Practice
Expressions: Radicals

Answer these problems, then check your answers using the key on the next page. If you missed something, look at the solutions after the answer key, and if you still don't understand, watch the review video again.

For problems #1-10:
Simplify without using a calculator. If answers contain exponents, make sure they are positive.

#1) $8^{\frac{1}{3}}$

#2) $25^{\frac{3}{2}}$

#3) $16^{\frac{5}{2}}$

#4) $16^{\frac{3}{4}}$

#5) $(-32)^{\frac{2}{5}}$

#6) $-2\left(81^{\frac{1}{2}}\right)$

#7) $b^{\frac{-6}{5}}b^{\frac{5}{3}}$

#8) $\left(\frac{1}{8}\right)^{\frac{-2}{3}}$

#9) $\left(\frac{-125}{27}\right)^{\frac{-1}{3}}$

#10) $\left(\frac{25}{16}\right)^{\frac{-3}{2}}$

For problems #11-14: Rewrite using exponents:

#11) $\sqrt{6}$ #12) $\sqrt[3]{7}$ #13) $\sqrt[5]{14^3}$ #14) $\sqrt[3]{6c^8}$

For problems #15-20: Simplify completely and leave in radical form:

#15) $\dfrac{\sqrt{45}}{\sqrt{5}}$ #16) $\dfrac{\sqrt{32}}{\sqrt{2}}$ #17) $\left(3\sqrt{2}\right)\left(5\sqrt{10}\right)$

#18) $\left(8\sqrt{5}\right)\left(2\sqrt{15}\right)$ #19) $3\sqrt{5}\left(2\sqrt{10}-2\sqrt{5}\right)$ #20) $2\sqrt{3}\left(3\sqrt{6}+5\sqrt{2}\right)$

#21) Convert $64^{\frac{4}{3}}$ to radical form #22) Write in simplified radical form $\dfrac{1}{\sqrt{5}}$

For problems #23-24: Rationalize the denominator and simplify:

#23) $\dfrac{12}{6\sqrt{3}}$ #24) $\dfrac{24}{4\sqrt{5}}$

For problems #25-26: Use a conjugate to simplify:

#25) $\dfrac{8}{\sqrt{5}-1}$

#26) $\dfrac{2}{3+\sqrt{2}}$

For problems #27-34: Simplify and leave in radical form:

#27) $\sqrt{98a^5b^{14}}$

#28) $\sqrt[3]{125}$

#29) $\sqrt[3]{216}$

#30) $-\sqrt[4]{81}$

#31) $\pm\sqrt[4]{\dfrac{16}{625}}$

#32) $\sqrt[3]{-32}$

#33) $\sqrt[3]{-375}$

#34) $-\sqrt[3]{16a^9b^5}$

For problems #35-36: Rewrite in fully simplified radical format (using no exponents):

#35) $6^{\frac{7}{2}}$

#36) $50^{\frac{1}{2}}$

For problems #37-45: Simplify:

#37) $2\sqrt{17} + 9\sqrt{17}$

#38) $\sqrt{16} - \sqrt{64} + \sqrt{100}$

#39) $-2\sqrt{50} + 5\sqrt{7} + 3\sqrt{18}$

#40) $2\sqrt{99} + 3\sqrt{44}$

#41) $\sqrt{27} + 3\sqrt{48}$

#42) $3\sqrt{20} + 4\sqrt{2} - 2\sqrt{45}$

#43) $6\sqrt{8} + 2\sqrt{18}$

#44) $\sqrt[3]{\sqrt{64}}$

#45) $\sqrt[4]{\sqrt[3]{81}}$

Answers:

#1) 2 #11) $6^{\frac{1}{2}}$ #21) $\left(\sqrt[3]{64}\right)^4$ #31) $\pm\dfrac{2}{5}$ #41) $15\sqrt{3}$

#2) 125 #12) $7^{\frac{1}{3}}$ #22) $\dfrac{\sqrt{5}}{5}$ #32) $-2\sqrt[3]{4}$ #42) $4\sqrt{2}$

#3) 1024 #13) $14^{\frac{3}{5}}$ #23) $\dfrac{2\sqrt{3}}{3}$ #33) $-5\sqrt[3]{3}$ #43) $18\sqrt{2}$

#4) 8 #14) $6^{\frac{1}{3}}c^{\frac{8}{3}}$ #24) $\dfrac{6\sqrt{5}}{5}$ #34) $-2a^3b\sqrt[3]{2b^2}$ #44) 2

#5) 4 #15) 3 #25) $2\sqrt{5}+2$ #35) $216\sqrt{6}$ #45) $\sqrt[3]{3}$

#6) -18 #16) 4 #26) $\dfrac{6-2\sqrt{2}}{7}$ #36) $5\sqrt{2}$

#7) $b^{\frac{7}{15}}$ #17) $30\sqrt{5}$ #27) $7a^2\left|b^7\right|\sqrt{2a}$ #37) $11\sqrt{17}$

#8) 4 #18) $80\sqrt{3}$ #28) 5 #38) 6

#9) $-\dfrac{3}{5}$ #19) $30\sqrt{2}-30$ #29) 6 #39) $5\sqrt{7}-\sqrt{2}$

#10) $\dfrac{64}{125}$ #20) $18\sqrt{2}+10\sqrt{6}$ #30) -3 #40) $12\sqrt{11}$

Solutions:
For problems #1-10:
Simplify without using a calculator. If answers contain exponents, make sure they are positive.

#1) $8^{\frac{1}{3}}$

$\sqrt[3]{8}$

$\boxed{2}$

#2) $25^{\frac{3}{2}}$

$\left(25^{1/2}\right)^3$

$\left(\sqrt{25}\right)^3$

$(5)^3$

$\boxed{125}$

#3) $16^{\frac{5}{2}}$

$\left(16^{1/2}\right)^5$

$\left(\sqrt{16}\right)^5$

$(4)^5$

$\boxed{1024}$

#4) $16^{\frac{3}{4}}$

$\left(16^{1/4}\right)^3$

$\left(\sqrt[4]{16}\right)^3$

$(2)^3$

$\boxed{8}$

#5) $(-32)^{\frac{2}{5}}$

$\left((-32)^{1/5}\right)^2$

$\left(\sqrt[5]{-32}\right)^2$

$(-2)^2$

$\boxed{4}$

#6) $-2\left(81^{\frac{1}{2}}\right)$

$-2\sqrt{81}$

$-2(9)$

$\boxed{-18}$

#7) $b^{\frac{-6}{5}} b^{\frac{5}{3}}$

$b^{\left(-\frac{6}{5}+\frac{5}{3}\right)}$

$b^{\left(\frac{-6\cdot 3}{5\cdot 3}+\frac{5\cdot 5}{3\cdot 5}\right)}$

$b^{\left(\frac{-18}{15}+\frac{25}{15}\right)}$

$\boxed{b^{\frac{7}{15}}}$

#8) $\left(\frac{1}{8}\right)^{\frac{-2}{3}}$

$\left(\frac{8}{1}\right)^{\frac{2}{3}}$

$(8)^{\frac{2}{3}}$

$\left(8^{1/3}\right)^2$

$\left(\sqrt[3]{8}\right)^2$

$(2)^2$

$\boxed{4}$

#9) $\left(\frac{-125}{27}\right)^{\frac{-1}{3}}$

$\left(\frac{-27}{125}\right)^{\frac{1}{3}}$

$\dfrac{\sqrt[3]{-27}}{\sqrt[3]{125}}$

$\boxed{\dfrac{-3}{5}}$

#10) $\left(\frac{25}{16}\right)^{\frac{-3}{2}}$

$\left(\frac{16}{25}\right)^{\frac{3}{2}}$

$\left(\left(\frac{16}{25}\right)^{1/2}\right)^3$

$\left(\frac{\sqrt{16}}{\sqrt{25}}\right)^3$

$\left(\frac{4}{5}\right)^3$

$\dfrac{4^3}{5^3} = \boxed{\dfrac{64}{125}}$

For problems #11-14: Rewrite using exponents:

#11) $\sqrt{6}$

$6^{1/2}$

#12) $\sqrt[3]{7}$

$7^{1/3}$

#13) $\sqrt[5]{14^3}$

$14^{3/5}$

#14) $\sqrt[3]{6c^8}$

$6^{1/3}c^{8/3}$

For problems #15-20: Simplify completely and leave in radical form:

#15) $\dfrac{\sqrt{45}}{\sqrt{5}}$

$\dfrac{\sqrt{45}}{\sqrt{5}}\cdot\dfrac{\sqrt{5}}{\sqrt{5}} = \dfrac{\sqrt{45}\sqrt{5}}{5}$

$\dfrac{\sqrt{9}\sqrt{5}\sqrt{5}}{5}$

$\dfrac{(3)(5)}{5} = \boxed{3}$

another way to → do this

#16) $\dfrac{\sqrt{32}}{\sqrt{2}}$

$\sqrt{\dfrac{32}{2}}$

$\sqrt{16}$

$\boxed{4}$

#17) $\left(3\sqrt{2}\right)\left(5\sqrt{10}\right)$

$(3)(5)\sqrt{2}\sqrt{10}$

$15\sqrt{20}$

$15\sqrt{4}\sqrt{5}$

$15(2)\sqrt{5}$

$\boxed{30\sqrt{5}}$

#18) $\left(8\sqrt{5}\right)\left(2\sqrt{15}\right)$

$16\sqrt{5}\sqrt{15}$

$16\sqrt{5}\sqrt{5}\sqrt{3}$

$16(5)\sqrt{3}$

$\boxed{80\sqrt{3}}$

#19) $3\sqrt{5}\left(2\sqrt{10}-2\sqrt{5}\right)$

$(3\sqrt{5})(2\sqrt{10}) - (3\sqrt{5})(2\sqrt{5})$

$6\sqrt{50} - 6\sqrt{25}$

$6\sqrt{25}\sqrt{2} - 6(5)$

$6(5)\sqrt{2} - 30$

$\boxed{30\sqrt{2}-30}$

#20) $2\sqrt{3}\left(3\sqrt{6}+5\sqrt{2}\right)$

$6\sqrt{18} + 10\sqrt{6}$

$6\sqrt{9}\sqrt{2} + 10\sqrt{6}$

$6(3)\sqrt{2} + 10\sqrt{6}$

$\boxed{18\sqrt{2}+10\sqrt{6}}$

#21) Convert $64^{\frac{4}{3}}$ to radical form

$\left(\sqrt[3]{64}\right)^4$ (it doesn't say to simplify)

#22) Write in simplified radical form $\dfrac{1}{\sqrt{5}}$

$\dfrac{1}{\sqrt{5}}\cdot\dfrac{\sqrt{5}}{\sqrt{5}} = \boxed{\dfrac{\sqrt{5}}{5}}$

For problems #23-24: Rationalize the denominator and simplify:

#23) $\dfrac{12}{6\sqrt{3}}\cdot\dfrac{\sqrt{3}}{\sqrt{3}}$

$\dfrac{12\sqrt{3}}{6(3)}$

$\dfrac{4(2)\sqrt{3}}{4(3)}$ $\boxed{\dfrac{2\sqrt{3}}{3}}$

#24) $\dfrac{24}{4\sqrt{5}}\cdot\dfrac{\sqrt{5}}{\sqrt{5}}$

$\dfrac{4(6)\sqrt{5}}{4(5)}$

$\boxed{\dfrac{6\sqrt{5}}{5}}$

For problems #25-26: Use a conjugate to simplify:

#25) $\dfrac{8}{\sqrt{5}-1}$

$\dfrac{8}{(\sqrt{5}-1)}\dfrac{(\sqrt{5}+1)}{(\sqrt{5}+1)}$

$\dfrac{8\sqrt{5}+8}{5+\sqrt{5}-\sqrt{5}-1}$

$\dfrac{8\sqrt{5}+8}{5-1}$

$\dfrac{8\sqrt{5}+8}{4}$

$\dfrac{8\sqrt{5}}{4}+\dfrac{8}{4}$

$\boxed{2\sqrt{5}+2}$

#26) $\dfrac{2}{3+\sqrt{2}}$

$\dfrac{2}{(3+\sqrt{2})}\dfrac{(3-\sqrt{2})}{(3-\sqrt{2})}$

$\dfrac{6-2\sqrt{2}}{9+3\sqrt{2}-3\sqrt{2}-2}$

$\dfrac{6-2\sqrt{2}}{9-2}$

$\boxed{\dfrac{6-2\sqrt{2}}{7}}$

or

$\boxed{\dfrac{6}{7}-\dfrac{2\sqrt{2}}{7}}$

For problems #27-34: Simplify and leave in radical form:

#27) $\sqrt{98a^5b^{14}}$

$\sqrt{98}\sqrt{a^5}\sqrt{b^{14}}$

$\sqrt{2}\sqrt{49}\ \sqrt{a^4}\sqrt{a}\ \sqrt{b^{14}}$

$\sqrt{2}(7)a^{4/2}\sqrt{a}\ b^{14/2}$

$\sqrt{2}(7)a^2\sqrt{a}\ b^7$ (from even root on outside)

$\boxed{7a^2b^7\sqrt{2a}}$

actually: $\boxed{7a^2|b^7|\sqrt{2a}}$

#28) $\sqrt[3]{125}$

$\boxed{5}$

#29) $\sqrt[3]{216}$

$\boxed{6}$

(don't have cubes memorized?
try $216^{1/3}$
in a calculator)

#30) $-\sqrt[4]{81}$

$\boxed{-3}$

#31) $\pm\sqrt[4]{\dfrac{16}{625}}$

$\pm\dfrac{\sqrt[4]{16}}{\sqrt[4]{625}}$

$\boxed{\pm\dfrac{2}{5}}$

#32) $\sqrt[3]{-32}$

perfect cubes!
$1^3=1$
$2^3=8$
$3^3=27$
$4^3=64$
$5^3=125$

$\sqrt[3]{-8}\ \sqrt[3]{4}$

$\boxed{-2\sqrt[3]{4}}$

#33) $\sqrt[3]{-375}$

$\sqrt[3]{-125}\ \sqrt[3]{3}$

$\boxed{-5\sqrt[3]{3}}$

#34) $-\sqrt[3]{16a^9b^5}$

$-\sqrt[3]{8}\ \sqrt[3]{2}\ \sqrt[3]{a^9}\ \sqrt[3]{b^3}\ \sqrt[3]{b^2}$

$-2\sqrt[3]{2}\ a^{9/3}\ b^{3/3}\sqrt[3]{b^2}$

$-2\sqrt[3]{2}\ a^3\ b\ \sqrt[3]{b^2}$

$\boxed{-2a^3b\sqrt[3]{2b^2}}$

For problems #35-36: Rewrite in fully simplified radical format (using no exponents):

#35) $6^{\frac{7}{2}}$

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

$\sqrt{6^2}\sqrt{6^2}\sqrt{6^2}\sqrt{6}$

$(6)(6)(6)\sqrt{6}$

$\boxed{216\sqrt{6}}$

#36) $50^{\frac{1}{2}}$

$\sqrt{50}$

$\sqrt{25}\sqrt{2}$

$\boxed{5\sqrt{2}}$

For problems #37-45: Simplify:

#37) $2\sqrt{17}+9\sqrt{17}$

$$\boxed{11\sqrt{17}}$$

#38) $\sqrt{16}-\sqrt{64}+\sqrt{100}$

$4-8+10$

$$\boxed{6}$$

#39) $-2\sqrt{50}+5\sqrt{7}+3\sqrt{18}$

$-2\sqrt{50}+5\sqrt{7}+3\sqrt{18}$

$-2\sqrt{25}\sqrt{2}+5\sqrt{7}+3\sqrt{9}\sqrt{2}$

$-2(5)\sqrt{2}+5\sqrt{7}+3(3)\sqrt{2}$

$-10\sqrt{2}+5\sqrt{7}+9\sqrt{2}$

$$\boxed{5\sqrt{7}-\sqrt{2}}$$

#40) $2\sqrt{99}+3\sqrt{44}$

$2\sqrt{99}+3\sqrt{44}$

$2\sqrt{9}\sqrt{11}+3\sqrt{4}\sqrt{11}$

$2(3)\sqrt{11}+3(2)\sqrt{11}$

$6\sqrt{11}+6\sqrt{11}$

$$\boxed{12\sqrt{11}}$$

#41) $\sqrt{27}+3\sqrt{48}$

$\sqrt{27}+3\sqrt{48}$

$\sqrt{9}\sqrt{3}+3\sqrt{16}\sqrt{3}$

$3\sqrt{3}+3(4)\sqrt{3}$

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

$$\boxed{15\sqrt{3}}$$

#42) $3\sqrt{20}+4\sqrt{2}-2\sqrt{45}$

$3\sqrt{20}+4\sqrt{2}-2\sqrt{45}$

$3\sqrt{4}\sqrt{5}+4\sqrt{2}-2\sqrt{9}\sqrt{5}$

$3(2)\sqrt{5}+4\sqrt{2}-2(3)\sqrt{5}$

$6\sqrt{5}+4\sqrt{2}-6\sqrt{5}$

$$\boxed{4\sqrt{2}}$$

#43) $6\sqrt{8}+2\sqrt{18}$

$6\sqrt{8}+2\sqrt{18}$

$6\sqrt{4}\sqrt{2}+2\sqrt{9}\sqrt{2}$

$6(2)\sqrt{2}+2(3)\sqrt{2}$

$12\sqrt{2}+6\sqrt{2}$

$$\boxed{18\sqrt{2}}$$

#44) $\sqrt[3]{\sqrt{64}}$

$\sqrt[3]{\sqrt{64}}$

$\sqrt[3]{8}$

$$\boxed{2}$$

#45) $\sqrt[4]{\sqrt[3]{81}}$

$\sqrt[4]{\sqrt[3]{81}}$

$\sqrt[12]{81}$

$\sqrt[3]{\sqrt[4]{81}}$

$$\boxed{\sqrt[3]{3}}$$

or can switch to exponents:

$\sqrt[4]{\sqrt[3]{81}}$

$\left(81^{1/3}\right)^{1/4}$

$\left(81^{1/4}\right)^{1/3}$

$(3)^{1/3}$

$$\boxed{\sqrt[3]{3}}$$