MAP4C **Date: _____**

Day 6: Exponential Equations II **Unit 6: Algebraic Models**

1. Rewrite each expression with base of 2.

a) 4	b) 32	c) 1	d) ½	e) 1/8
$=2^2$	$=2^5$ 32 | 2 16 | 2 8 | 2 4 | 2 2 | 2 1	$=2^0$	$=2^{-1}$	$=2^{-3}$

2. Rewrite each expression with base of 3.

a) 9	b) 243	c) 1	d) 1/9	e) 1/27
$=3^2$	$=3^5$ 243 | 3 81 | 3 27 | 3 9 | 3 0 | 3 1	$=3^0$	$=9^{-1}$ $=(3^2)^{-1}$ $=3^{-2}$	$=27^{-1}$ $=(3^3)^{-1}$ $=3^{-3}$

3. Rewrite each expression with base of 5

a) 5	b) 25	c) 1	d) 1/125	e) 1/625
$=5^1$	$=5^2$	$=5^0$	$=125^{-1}$ 125 | 5 25 | 5 5 | 5 1 $=(5^3)^{-1}$ $=5^{-3}$	$=625^{-1}$ 625 | 5 125 | 5 25 | 5 5 | 5 1 $=(5^4)^{-1}$ $=5^{-4}$

4. Solve each equation:

$x - 8 = 10$	$5x + 1 = 11$	$22 - 4x = 10 + 2x$	$3(x - 5) = 2x$
$+8 \quad +8$ $x = 18$	$-1 \quad -1$ $5x = 10$ $\div 5 \quad \div 5$ $x = 2$	$-22 \quad -22$ $-4x = -12 + 2x$ $-2x \quad -2x$ $-6x = -12$ $\div -6 \quad \div -6$ $x = 2$	$3x - 15 = 2x$ $+15 \quad +15$ $3x = 2x + 15$ $-2x \quad -2x$ $x = 15$

5. Express the right side of the equation as a power of 3, then solve the equation. (Changing to a common base method)

a) $3^x = 27$	b) $3^x = 1/27$	c) $3^{5x} = 243$	d) $3^{2x+2} = 81$
if $3^x = 3^3$ then $x = 3$	$3^x = 27^{-1}$ $3^x = (3^3)^{-1}$ if $3^x = 3^{-3}$ then $x = -3$	if $3^{5x} = 3^5$ then $5x = 5$ $\div 5 \quad \div 5$ $x = 1$	if $3^{2x+2} = 3^4$ then $2x + 2 = 4$ $-2 \quad -2$ $2x = 2$ $\div 2 \quad \div 2$ $x = 1$

6. Solve each equation by changing to a common base.

a) $2^x = 16$

if $2^x = 2^4$
then $x = 4$

b) $6^{x-1} = 36$

$6^{x-1} = 6^2$

$x - 1 = 2$
$+1 \quad +1$
$x = 3$

c) $10^{1-2x} = 100$

$10^{1-2x} = 10^2$

$1 - 2x = 2$
$-1 \quad -1$
$-2x = 1$
$\div -2 \quad \div -2$
$x = -0.5$

d) $4^{2x} = 64$

$4^{2x} = 4^3$

$2x = 3$
$\div 2 \quad \div 2$
$x = 1.5$

e) $4^{x-3} = 1$

$4^{x-3} = 4^0$

$x - 3 = 0$
$+3 \quad +3$
$x = 3$

f) $2^x - 4 = 28$

$+4 \quad +4$
$2^x = 32$
$2^x = 2^5$
$x = 5$

g) $8^x = 4^3$

$(2^3)^x = (2^2)^3$
$2^{3x} = 2^6$
$3x = 6$
$\div 3 \quad \div 3$
$x = 2$

h) $5^{2n+1} = 1/125$

$5^{2n+1} = 125^{-1}$
$5^{2n+1} = (5^3)^{-1}$
$5^{2n+1} = 5^{-3}$
$2n + 1 = -3$
$-1 \quad -1$
$2n = -4$
$n = -2$

i) $3^{2(x+2)} = 27^{(x+2)}$

$3^{2x+4} = 3^{3(x+2)}$

$2x + 4 = 3x + 6$
$-4 \quad -4$
$2x = 3x + 2$
$-3x \quad -3x$
$-x = 2$
$x = -2$

j) $100^{(2x-3)} = 1000^{(3x+1)}$

$10^{2(2x-3)} = 10^{3(3x+1)}$

$2(2x-3) = 3(3x+1)$
$4x - 6 = 9x + 3$
$+6 \quad +6$
$4x = 9x + 9$
$-9x \quad -9x$
$-5x = 9$
$\div -5 \quad \div -5$
$x = -1.8$

k) $5^{2(x-5)} = 125^{(x-1)}$

$5^{2(x-5)} = 5^{3(x-1)}$

$2(x-5) = 3(x-1)$
$2x - 10 = 3x - 3$
$+10 \quad +10$
$2x = 3x + 7$
$-3x \quad -3x$
$-1x = 7$
$\div -1 \quad \div -1$
$x = -7$

l) $4^{3(x+1)} = 16^{(x+2)}$

$4^{3(x+1)} = 4^{2(x+2)}$

$3(x+1) = 2(x+2)$
$3x + 3 = 2x + 4$
$-3 \quad -3$
$3x = 2x + 1$
$-2x \quad -2x$
$x = 1$

7. A strain of bacteria doubles every hour. A lab technician starts with 200 bacteria. They use the equation $B = 200(2)^t$ to model the number of bacteria, *B*, after *t* hours.

a) Write an exponential equation that can be used to determine when there are 6400 bacteria in the culture.

$6400 = 200(2)^t$

b) Solve the equation you set up in section (a).

$6400 = 200(2)^t$
$\div 200 \quad \div 200$
$\rightarrow 32 = 2^t$
$2^5 = 2^t$
$t = 5$