = -1$$

$$x = -2/3$$

$$27) 2^{3x-1} = \left(\frac{1}{8}\right)^x$$

$$2^{3x-1} = 2^{-3x}$$

$$3x - 1 = -3x$$

$$6x = 1 \quad x = 1/6$$

$$28) \left(\frac{1}{16}\right)^{x+1} = \left(\frac{1}{64}\right)^{2x-1}$$

$$4^{-2(x+1)} = 4^{-3(2x-1)}$$

$$-2x - 2 = -6x + 3$$

$$-5 = -4x$$

$$x = 5/4$$

$$29) 5^{x+2} = 7^x$$

no like bases
MUST USE CALCULATOR
INTERSECT not like bases.