

P.2 Exponents & Radicals

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Properties of Exponents

$$a^m \pm a^n = a^m \pm a^n \quad \text{Cannot simplify}$$

$$a^m \cdot a^n = a^{m+n}$$

$$\frac{a^m}{a^n} = a^{m-n}$$

$$(a^m)^n = a^{mn}$$

$$a^{-m} = \frac{1}{a^m}$$

$$a^0 = 1$$

$$* -3^2 = -9$$

$$(ab)^m = a^m b^m$$

$$(-3)^2 = 9$$

$$\left(\frac{a}{b}\right)^m = \frac{a^m}{b^m}$$

$$* \sqrt{x^3} = x^{\frac{3}{2}}$$

$$a^{\frac{1}{n}} = \sqrt[n]{a}$$

Evaluate each expression

$$\textcircled{1} \frac{4^5}{4^3} = 4^{5-3}$$

$$= 4^2$$

$$= \boxed{16}$$

$$\textcircled{2} (2^2 \cdot 3)^2 = 2^4 \cdot 3^2$$

$$= 16 \cdot 9$$

$$= \boxed{144}$$

$$\textcircled{3} 2(-3)^{-2} = \frac{2}{(-3)^2}$$

$$= \boxed{\frac{2}{9}}$$

$$\textcircled{4} \frac{4 \cdot 3^{-2}}{2^{-2} \cdot 3^{-1}} = \frac{4 \cdot 2^2 \cdot 3^1}{3^2}$$

$$= \boxed{\frac{16}{3}}$$

$$\textcircled{5} (2x^3y)^3 = 2^3 x^9 y^3$$

$$= \boxed{8x^9y^3}$$

$$\textcircled{6} 2y^3x(3x^{-2}y^0)^2 = 2y^3x \cdot 3^2x^{-4} |^2$$

$$= \frac{2y^3x \cdot 9}{x^4}$$

$$= \boxed{\frac{18y^3}{x^3}}$$

$$\textcircled{7} \left(\frac{x^{-2}}{y^{-3}}\right) \left(\frac{x^4}{y}\right)^2 = \left(\frac{y^3}{x^2}\right) \left(\frac{x^8}{y^2}\right)$$

$$= \frac{x^8y^3}{x^2y^2}$$

$$= \boxed{x^6y}$$

Evaluate without a calculator

$$\textcircled{1} 8^{-\frac{2}{3}} = \frac{1}{\sqrt[3]{8^2}}$$

$$= \frac{1}{2^2}$$

$$= \boxed{\frac{1}{4}}$$

$$\textcircled{2} \left(\frac{9}{4}\right)^{-\frac{1}{2}} = \frac{9^{-\frac{1}{2}}}{4^{\frac{1}{2}}}$$

$$= \frac{\sqrt{4}}{\sqrt{9}}$$

$$= \boxed{\frac{2}{3}}$$

$2^2 = 4$

$2^3 = 8$

$2^4 = 16$

$2^5 = 32$

$3^2 = 9$

$3^3 = 27$

$3^4 = 81$

$3^5 = 243$

$4^2 = 16$

$4^3 = 64$

$4^4 = 256$

$4^5 = 1024$

$5^2 = 25$

$5^3 = 125$

$5^4 = 625$

$5^5 = 3125$

P.2 Exponents & Radicals (cont'd)

Simplify Each Radical Expression

$$\textcircled{1} \sqrt[3]{\frac{16}{27}} = \frac{\sqrt[3]{16}}{\sqrt[3]{27}} \quad * \sqrt[3]{16} = \sqrt[3]{8 \cdot 2}$$

$$= \sqrt[3]{8} \sqrt[3]{2}$$

$$= 2 \sqrt[3]{2}$$

$$= \frac{2 \sqrt[3]{2}}{3}$$

$$\textcircled{2} 4\sqrt{27} - \sqrt{75}$$

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

$$12\sqrt{3} - 5\sqrt{3}$$

$$\boxed{7\sqrt{3}}$$

$$\sqrt{27} = \sqrt{9 \cdot 3} = \sqrt{9}\sqrt{3} = 3\sqrt{3}$$

$$\sqrt{75} = \sqrt{25 \cdot 3} = \sqrt{25}\sqrt{3} = 5\sqrt{3}$$

Rationalize the denominator

$$\textcircled{1} \frac{3}{\sqrt{5} + \sqrt{6}} \quad \text{multiply by the conjugate } \sqrt{5} - \sqrt{6}$$

$$= \frac{3}{\sqrt{5} + \sqrt{6}} \cdot \frac{\sqrt{5} - \sqrt{6}}{\sqrt{5} - \sqrt{6}}$$

$$= \frac{3\sqrt{5} - 3\sqrt{6}}{5 - 6}$$

$$= \frac{3\sqrt{5} - 3\sqrt{6}}{-1}$$

$$= \boxed{-3\sqrt{5} + 3\sqrt{6}}$$

Reduce the index of the radical

$$\begin{aligned} \textcircled{1} \sqrt[6]{x^3} &= x^{\frac{3}{6}} \\ &= x^{\frac{1}{2}} \\ &= \boxed{\sqrt{x}} \end{aligned}$$

$$\begin{aligned} \textcircled{2} \sqrt[4]{(3x^2)^4} &= (3^4 x^8)^{\frac{1}{4}} \\ &= 3^{\frac{4}{4}} x^{\frac{8}{4}} \\ &= \boxed{3x^2} \end{aligned}$$

Write each expression as a single radical

$$\textcircled{1} \sqrt{\sqrt{243(x+1)}} = ((243(x+1))^{\frac{1}{2}})^{\frac{1}{2}}$$

$$= 243(x+1)^{\frac{1}{4}}$$

$$= \sqrt[4]{243} \sqrt[4]{x+1}$$

$$= 3 \sqrt[4]{3} \sqrt[4]{x+1}$$

$$= 3 \sqrt[4]{3(x+1)}$$

$$= \boxed{3 \sqrt[4]{3x+3}}$$

$$\begin{aligned} * \sqrt[4]{243} &= \sqrt[4]{81 \cdot 3} \\ &= \sqrt[4]{81} \sqrt[4]{3} \\ &= 3 \sqrt[4]{3} \end{aligned}$$

Simplify each expression

$$\begin{aligned} \textcircled{1} \sqrt{80x^3y^4} &= \sqrt{16 \cdot 5} \sqrt{x^2x} \sqrt{y^4} \\ &= 4 \sqrt{5 \cdot x} \sqrt{x} y^2 \\ &= \boxed{4xy^2 \sqrt{5x}} \end{aligned}$$