# Algebra 2R

## UNIT 8: Radicals and the Quadratic Formula

## Problem Set

8.1 Square Root Functions – A2.L.12
8.2 Solving Square Root Functions – A2.L.13
8.3 The Basic Exponent Properties – A1.V.1 through A1.V.10
8.4 Fractional Exponents Revisited – A2.M.1 through A2.M.6
8.5 More Exponent Practice - A2.M.1 through A2.M.6
8.6 The Quadratic Formula – A2.J.9, A2.J.10
8.7 More Work with the Quadratic Formula - A2.J.9, A2.J.10

Prerequisite Learning with IXL Practice:

**Algebra 1**

1. Simplifying Radicals – IXL A1.EE.1 and A1.EE.2
2. Rational Exponents – IXL A1.V.10
3. Basic Exponent Properties – IXL A1.V**
4. Quadratic Formula – IXL A1.BB.10, A1.BB.11

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Algebra 2R Unit 8: Radicals and the Quadratic Formula

8.1 Problem Set – Square Root Functions

## FLUENCY

1. Which of the following represents the domain and range of $y=\sqrt{x-5}+7$ ? Solve this either by considering the shifting that has occurred to $y=\sqrt{x}$ or by producing a graph on your calculator.

(1) Domain: $[-5,\infty)$
Range: $[7,\infty)$

(3) Domain: $(-7,\infty)$
Range: $(5,\infty)$

(2) Domain: $[5,\infty)$
Range: $[7,\infty)$

(4) Domain: $[7,\infty)$
Range: $[5,\infty)$

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2. Which of the following values of $x$ is *not* in the domain of $y=\sqrt{1-3x}$ ?

(1) $x=\frac{1}{3}$

(3) $x=0$

(2) $x=-1$

(4) $x=4$

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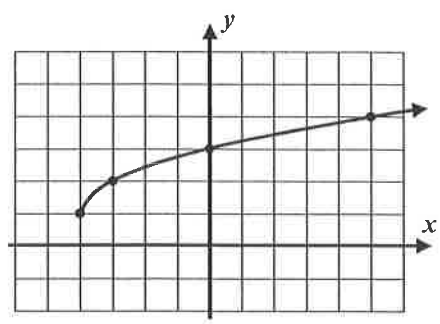
3. Which of the following equations describes the graph shown below?

(1) $y=\sqrt{x+4}+1$

(2) $y=\sqrt{x-4}-1$

(3) $y=\sqrt{x+4}-1$

(4) $y=\sqrt{x-4}+1$

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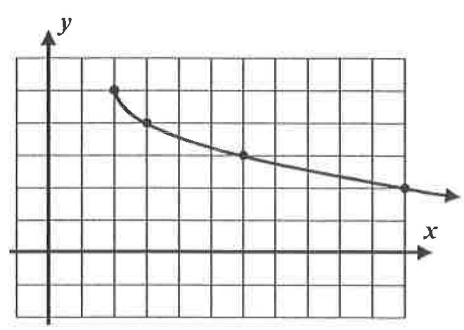
4. Which equation below represents the graph shown?

(1) $y=\sqrt{x-2}-5$

(2) $y=-\sqrt{x+2}+5$

(3) $y=-\sqrt{x-2}+5$

(4) $y=\sqrt{x+2}+5$

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5. Determine the domains of each of the following functions. State your answers in set-builder notation.

(a) $y=\sqrt{x+10}$

(b) $y=\sqrt{3x-5}$

(c) $y=\sqrt{7-2x}$

6. Set up and *algebraically* solve a quadratic inequality that results in the domain of each of the following. Verify your answers by graphing the function in a standard viewing window.

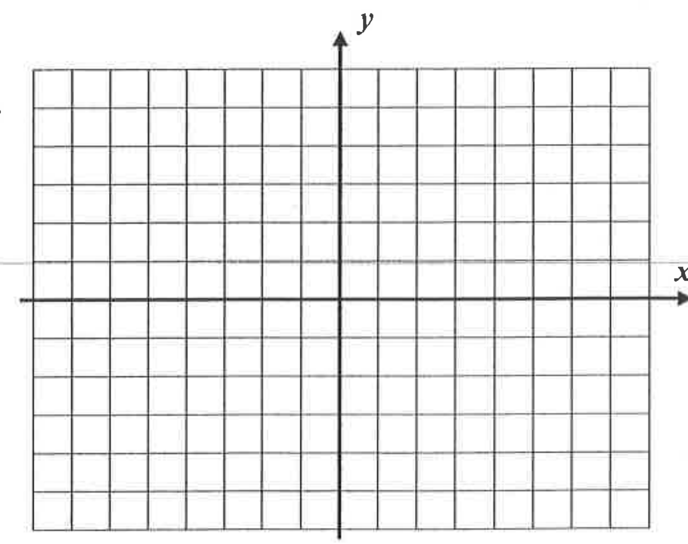
(a) $y=\sqrt{x^2-4x-5}$

(b) $y=\sqrt{9-x^2}$

7. Consider the function $g(x)=-\sqrt{x+5}+3$.

(a) Graph the function $y=g(x)$ on the grid shown.

(b) Describe the transformations that have occurred to the graph of $y=\sqrt{x}$ to produce the graph of $y=g(x)$. Specify both the transformations and their order.



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Algebra 2R Unit 8: Radicals and the Quadratic Formula

8.2 Problem Set – Solving Square Root Equations

## FLUENCY

1. Solve each of the following square root equations. As in the lesson, they are arranged from lesser to more complex. Check your answers.

(a) $\sqrt{x}=5$

(b) $\sqrt{x+2}=10$

(c) $\sqrt{\frac{2x}{3}}=6$

(d) $4\sqrt{x}=24$

(e) $2\sqrt{x}=1$

(f) $\sqrt{3x+4}=8$

(g) $\frac{1}{2}\sqrt{x}-5=2$

(h) $\sqrt{4x-1}+3=4$

(i) $5\sqrt{1-5x}-3=27$

(j) $\sqrt{x^2-10x+25}=5$

(k) $\sqrt{2x^2+17x}=3$

(l) $\sqrt{3x^2+7x+10}=4$

2. Which of the following values solves the equation $\frac{\sqrt{4x+19}}{2}=2$?

(1) $-\frac{9}{2}$ (3) $\frac{4}{3}$

(2) $-\frac{3}{4}$ (4) $\frac{1}{2}$ ________

3. Solve each of the following equations for all values of $x$. Check your possible solutions in the original equation. Reject any extraneous roots.

(a) $x-1=\sqrt{x+11}$

(b) $\sqrt{4x+36}=2x-6$

4. Solve each of the following equations for all values of $x$. As in problem #1, be sure to isolate the square root expression first before squaring both sides of the equation. Check your possible solutions in the original equation. Reject any extraneous roots.

(a) $6x=2\sqrt{24x+17}-8$

(d) $\frac{\sqrt{6x+4}-1}{4}=x$

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8.3 Problem Set – The Basic Exponent Properties

## FLUENCY

1. Express each of the following expressions in "expanded" form, i.e., do all of the multiplication and/or division possible and combine as many exponents as possible.

(a) $x^3 \cdot x^{12}$ (b) $4x^3 \cdot 5x^5$ (c) $\left(-3x^2y\right)\left(5x^7y^3\right)$ (d) $\left(4x^3y^6\right)\left(-7x^4\right)$

(e) $\dfrac{x^9}{x^3}$ (f) $\dfrac{5x^3y^7}{15xy^2}$ (g) $\dfrac{x^3}{x^{10}}$ (h) $\dfrac{10x^4y^3}{25x^8}$

(i) $\left(x^5\right)^8$ (j) $\left(10x^3\right)^0$ (k) $\left(-4x^5\right)^3$ (l) $\left(x^{-2}\right)^4$

2. Which of the following is *not* equal to $2^{-2}$? Do *not* use your calculator to do this problem.

(1) $\dfrac{1}{4}$ (3) 0.25

(2) $-4$ (4) $\dfrac{1}{2^2}$

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3. If the expression $\dfrac{1}{2x}$ was placed in the form $ax^b$ where $a$ and $b$ are real numbers, then which of the following is equal to $a+b$? Show how you arrived at your answer.

(1) 1 (3) $\dfrac{1}{2}$

(2) $\dfrac{3}{2}$ (4) $-\dfrac{1}{2}$

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4. If $f(x)=5x^0+4x^{-3}$ then $f(a)=$

(1) $12a-5$ (3) $\frac{1}{4a^3}+5$

(2) $5+\frac{4}{a^3}$ (4) $-12a+1$

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5. Which of the following is equivalent to $\frac{(4x^8)^3}{(6x^5)^2}$ for all $x\neq 0$? Show the manipulations that lead to your final answer.

(1) $\frac{16}{9}x^{14}$ (3) $\frac{2}{3}x^{14}$

(2) $\frac{16}{9}x^4$ (4) $\frac{2}{3}x^4$

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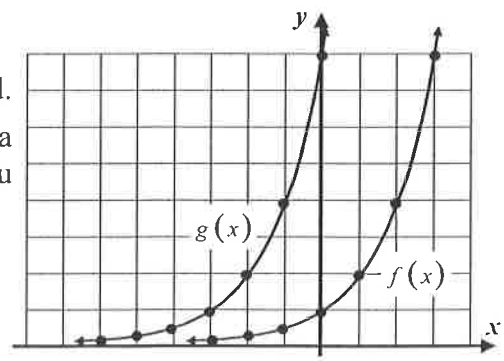
## APPLICATIONS

6. It is helpful to be able to think about very large numbers in terms of powers of 10. You should be familiar with many of these terms, but have you thought about how many 10's are multiplying each other? Here are some numbers to think about and examples of things that would be counted in these quantities. Fill in the proper power of 10. The first has been done for you.

| NUMBER | POWER OF 10 | EXAMPLE |
|---|---|---|
| 1 million | $=1,000\cdot 1,000=10^3\cdot 10^3=10^6$ | The distance between New York City and Boston is approximately 1 million feet. |
| 1 billion | $=1,000\cdot 1$ million $=10^3\cdot 10^6=$ | There are approximately 3 billion seconds in a century. |
| 1 trillion | $=(1\text{ million})^2=(10^6)^2=$ | There are 6 trillion miles in a light year, i.e. the distance light can travel in a year. |
| 1 quadrillion | $=1000\cdot 1$ trillion $=$ | There are approximately 1 quadrillion ants populating the earth at any time. |
| 1 quintillion | $=(1\text{ billion})^2=$ | There are approximately 8 quintillion grains of sand on all of the Earth's beaches. |

## REASONING

7. The functions $f(x)=2^x$ and $g(x)=8(2)^x$ are both shown graphed. The graph of $g$ is certainly a vertical stretch of the function $f$ by a factor of 8. But, it is also a shift of $f$ by three units left? Can you explain why this is using an exponent law?



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Algebra 2R Unit 8: Radicals and the Quadratic Formula

8.4 Problem Set – Fractional Exponents Revisited

## FLUENCY

1. Which of the following is equivalent to $x^{5/2}$?

(1) $\frac{5x}{2}$ (3) $\sqrt{x^5}$

(2) $\frac{2x}{5}$ (4) $\sqrt[5]{x^2}$

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2. If the expression $\frac{1}{\sqrt{x}}$ was placed in $x^a$ form, then which of the following would be the value of $a$?

(1) $-2$ (3) $\frac{1}{2}$

(2) 2 (4) $-\frac{1}{2}$

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3. Which of the following is *not* equivalent to $\sqrt{x^9}$?

(1) $x^3$ (3) $x^{9/2}$

(2) $\left(\sqrt{x}\right)^9$ (4) $x^4\sqrt{x}$

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4. The radical expression $\sqrt{50x^5y^3}$ can be rewritten equivalently as

(1) $25xy\sqrt{2xy}$ (3) $5x^2y\sqrt{2xy}$

(2) $5xy\sqrt{xy}$ (4) $10x^2y\sqrt{5xy}$

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5. If the function $y=12\sqrt[3]{x}$ was placed in the form $y=ax^b$ then which of the following is the value of $a\cdot b$?

(1) $-36$ (3) 36

(2) $-4$ (4) 4

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6. Rewrite each of the following expressions without roots by using fractional exponents.

(a) $\sqrt{x}$ (b) $\sqrt[3]{x}$ (c) $\sqrt[7]{x}$ (d) $\sqrt{x^5}$

(e) $\sqrt[3]{x^{11}}$ (f) $\frac{1}{\sqrt[4]{x}}$ (g) $\frac{1}{\sqrt[3]{x^2}}$ (h) $\frac{1}{\sqrt{x^9}}$

7. Rewrite each of the following without the use of fractional or negative exponents by using radicals.

(a) $x^{1/6}$ (b) $x^{1/10}$ (c) $x^{-1/3}$ (d) $x^{-1/5}$

(e) $x^{3/5}$ (f) $x^{-7/2}$ (g) $x^{9/4}$ (h) $x^{-2/11}$

8. Simplify each of the following square roots that contain variables in the radicand.

(a) $\sqrt{8x^9}$ (b) $\sqrt{75x^{16}y^{11}}$ (c) $2x\sqrt{18x^7}$ (d) $3x^2y\sqrt{98x^5y^8}$

9. Express each of the following roots in simplest radical form.

(a) $\sqrt[3]{16x^8}$ (b) $\sqrt[3]{108x^5y^{10}}$ (c) $\sqrt[3]{64x^{12}y^{14}}$ (d) $\sqrt[3]{375x^7y^{11}}$

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10. Mikayla was trying to rewrite the expression $25x^{1/2}$ in an equivalent form that is more convenient to use. She incorrectly rewrote it as $5\sqrt{x}$. Explain Mikalya's error.

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Algebra 2R Unit 8: Radicals and the Quadratic Formula

8.5 Problem Set – More Exponent Practice

## FLUENCY

1. Rewrite each of the following expressions in simplest form and without negative exponents.

(a) $\dfrac{x^3x^7}{\left(x^2\right)^3}$ (b) $\dfrac{5x^4}{25x^{10}}$ (c) $\dfrac{\left(x^3y^4\right)^2}{\left(x^3y\right)^3}$ (d) $\dfrac{\left(2x^3\right)^5}{8x^{-3}}$

2. Which of the following represents the value of $\dfrac{a^{-4}}{b^{-2}}$ when $a=3$ and $b=2$?

(1) $\dfrac{4}{9}$ (3) $\dfrac{1}{36}$

(2) $\dfrac{4}{81}$ (4) $\dfrac{1}{3}$

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3. Simplify each expression below so that it contains no negative exponents. Do not write the expressions using radicals.

(a) $\dfrac{x^{7/2}y^{1/2}}{x^{3/4}y^2}$ (b) $\dfrac{\left(x^{1/3}\right)^4}{x^{-2/3}}$ (c) $\left(5x^{2/3}y^{-1/2}\right)\left(2x^2y^{-3}\right)$

4. Which of the following represents the expression $\dfrac{24x^{-1/2}}{6x^{5/2}}$ written in simplest form?

(1) $\dfrac{4}{x^3}$ (3) $\dfrac{x^2}{4}$

(2) $4x^3$ (4) $4x^2$

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5. Rewrite each of the following expressions using radicals. Express your answers in simplest form.

(a) $(4x)^{3/2}$ (b) $x^{-2/3}$ (c) $(x^4)^{3/5}$

(d) $\dfrac{\sqrt[3]{x}}{\sqrt{x}}$ (e) $\dfrac{\sqrt{x}\cdot x^2}{x^{5/3}}$ (f) $\dfrac{(2\sqrt{x})^3}{24x}$

6. Which of the following is equivalent to $\dfrac{5\sqrt{x}}{20x^3}$ ?

(1) $\dfrac{1}{4\sqrt{x^3}}$ (3) $\dfrac{1}{4\sqrt[5]{x^2}}$

(2) $\dfrac{4}{\sqrt{x^5}}$ (4) $\dfrac{1}{4\sqrt{x^5}}$

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7. When written in terms of a fractional exponent the expression $\dfrac{\sqrt{x}\cdot x}{x^{-2}}$ is

(1) $x^{7/2}$ (3) $x^{-1/2}$

(2) $x^{5/2}$ (4) $x^{-3/2}$

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8. Expressed as a radical expression, the fraction $\dfrac{x^{1/3}x^{1/2}}{x^{-1}}$ is

(1) $\dfrac{1}{\sqrt[6]{x}}$ (3) $\sqrt[11]{x^6}$

(2) $\dfrac{1}{\sqrt[11]{x^6}}$ (4) $\sqrt[6]{x^{11}}$

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Algebra 2R Unit 8: Radicals and the Quadratic Formula

8.6 Problem Set – The Quadratic Formula

$$x=\frac{-b\pm\sqrt{b^2-4ac}}{2a} \quad \textbf{or} \quad x=\frac{-b}{2a}\pm\frac{\sqrt{b^2-4ac}}{2a}$$

## FLUENCY

1. Solve each of the following quadratic equations using the quadratic formula. Express all answers in simplest form.

(a) $x^2+7x-18=0$

(b) $x^2-2x-1=0$

(c) $x^2+8x+13=0$

(d) $3x^2-2x-3=0$

(e) $6x^2-7x+2=0$

(f) $5x^2+3x-4=0$

2. Which of the following represents all solutions of $x^2 - 4x - 1 = 0$?

(1) $2 \pm \sqrt{5}$  (3) $2 \pm \sqrt{10}$

(2) $-2 \pm \sqrt{5}$  (4) $-2 \pm \sqrt{12}$

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3. Which of the following is the solution set of the equation $4x^2 - 12x - 19 = 0$?

(1) $\frac{5}{2} \pm \sqrt{3}$  (3) $\frac{3}{2} \pm \sqrt{7}$

(2) $-\frac{2}{3} \pm \sqrt{2}$  (4) $-\frac{7}{3} \pm \sqrt{6}$

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4. Rounded to the nearest *hundredth* the larger root of $x^2 - 22x + 108 = 0$ is

(1) 18.21  (3) 6.74

(2) 13.25  (4) 14.61

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5. *Algebraically* find the $x$-intercepts of the quadratic function whose equation is $y = x^2 - 4x - 6$. Express your answers in simplest radical form.

## APPLICATIONS

6. A missile is fired such that its height above the ground is given by $h = -9.8t^2 + 38.2t + 6.5$, where $t$ represents the number of seconds since the rocket was fired. Using the quadratic formula, determine, to the nearest *tenth* of a second, when the rocket will hit the ground.

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Algebra 2R Unit 8: Radicals and the Quadratic Formula

8.7 Problem Set – More Work with the Quadratic Formula

$$x=\frac{-b\pm\sqrt{b^2-4ac}}{2a} \text{ or } x=\frac{-b}{2a}\pm\frac{\sqrt{b^2-4ac}}{2a}$$

## FLUENCY

1. Which of the following represents the solutions to $x^2-4x+12=6x-2$?

(1) $x=4\pm\sqrt{7}$ (3) $x=5\pm\sqrt{22}$

(2) $x=5\pm\sqrt{11}$ (4) $x=4\pm\sqrt{13}$

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2. The smaller root, to the nearest *hundredth*, of $2x^2-3x-1=0$ is

(1) −0.28 (3) 1.78

(2) −0.50 (4) 3.47

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3. The $x$-intercepts of $y=2x^2+7x-30$ are

(1) $x=\frac{-7\pm\sqrt{191}}{2}$ (3) $x=-6$ and $\frac{5}{2}$

(2) $x=-3$ and 5 (4) $x=-3\pm\sqrt{131}$

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4. Solve the following equation for all values of $x$. Express your answers in simplest radical form.

$$4x^2-4x-5=8x+6$$

5. Solve the following equation for all values of $x$. Express your answers in simplest radical form.

$$9x^2=6x+4$$

6. Algebraically solve the system of equations shown below. Note that you can use either factoring or the quadratic formula to find the $x$-coordinates, but the quadratic formula is probably easier.

$y=6x^2+19x-15$ and $y=-12x+15$

## APPLICATIONS

7. The Celsius temperature, $C$, of a chemical reaction increases and then decreases over time according to the formula $C(t)=-\frac{1}{2}t^2+8t+93$, where $t$ represents the time in minutes. Use the Quadratic Formula to help determine the amount of time, to the nearest tenth of a minute, it takes for the reaction to reach 110 degrees Celsius.

## REASONING

8. For every quadratic there are two roots (or zeroes or $x$-intercepts). They are always given by

$$x_1=\frac{-b-\sqrt{b^2-4ac}}{2a} \text{ and } x_2=\frac{-b+\sqrt{b^2-4ac}}{2a}$$

Determine a formula, in terms of $b$ and $a$ for the sum of these two roots.