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) $5g^4 \cdot 4g^3 =$ $20g^7$

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

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

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

c) $3x^2(2x)^4 =$ $48x^6$

$3x^2 \cdot 16x^4 =$

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

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

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

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

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

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

$\left(\frac{y^3}{x^2}\right)^2 =$

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

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

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

$30\sqrt{6}$

b) $7\sqrt{3} + 6\sqrt{2} =$ same

like

$7x + 6y$

c) $5\sqrt{20} - 3\sqrt{45}$ $\sqrt{5}$

$5\sqrt{4}\sqrt{5} - 3\sqrt{9}\sqrt{5}$

$10\sqrt{5} - 9\sqrt{5} = \sqrt{5}$

Simplify each expression.

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

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

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

$= 2^{1\sqrt{3}} \cdot 2^{3\sqrt{3}}$

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

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

$3^{1\sqrt{2}} \cdot 3^{2\sqrt{2}}$

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

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

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

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

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

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

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

$5^{\sqrt{16}\sqrt{2}}$

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

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

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

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

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

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

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

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

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

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

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

$4x + 6 = 2$

$4x = -4$

$x = -1$

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

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

$-2 = x + 2$

$-4 = x$

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) $\left(m^{\sqrt{10}}\right)^{\sqrt{20}}$ $m^{10\sqrt{2}}$

$= m^{\sqrt{200}}$

$= m^{\sqrt{100}\sqrt{2}}$

$= m^{10\sqrt{2}}$

8) $\sqrt{8}\sqrt{96}$ $12\sqrt{12}$

$\sqrt{4}\sqrt{2}\sqrt{4}\sqrt{4}\sqrt{6}$

$8\sqrt{12}$

$= 8\sqrt{4}\sqrt{3} = 16\sqrt{3}$

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

$4\sqrt{5} - 2\sqrt{5}$

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

$(3\sqrt{2} - 4\sqrt{6})(3\sqrt{2} - 4\sqrt{6})$

$= 18 - 12\sqrt{12} - 12\sqrt{12} + 16 \cdot 6$

$= 18 + 96 - 24\sqrt{4}\sqrt{3}$

$= 114 - 48\sqrt{3}$

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

$\sqrt{4}\sqrt{6} - 4\sqrt{2}$

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

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

$- 20\sqrt{6}$

$= 11\sqrt{2} - 18\sqrt{6}$

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

$x^{\frac{7}{2}} \cdot x^{\frac{5}{2}} \cdot x^{\frac{3}{2}}$

$= x^{\frac{15}{2}}$

$= \sqrt{x^{14}}\sqrt{x}$

$x^7\sqrt{x}$

13) $\left(c^{\sqrt{6}}\right)^{\sqrt{63}}$ $c^{3\sqrt{42}}$

$\left(c^{\sqrt{6}}\right)\left(c^{\sqrt{7}\sqrt{9}}\right)$

$= c^{3\sqrt{42}}$

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

$x^2 \cdot y^6$

15) $32^{\sqrt{5}} \div 4^{\sqrt{5}}$

$\frac{2^{5\sqrt{5}}}{2^{2\sqrt{5}}}$

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

16) $25^{\sqrt{2}} \cdot 125^{\sqrt{2}}$ _____

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

17) $32^{\sqrt{3}} \cdot 16^{\sqrt{2}}$ _____

$2^{5\sqrt{3}} \cdot 2^{4\sqrt{2}} =$ $2^{4\sqrt{2}+5\sqrt{3}}$

18) $\left(r^{\sqrt{3}} \cdot p^{\sqrt{5}}\right)^2$ _____

$\left(r^{\sqrt{3}} \cdot p^{\sqrt{5}}\right)\left(r^{\sqrt{3}} \cdot p^{\sqrt{5}}\right)$

$r^{2\sqrt{3}} \; p^{2\sqrt{5}}$

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

19) $\left(r^{\sqrt{3}} + p^{\sqrt{5}}\right)^2$ _____

$\left(r^{\sqrt{3}} + p^{\sqrt{5}}\right)\left(r^{\sqrt{3}} + r^{\sqrt{5}}\right)$

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

20) $\left(n^{\sqrt{6}} + w^{\sqrt{3}}\right)\left(n^{\sqrt{6}} - w^{\sqrt{3}}\right)$ _____

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

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) $5^{2x+3} = \left(\sqrt{5}\right)^{x+4}$ _____

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

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

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

$x = -2/3$

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

$2^{-1/2} = \sqrt{\frac{1}{8}}$

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

$3x - 1 = -3x$

$6x = 1$

$x = 1/6$

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) $5^{x+2} = 7^x$ not like bases

MUST USE CAL INTERSECT not like bases.