Unit 4: 1/31/17 or 2/1/17

1. Review of Properties of Exponents
2. Simplifying Expressions
3. Converting between Rational and Exponent Form)

Properties of Exponents

Let a and b be real numbers and let m and n be integers.

Product of Powers Property	$a^m \cdot a^n = a^{m+n}$
Power of a Power Property	$(a^m)^n \quad a^{mn}$
Power of a Product Property	$(ab)^m \quad a^m b^m$
Negative Exponent Property	$a^{-m} \quad \frac{1}{a^m} \quad a \neq 0$
Zero Exponent Property	$a^0 = 1 \quad a \neq 0$
Quotient of Powers Property	$\frac{a^m}{a^n} = a^{m-n} \quad a \neq 0$
Power of a Quotient Property	$\left(\frac{a}{b}\right)^m = \frac{a^m}{b^m} \quad b \neq 0$

Properties of Exponents Worksheet Name_____

Evaluate the expression.

1. $4^2 \cdot 4^4$ 2. $(b^2)^4$ 3. $\frac{5^7}{5^4}$

4. $\left(\frac{3}{7}\right)^0$ 5. $\frac{7^7}{2^7}$ 6. $(9)(9)^2$

Simplify the expression

7. $a^5 \cdot a^3$ 8. $(x^4)^2$ 9. $(4a^2b^3)^2$

10. $\frac{x^5}{x^2}$ 11. $\frac{x^5}{x^2}$ 12. $\frac{x^5}{x^2}$

13. $\left(\frac{4a^2y^7}{2b^3}\right)^2$ 14. $(2^3x^2)^3$ 15. $(x^3y^7)^3$

16. $\frac{x^{10}y^{20}}{x^7y^3}$ 17. $3x^{-4}y^0$ 18. $\frac{5x^3y^4}{70x^7y^{-2}}$

19. $\frac{x^5}{x^{-2}}$ 20. $\frac{x^5y^7}{x^{-2}y^0}$ 21. $(x^3)^0$

22. $(10x^5y^4)^3$ 23. $\frac{x^{-2}y}{xy^{-2}}$ 24. $(4x^2y^0)^2$

25. $\frac{7x^2y}{6xy^7}$ 26. $\frac{xy^0}{3y^{-2}} \cdot \frac{-7y}{21x^8}$ 27. $\frac{12xy}{7x^3} \cdot \frac{7x^5y^2}{4y}$

Name:			Date:
Topic: Converting Between Radical and Exponents			Block:
Main Ideas/Questions	Notes/Examples		
Warm-Up List the perfect squares, cubes, and fourths.	Perfect Squares:		
	Perfect Cubes:		
	Perfect Fourths:		
Parts of a Radical	The n^{th} root of a real number, a, can be written as the radical expression $\sqrt[n]{a}$ $\sqrt[n]{a}$ *If there is **no index**, it is assumed that _____.		
Number of Roots	Give ALL POSSIBLE ROOTS to the radicals below.		
	$\sqrt{16} =$	$\sqrt{121} =$	$\sqrt{289} =$	$\sqrt{\frac{4}{25}} =$
	$\sqrt[3]{8} =$	$\sqrt[3]{343} =$	$\sqrt[3]{-125} =$	$\sqrt[3]{-\frac{1}{27}} =$
	$\sqrt[4]{1} =$	$\sqrt[4]{2.401} =$	$\sqrt[4]{4.096} =$	$\sqrt[4]{\frac{81}{16}} =$

Index	Radicand	Type of Roots	# of Roots
Even	Positive		
Odd	Positive		
Odd	Negative		
★ Even	Negative		

Simplifying Radicals	*If a radical has **more than one root**, the radical sign indicates only the **principal, or positive, root**.	
	1. $\sqrt{117}$	2. $4\sqrt{320}$
	3. $2\sqrt[3]{48}$	4. $3\sqrt[3]{108}$

	5. $\sqrt[3]{-250}$	6. $6\sqrt[4]{-2}$	
	7. $3\sqrt{162}$	8. $5\sqrt[3]{2.592}$	
Radicals with Variables	**Square Roots** Exponents must be multiples of ____	**Cube Roots** Exponents must be multiples of ____	**4th Roots** Exponents must be multiples of ____
	9. $\sqrt{32x^4y^8}$	10. $\sqrt{324x^2y^2}$	
	11. $\sqrt[3]{216m^3n^9}$	12. $\sqrt[4]{56^4x^4}$	
	13. $\sqrt[3]{-64c^{33}p^{21}}$	14. $\sqrt[5]{-81p^{27}q^{22}}$	
	15. $\sqrt[5]{w^4v^{17}}$	16. $\sqrt[3]{48m^8n^3}$	
	17. $\sqrt[4]{625c^{23}d^{12}}$	18. $\sqrt[3]{(y+3)^6}$	

Name: Date:

Topic: Class:

Main Ideas/Questions	Notes/Examples		
RATIONAL EXPONENTS	Expressions with rational exponents can be rewritten as radicals using the following rules:		
	Exponential Form	**Meaning**	**Radical Form**
	$a^{\frac{1}{n}}$	The n^{th} root of a	$a^{\frac{1}{n}} =$
	$a^{\frac{m}{n}}$	The n^{th} root of a, raised to the m^{th} power	$a^{\frac{m}{n}} =$
Converting between Exponential & Radical Form	**Directions:** Write each expression in **radical form**. Simplify if needed.		
	1. $x^{\frac{1}{4}}$	2. $(15n)^{\frac{1}{2}}$	3. $24^{\frac{1}{3}}$
	4. $7^{\frac{2}{3}}$	5. $k^{\frac{2}{5}}$	6. $3^{\frac{3}{4}}$
	7. $(ab)^{\frac{3}{4}}$	8. $(-6v)^{\frac{1}{3}}$	9. $7(12w)^{\frac{1}{3}}$
	Directions: Write each expression in **exponential form**.		
	10. $\sqrt[3]{16}$	11. $\sqrt{xy}$	12. $\sqrt[4]{8w}$
	13. $\sqrt[3]{11^2}$	14. $\sqrt[4]{k^3}$	15. $\left(\sqrt{3m}\right)^7$
	16. $\left(\sqrt[5]{-2a}\right)^3$	17. $\sqrt{10^3x^5b}$	18. $\sqrt[3]{9x^7y^4}$

Simplifying Expressions with Rational Exponents		
	① Rewrite all radicals in **exponential form**.	
	② Use the **exponent rules** to simply the expression.	
	③ Write your **answer as a radical in simplest form**. Rationalize if needed.	
	19. $x^{\frac{1}{3}} \cdot x^{\frac{4}{3}}$	20. $p^{\frac{1}{4}} \cdot p^{\frac{3}{4}}$
	21. $\frac{m^{\frac{3}{7}}}{m^{\frac{4}{7}}}$	22. $\left(\frac{1}{a^3}\right)^{\frac{1}{3}}$
	23. $\left(32^{\frac{1}{5}}\right)^{\frac{1}{2}}$	24. $(8x^2)^{\frac{2}{3}}$
	25. $100^{-\frac{1}{2}}$	26. $16^{\frac{3}{4}} \cdot 16^{-\frac{1}{4}}$
	27. $(-216)^{\frac{1}{3}}$	28. $\left(\frac{112}{7}\right)^{\frac{1}{4}}$
	29. $\sqrt[3]{v} \cdot \sqrt{v}$	30. $\sqrt[3]{r^2} \cdot \sqrt{r}$
	31. $\frac{4}{\sqrt[3]{4}}$	32. $\frac{\sqrt{7^3}}{\sqrt{7}}$
	33. $\sqrt[3]{x^{10}}$	34. $\sqrt[3]{25m^2}$

Name: _____ **Unit 6:** Radical Functions

Date: _____ **Bell:** _____ **Homework 4:** Rational Exponents

Directions: Rewrite each expression in **radical form**. Simplify if needed.

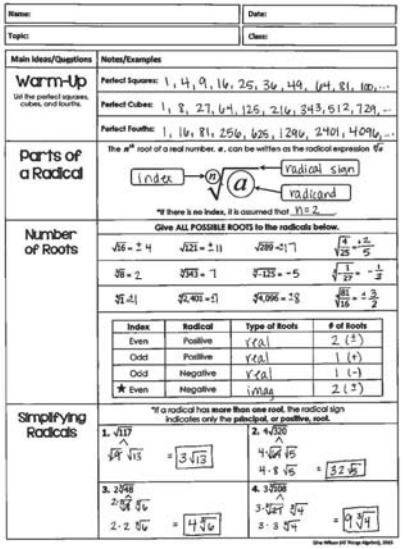
1. $28^{\frac{1}{2}}$	2. $2^{\frac{1}{3}}$	3. $x^{\frac{1}{3}}$
4. $(256z)^{\frac{1}{4}}$	5. $(mn)^{\frac{2}{3}}$	6. $(-2x)^{\frac{4}{5}}$

Directions: Rewrite each expression in **exponential form**.

7. $\sqrt[3]{10^2}$	8. $\sqrt{3ab}$	9. $\left(\sqrt[3]{2w}\right)^5$	10. $\sqrt[3]{18x^3y^2}$

Directions: Simplify each expression. **Give final answers in simplest radical form.**

11. $5^{\frac{1}{2}} \cdot 5^{\frac{1}{2}}$	12. $\frac{x^{\frac{2}{3}}}{x^{\frac{1}{3}}}$	13. $\left(28^{\frac{1}{2}}\right)^{\frac{1}{2}}$
14. $(-64)^{\frac{1}{3}}$	15. $45^{\frac{1}{2}} \cdot 45^{\frac{1}{2}}$	16. $2\left(\frac{48}{3}\right)^{\frac{1}{4}}$
17. $\sqrt[3]{p} \cdot \sqrt{p^3}$	18. $\frac{\sqrt[3]{24^4}}{24}$	19. $\frac{m}{\sqrt[3]{m}}$
20. $\frac{16}{\sqrt[3]{16^2}}$	21. $\sqrt[4]{x^3y^{12}}$	22. $\sqrt[3]{36w^8}$



Name: Date:

Topic: Class:

Main Ideas/Questions | **Notes/Examples**

Warm-Up

List the perfect squares, cubes, and fourths.

Perfect Squares: 1, 4, 9, 16, 25, 36, 49, 64, 81, 100, ...

Perfect Cubes: 1, 8, 27, 64, 125, 216, 343, 512, 729, ...

Perfect Fourths: 1, 16, 81, 256, 625, 1296, 2401, 4096, ...

Parts of a Radical

The n^{th} root of a real number, a, can be written as the radical expression $\sqrt[n]{a}$

$\sqrt[n]{a}$ — index: n; radicand: a; radical sign

*If there is no index, it is assumed that $n=2$

Number of Roots

Give ALL POSSIBLE ROOTS to the radicals below.

$\sqrt{16} = \pm 4$ $\sqrt{121} = \pm 11$ $\sqrt{289} = \pm 17$ $\sqrt{\frac{4}{25}} = \pm\frac{2}{5}$

$\sqrt[3]{8} = 2$ $\sqrt[3]{343} = 7$ $\sqrt[3]{-125} = -5$ $\sqrt[3]{\frac{1}{27}} = -\frac{1}{3}$

$\sqrt[4]{1} = \pm 1$ $\sqrt[4]{2,401} = \pm 7$ $\sqrt[4]{4,096} = \pm 8$ $\sqrt[4]{\frac{81}{16}} = \pm\frac{3}{2}$

Index	Radical	Type of Roots	# of Roots
Even	Positive	$\sqrt{a}$	2 (±)
Odd	Positive	$\sqrt[n]{a}$	1 (+)
Odd	Negative	$\sqrt[n]{a}$	1 (−)
★ Even	Negative	imag	2 (±)

Simplifying Radicals

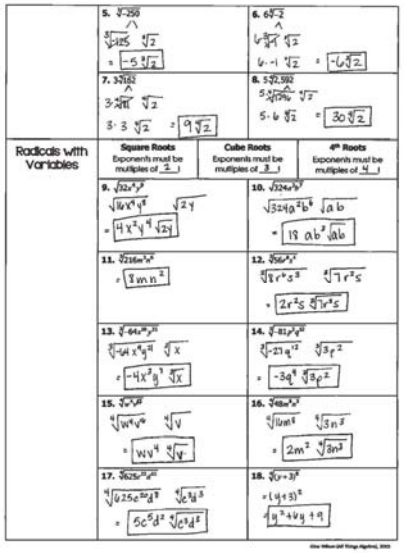
*If a radical has **more than one root**, the radical sign indicates only the **principal, or positive, root.**

1. $\sqrt{117} = \sqrt{9}\cdot\sqrt{13} = 3\sqrt{13}$

2. $4\sqrt{320} = 4\cdot\sqrt{64}\cdot\sqrt{5} = 4\cdot 8\sqrt{5} = 32\sqrt{5}$

3. $2\sqrt[3]{48} = 2\cdot\sqrt[3]{8}\cdot\sqrt[3]{6} = 2\cdot 2\sqrt[3]{6} = 4\sqrt[3]{6}$

4. $3\sqrt[3]{108} = 3\cdot\sqrt[3]{27}\cdot\sqrt[3]{4} = 3\cdot 3\sqrt[3]{4} = 9\sqrt[3]{4}$



Radicals with Variables

Square Roots (Exponents must be multiples of 2)	Cube Roots (Exponents must be multiples of 3)	4th Roots (Exponents must be multiples of 4)

5. $\sqrt{250} = \sqrt{125}\cdot\sqrt{2} = -5\sqrt{2}$

6. $6\sqrt[3]{2} = 6\cdot\sqrt[3]{1}\cdot\sqrt[3]{2} = 6\cdot 1\cdot\sqrt[3]{2} = 6\sqrt[3]{2}$

7. $3\sqrt[3]{162} = 3\cdot\sqrt[3]{81}\cdot\sqrt[3]{2} = 3\cdot 3\sqrt[3]{2} = 9\sqrt[3]{2}$

8. $5\sqrt[5]{2,592} = 5\sqrt[5]{1,296}\cdot\sqrt[5]{2} = 5\cdot 6\sqrt[5]{2} = 30\sqrt[5]{2}$

9. $\sqrt{324x^4y^8} = \sqrt{16}\sqrt{x^4}\sqrt{y^8}\sqrt{2y} = 4x^2y^4\sqrt{2y}$

10. $\sqrt{3240a^2b^6} = \sqrt{324}\sqrt{a^2}\sqrt{b^6}\sqrt{ab} = 18ab^3\sqrt{ab}$

11. $\sqrt[3]{216m^3n^6} = 6mn^2$

12. $\sqrt[5]{56r^7s^5} = \sqrt[5]{8r^5s^5}\sqrt[5]{7r^2s} = 2rs\sqrt[5]{7r^2s}$

13. $\sqrt[3]{-64x^9y^{12}}\sqrt[3]{x} = -4x^3y^4\sqrt[3]{x}$

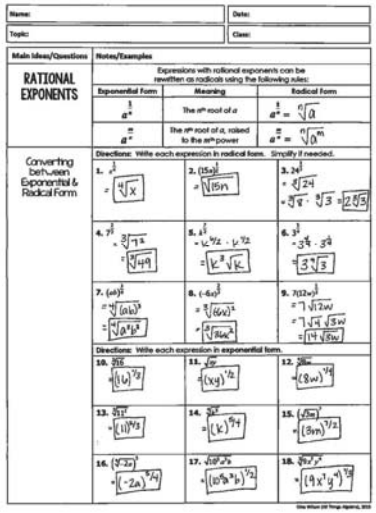
14. $\sqrt[3]{-81p^9q^{12}}\sqrt[3]{3p^2} = -3q^4\sqrt[3]{3p^2}$

15. $\sqrt[4]{w^4v^9}\sqrt[4]{v} = wv^2\sqrt[4]{v}$

16. $\sqrt[4]{16m^8n^3}\sqrt[4]{3n^3} = 2m^2\sqrt[4]{3n^3}$

17. $\sqrt[4]{625c^{20}d^8}\sqrt[4]{c^3d^3} = 5c^5d^2\sqrt[4]{c^3d^3}$

18. $\sqrt{(y+3)^2} = (y+3)^2 = y^2+6y+9$



Name: Date:

Topic: Class:

Main Ideas/Questions | **Notes/Examples**

RATIONAL EXPONENTS

Expressions with rational exponents can be rewritten as radicals using the following rules:

Exponential Form	Meaning	Radical Form
$a^{\frac{1}{n}}$	The n^{th} root of a	$a^{\frac{1}{n}} = \sqrt[n]{a}$
$a^{\frac{m}{n}}$	The n^{th} root of a, raised to the m^{th} power	$a^{\frac{m}{n}} = \sqrt[n]{a^m}$

Converting between Exponential & Radical Form

Directions: Write each expression in radical form. Simplify if needed.

1. $x^{\frac{1}{4}} = \sqrt[4]{x}$

2. $(15n)^{\frac{1}{2}} = \sqrt{15n}$

3. $24^{\frac{1}{3}} = \sqrt[3]{24} = \sqrt[3]{8}\cdot\sqrt[3]{3} = 2\sqrt[3]{3}$

4. $7^{\frac{2}{3}} = \sqrt[3]{7^2} = \sqrt[3]{49}$

5. $k^{\frac{3}{2}} = k^{1+\frac{1}{2}} = k^1\cdot k^{\frac{1}{2}} = k\sqrt{k}$

6. $3^{\frac{3}{4}} = 3^{\frac{2}{4}+\frac{1}{4}} = 3^{\frac{2}{4}}\cdot 3^{\frac{1}{4}} = 3\sqrt[4]{3}$

7. $(ab)^{\frac{3}{2}} = \sqrt{(ab)^3} = \sqrt{a^3b^3}$

8. $(-6w)^{\frac{2}{3}} = \sqrt[3]{(6w)^2} = \sqrt[3]{36w^2}$

9. $7(12w)^{\frac{1}{2}} = 7\sqrt{12w} = 7\sqrt{4}\sqrt{3w} = 14\sqrt{3w}$

Directions: Write each expression in exponential form.

10. $\sqrt[3]{16} = (16)^{\frac{1}{3}}$

11. $\sqrt{xy} = (xy)^{\frac{1}{2}}$

12. $\sqrt[4]{(8w)} = (8w)^{\frac{1}{4}}$

13. $\sqrt[3]{11^2} = (11)^{\frac{2}{3}}$

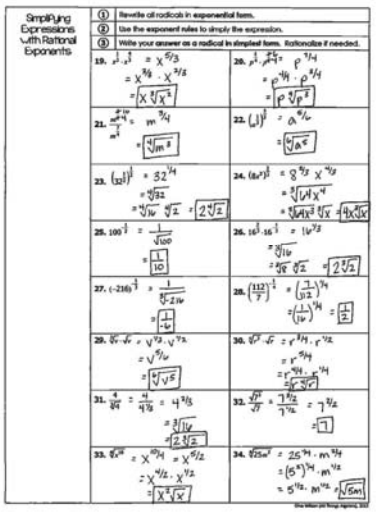
14. $\sqrt[4]{k^3} = (k)^{\frac{3}{4}}$

15. $(\sqrt{9m})^3 = (9m)^{\frac{3}{2}}$

16. $(\sqrt[3]{-2a})^2 = (-2a)^{\frac{2}{3}}$

17. $\sqrt{10^6r^8} = (10^6r^8)^{\frac{1}{2}}$

18. $\sqrt[3]{9x^2y^6} = (9x^2y^6)^{\frac{1}{3}}$



Simplifying Expressions with Rational Exponents

1. Rewrite all radicals in exponential form.
2. Use the exponent rules to simply the expression.
3. Write your answer as a radical in simplest form. Rationalize if needed.

19. $x^{\frac{1}{3}}\cdot x^{\frac{1}{3}} = x^{\frac{2}{3}} = x^{\frac{3}{3}}\cdot x^{\frac{2}{3}} = x\sqrt[3]{x^2}$

20. $p^{\frac{1}{4}}\cdot p^{\frac{3}{4}} = p^{\frac{4}{4}}\cdot p^{\frac{3}{4}} = p\sqrt[4]{p^3}$

21. $\frac{m^{\frac{3}{4}}}{m^{-\frac{1}{4}}} = m^{\frac{4}{4}} = m^1 = m$

22. $(a)^{\frac{3}{4}} = a^{\frac{3}{4}} = \sqrt[4]{a^3}$

23. $(32k)^{\frac{1}{2}} = 32^{\frac{1}{2}}k^{\frac{1}{2}} = \sqrt{32}\sqrt{k} = \sqrt{16}\sqrt{2}\sqrt{k} = 4\sqrt{2k}$

24. $(8x^4)^{\frac{1}{3}} = 8^{\frac{1}{3}}x^{\frac{4}{3}} = \sqrt[3]{8}\sqrt[3]{x^4} = \sqrt[3]{8}\sqrt[3]{x^3}\sqrt[3]{x} = 2x\sqrt[3]{x}$

25. $100^{-\frac{1}{2}} = \frac{1}{100^{\frac{1}{2}}} = \frac{1}{\sqrt{100}} = \frac{1}{10}$

26. $16^{\frac{3}{4}}\cdot 16^{\frac{1}{4}} = 16^{\frac{4}{4}} = \sqrt{16}\sqrt{2} = 4\sqrt{2}$

27. $(-216)^{-\frac{1}{3}} = \frac{1}{\sqrt[3]{-216}} = \frac{1}{-6}$

28. $\left(\frac{12}{7}\right)^{-\frac{1}{2}} = \left(\frac{7}{12}\right)^{\frac{1}{2}} = \left(\frac{1}{12}\right)^{\frac{1}{2}} = \frac{1}{2}$

29. $\sqrt[3]{v}\cdot\sqrt{v} = v^{\frac{1}{3}}\cdot v^{\frac{1}{2}} = v^{\frac{5}{6}} = \sqrt[6]{v^5}$

30. $\sqrt[4]{r^3}\cdot\sqrt{r} = r^{\frac{3}{4}}\cdot r^{\frac{1}{2}} = r^{\frac{5}{4}} = r^{\frac{4}{4}}\cdot r^{\frac{1}{4}} = r\sqrt[4]{r}$

31. $\frac{4}{64^{\frac{1}{3}}} = \frac{4}{4^{\frac{1}{3}}} = 4^{\frac{2}{3}} = \sqrt[3]{4^2} = \sqrt[3]{16} = 2\sqrt[3]{2}$

32. $\frac{\sqrt{7^3}}{\sqrt{7}} = \frac{7^{\frac{3}{2}}}{7^{\frac{1}{2}}} = 7^{\frac{2}{2}} = 7^1 = 7$

33. $\sqrt[4]{x^{12}} = x^{\frac{12}{4}} = x^{\frac{6}{3}} = x^{\frac{3}{2}} = x^{\frac{2}{2}}\cdot x^{\frac{1}{2}} = x\sqrt{x}$

34. $\sqrt[4]{625m^2} = 25^{\frac{1}{4}}\cdot m^{\frac{2}{4}} = (5^2)^{\frac{1}{4}}\cdot m^{\frac{1}{2}} = 5^{\frac{1}{2}}\cdot m^{\frac{1}{2}} = \sqrt{5m}$

Name: _____ Unit 6: Radical Functions

Date: _____ Bell: ____ Homework 4: Rational Exponents

Directions: Rewrite each expression in radical form. Simplify if needed.

1. $28^{\frac{1}{2}} = \sqrt{28}$ $= \sqrt{4}\sqrt{7}$ $= \boxed{2\sqrt{7}}$

2. $2^{\frac{3}{2}} = \sqrt[2]{2^3}$ $= \sqrt{2^2 \cdot 2}$ $= \boxed{2\sqrt{2}}$

3. $x^{\frac{5}{2}} = \sqrt{x^5}$ $= \sqrt{x^4 \cdot x}$ $= \boxed{x^2\sqrt{x}}$

4. $(256x)^{\frac{1}{2}} = \sqrt[2]{256x}$ $= \boxed{16\sqrt{x}}$

5. $(mn)^{\frac{3}{2}} = \sqrt{(mn)^3}$ $= \sqrt{(mn)^2}\sqrt{mn}$ $= \boxed{mn\sqrt{mn}}$

6. $(-2a)^{\frac{3}{2}} = \sqrt{(-2a)^3}$ $= \sqrt{(2a)^3}$ $= \sqrt{8a^3}\sqrt{2a} = \boxed{2a\sqrt{2a}}$

Directions: Rewrite each expression in exponential form.

7. $\sqrt{10^3} = \boxed{10^{3/4}}$

8. $\sqrt{3ab} = \boxed{(3ab)^{1/2}}$

9. $(\sqrt[3]{2w})^2 = \boxed{(2w)^{2/3}}$

10. $\sqrt{18x^4y^2} = \boxed{(18x^4y^2)^{1/4}}$

Directions: Simplify each expression. Give final answers in simplest radical form.

11. $9^{\frac{1}{2}} \cdot 9^{\frac{1}{2}} = 9^{1/2}$ $= 9^1$ $= \boxed{9}$

12. $\frac{x^2}{x^{\frac{1}{3}}} = x^{2-1/3}$ $= \sqrt[3]{x^5}$ $= \boxed{x\sqrt[3]{x^2}}$

13. $(28^2)^{\frac{1}{2}} = 28^{\frac{2}{2}}$ $= 28^{2/2}$ $= \sqrt{28}$ $= \sqrt{4}\sqrt{7}$ $= \boxed{2\sqrt{7}}$

14. $(-64)^{-\frac{1}{3}} = \frac{1}{(-64)^{1/3}}$ $= \frac{1}{\sqrt[3]{-64}}$ $= \boxed{-\frac{1}{4}}$

15. $45^{\frac{1}{2}} \cdot 45^{\frac{1}{2}} = 45^{1/2}$ $= \sqrt{45}$ $= \sqrt{9}\sqrt{5}$ $= \boxed{3\sqrt{5}}$

16. $2\left(\frac{48}{3}\right)^{\frac{1}{4}} = 2\left(\frac{1}{16}\right)^{1/4}$ $= 2\left(\frac{1}{2}\right)$ $= \boxed{1}$

17. $\sqrt[3]{\rho^2} \cdot \rho^{\frac{3}{2}} = \rho^{\frac{2}{3}} \rho^{3/2}$ $= \rho^{4/6} \cdot \rho^{9/6}$ $= \boxed{\rho\sqrt[6]{\rho^3}}$

18. $\frac{\sqrt[3]{24^2}}{24} = \frac{24^{2/3}}{24}$ $= 24^{-1/3}$ $= \frac{\sqrt[3]{1}}{\sqrt[3]{2^3 3}}$

19. $\frac{m}{\sqrt[3]{m}} = \frac{m^1}{m^{1/3}} = m^{2/3}$ $= \boxed{\sqrt[3]{m^2}}$

20. $\frac{16}{\sqrt[4]{16^3}} = \frac{16}{16^{3/4}} = 16^{1/4}$ $= \boxed{2}$

21. $\sqrt[4]{a^2b^4} = (a^2b^4)^{1/4}$ $= a^{2/4}b^{4/4}$ $= \boxed{b^1\sqrt{ab}}$

22. $\sqrt[4]{36w^2} = (36w^2)^{1/4}$ $= (6^2w^2)^{1/4}$ $= 6^{2/4}w^{2/4}$ $= \boxed{w\sqrt{w}}$