Honors Algebra 2 Name______________________

Properties of Exponents and Radicals Date____________ Block______

Rule/PROPERTY	Description	Example	Solution
Definitions.	In the algebraic term Ax^b, A is the coefficient, x is the base, and b is the exponent. The expression, Ax^b, is called a power.	$3x^2$: 3 is the coefficient, x is the base, and 2 is the power or exponent.	
1. $x^a \bullet x^b = x^{a+b}$	When you multiply powers that have the same base, you keep the base and *add* the exponents. **Multiply* the coefficients, whether or not the bases are the same.	1. $m^2 \bullet m^7$ 2. $2^3 \bullet 2^4$ 3. $2p^3 \bullet 4p^6$	1. m^9 2. $2^7 = 128$ 3. $8p^9$
2. $(x^a)^b = x^{a \bullet b}$	When you raise a power to a power, you keep the inner base and *multiply* the exponents.	4. $(x^3)^4$ 5. $(2^3)^2$	4. x^{12} 5. $2^6 = 64$
3. $(Axy)^b = A^b x^b y^b$	When you raise a product, (Axy), to an exponent, b, you raise *each factor* to that exponent.	6. $(3st)^2$ 7. $(a^2b^3)^2$	6. $3^2s^2t^2$ $9s^2t^2$ 7. a^4b^6
4. $x^{-a} = \frac{1}{x^a}, x \neq 0$	A base raised to a *negative* exponent equals the *reciprocal* of that base to the same *positive* exponent. $\left(\frac{1}{2}\right)^{-3} = \left(\frac{2}{1}\right)^3 = 8$	8. 3^{-3} 9. $\frac{m^{-6}n^3}{p^{-2}}$	8. $\frac{1}{3^3} = \frac{1}{27}$ 9. $\frac{n^3p^2}{m^6}$
5. $x^0 = 1, x \neq 0$	Any expression raised to the exponent of zero (0) is equal to one (1).	10. 972^0 11. $(-47x^3y^{-5})^0$	10. 1 11. 1
6. $\frac{x^a}{x^b} = x^{a-b}$	When you *divide* powers that have the same base, you keep the base and *subtract* the exponents.	12. $\frac{s^{12}}{s^4}$ 13. $\frac{6^{10}}{6^8}$ 14. $\frac{9s^2}{3s^6}$ $3s^{-4}$	12. s^8 13. $6^2 = 36$ 14. $\frac{3}{s^4}$
7. $\left(\frac{x}{y}\right)^a = \frac{x^a}{y^a}$	When you raise a quotient to an exponent, you raise (each factor in) the numerator to the exponent and (each factor in) the denominator to the exponent.	15. $\left(\frac{x}{y}\right)^5$ 16. $\left(\frac{5x}{6y}\right)^2$	15. $\frac{x^5}{y^5}$ 16. $\frac{5^2x^2}{6^2y^2} = \frac{25x^2}{36y^2}$

Properties of Exponents Practice

Use the properties of exponents to simplify the expressions.

1. $(x^3y^4)(x^2y^5)$

x^5y^9

2. $\frac{x^{2y}}{x^y}$

x^y

3. $(x^2y)^3$

x^6y^3

4. $\frac{3x^3y^8}{81x^4y^5}$

$\frac{y^3}{27x}$

5. $(x^6y^2z^{15})^0$

1

6. $2^x \bullet 2^x$

2^{2x}

2^{2x}

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

7. $(x^7)^y$

x^{7y}

8. $\frac{m^{-4}}{m^{-2} \bullet m^2} = \frac{m^{-4}}{m^0} = m^{-4} = \frac{1}{m^4}$

$\frac{\cancel{m^2}}{m^4\cancel{m^2}} = \frac{1}{m^4}$

9. $(x^{2y})(x^{3y})$

x^{5y}

10. $\left(\frac{c^9}{d^3}\right)^2$

$\frac{c^{18}}{d^6}$

Simplifying using Properties of Radicals (not using your calculator)

Properties of Radicals

Product Property $\sqrt{ab} = \sqrt{a} \bullet \sqrt{b}$ Quotient Property $\sqrt{\frac{a}{b}} = \frac{\sqrt{a}}{\sqrt{b}}$

I. A square root expression is written in simplest form when the radicand has no perfect square factors.

Write each radical expression in simplest form; assume all variables are positive.

1. $\sqrt{20} = \sqrt{4}\cdot\sqrt{5}$ $\boxed{2\sqrt{5}}$	2. $\sqrt{54}$ $\sqrt{9}\cdot\sqrt{6}$ $\boxed{3\sqrt{6}}$	3. $\sqrt{300}$ $\sqrt{100}\cdot\sqrt{3}$ $\boxed{10\sqrt{3}}$
4. $\sqrt{108} \to \sqrt{36}\cdot\sqrt{3} = \boxed{6\sqrt{3}}$ $\sqrt{9}\cdot\sqrt{12}$ $\sqrt{9}\cdot\sqrt{4}\cdot\sqrt{3}$ $3\cdot 2\sqrt{3}$ $\boxed{6\sqrt{3}}$	5. $(2-\sqrt{5})(1-\sqrt{3})$ $2-2\sqrt{3}-\sqrt{5}+\sqrt{15}$ ✓	6. $(3+\sqrt{7})(3-\sqrt{7})$ FOIL $9-\cancel{3\sqrt{7}}+\cancel{3\sqrt{7}}-\sqrt{49}$ $9-7=\boxed{2}$

* radical conjugates *
$a+\sqrt{b},\ a-\sqrt{b}$

II. A radical expression with index or root *n* is written in simplest form when there are no radicals in the denominator (rationalize the denominator).

Write each radical expression in simplest form; assume all variables are positive.

7. $\frac{2}{\sqrt{5}}\cdot\frac{\sqrt{5}}{\sqrt{5}} = \frac{2\sqrt{5}}{\sqrt{25}} = \boxed{\frac{2\sqrt{5}}{5}}$	8. $\sqrt{\frac{3}{10}} = \frac{\sqrt{3}}{\sqrt{10}}\cdot\frac{\sqrt{10}}{\sqrt{10}} = \frac{\sqrt{30}}{\sqrt{100}} = \frac{\sqrt{30}}{10}$
9. $\frac{4}{5+\sqrt{2}}\cdot\frac{5-\sqrt{2}}{5-\sqrt{2}} = \frac{4(5-\sqrt{2})}{23} = \boxed{\frac{20-4\sqrt{2}}{23}}$ $(5+\sqrt{2})(5-\sqrt{2})$ $25-\cancel{5\sqrt{2}}+\cancel{5\sqrt{2}}-\sqrt{4}$ $25-2=23$	10. $\frac{3}{(4-\sqrt{7})}\cdot\frac{4+\sqrt{7}}{(4+\sqrt{7})} = \frac{\cancel{3}^{1}(4+\sqrt{7})}{\cancel{9}\ 3}$ $16-\sqrt{49}$ $16-7=9$ $\frac{4+\sqrt{7}}{3}$

Simplifying Radicals Additional Practice
Show work as needed on a separate sheet of paper; copy your answer onto this sheet.

RADICALS ARE IN SIMPLEST FORM WHEN…
☆ NO perfect square factors other than 1 are under the radical.
☆ NO fractions are under the radical
☆ NO radicals are in the denominator

1. $\sqrt{98}$ $7\sqrt{2}$

2. $\sqrt{63}$ $3\sqrt{7}$

3. $-4\sqrt{40}$ $-8\sqrt{10}$

4. $\sqrt{2}(3\sqrt{14}-\sqrt{7})$ $6\sqrt{7}-\sqrt{14}$

$3\sqrt{28}-\sqrt{14}$

$3\cdot 2\sqrt{7}-\sqrt{14}$

5. $\sqrt{5}(8\sqrt{10}+1)$ $40\sqrt{2}+\sqrt{5}$

6. $\sqrt{7}(3-2\sqrt{7})$ $-14+3\sqrt{7}$

$3\sqrt{7}-2\sqrt{49}$ $a+\sqrt{b}$

$3\sqrt{7}-2(7)$

$3\sqrt{7}-14$

7. $\sqrt{\frac{5}{15}}$ $\frac{\sqrt{3}}{3}$

8. $\sqrt{\frac{250}{2}}$ $5\sqrt{5}$

9. $\frac{7}{6-\sqrt{2}}$ $\frac{42+7\sqrt{2}}{34}$

10. $\frac{2}{3+\sqrt{5}}$ $\frac{3-\sqrt{5}}{2}$

11. $2\sqrt{45}-2\sqrt{5}$ $4\sqrt{5}$

$2\cdot 3\sqrt{5}-2\sqrt{5}$

$6\sqrt{5}-2\sqrt{5}$

12. $3\sqrt{18}+3\sqrt{12}+2\sqrt{27}$

$9\sqrt{2}+12\sqrt{3}$

9 $\frac{7}{6-\sqrt{2}} \cdot \frac{6+\sqrt{2}}{6+\sqrt{2}} = \frac{7(6+\sqrt{2})}{34} = \frac{42+7\sqrt{2}}{34}$

$= \frac{42}{34} + \frac{7\sqrt{2}}{34}$

$\frac{21}{17} + \frac{7\sqrt{2}}{34}$

D: $(6-\sqrt{2})(6+\sqrt{2})$

$36-\sqrt{4}$

$36-2=34$