Name: ______________________________ Date: ______________

THE METHOD OF COMMON BASES
ALGEBRA 2 WITH TRIGONOMETRY

Solving exponential equations, that is ones where the variable occurs in the exponent, is an important algebraic skill to gain proficiency with in this course. There will be two primary ways to solve these equations, the first of which we will work with in this lesson – **The Method of Common Bases**. But, first, an introduction.

***Exercise* #1:** Solve each of the following simple exponential equations.

(a) $2^x = 16$ (b) $3^x = 27$ (c) $5^x = \frac{1}{25}$ (d) $16^x = 4$

In each of these cases, even the last, more challenging one, we could manipulate the right-hand side of the equation so that it shared a **common base** with the left-hand side of the equation. We can exploit this fact by manipulating both sides so that they have a common base. First, though, we need to review an exponent law.

***Exercise* #2:** Simplify each of the following exponential expressions.

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

***Exercise* #3:** Solve each of the following equations by finding a common base for each side.

(a) $8^x = 32$ (b) $9^{2x+1} = 27$ (c) $125^x = \left(\frac{1}{25}\right)^{4-x}$

***Exercise* #4:** Which of the following represents the solution set to the equation $2^{x^2-3} = 64$?

(1) $\{\pm 3\}$ (3) $\{\pm\sqrt{11}\}$

(2) $\{0, 3\}$ (4) $\{\pm\sqrt{35}\}$

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Almost any equation solving technique that you have encountered so far can arise in these types of equations.

***Exercise* #5:** Find all solutions to the following equation. Check your solutions using a table on your graphing calculator.

$$25^{x^2-5x}=125^{x-2}$$

***Exercise* #6:** Solve the following equation for all values of θ on the interval $0^\circ \le \theta \le 360^\circ$.

$$9^{\cos\theta}=3$$

***Exercise* #7:** Find all solutions to the following equation.

$$36^{\sqrt{x}}=216$$

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THE METHOD OF COMMON BASES
ALGEBRA 2 WITH TRIGONOMETRY - HOMEWORK

SKILLS

1. Solve each of the following exponential equations using the Method of Common Bases. Each equation will result in a linear equation with one solution. Check your answers.

(a) $3^{2x-5}=9$ (b) $2^{3x+7}=16$ (c) $5^{4x-5}=\frac{1}{125}$

(d) $8^{x}=4^{2x+1}$ (e) $216^{x-2}=\left(\frac{1}{1296}\right)^{3x-2}$ (f) $\left(\frac{1}{25}\right)^{x+15}=3125^{\frac{3}{5}x-1}$

2. *Algebraically* determine the intersection point of the two exponential functions shown below. Recall that most systems of equations are solved by substitution.

$$y=8^{x-1} \text{ and } y=4^{2x-3}$$

3. *Algebraically* determine the *x*-intercept of the exponential function $y=2^{2x-9}-32$. Recall that the *y*-coordinate of **all** *x*-intercepts is zero.

4. Solve the following exponential equation for all possible values of x. Check your solutions by setting up an appropriate table on your calculator.

$$9^{x^2+x} = 243^{x+1}$$

5. Find all values of x on the interval $0^\circ \le x \le 360^\circ$ that satisfy the exponential equation shown below.

$$4^{\sin^2 x} = 2$$

6. Solve the exponential equation shown below for all values of x.

$$9^{\sqrt{16x+17}} = 81^{x+2}$$

7. Solve the exponential equation shown below for all values of x.

$$5^{|x+1|} = \left(\frac{1}{625}\right)^{2-x}$$