Solving Exponential Equations

Example 1: Solve for x: $3^{x+1} = 81$.

First, we re-write 81 as a power of 3: $3^{x+1} = 3^4$
Next, set the exponents equal to each other: $x+1 = 4$
Solve! $x = 3$

Example 2: Solve: $2^{3x+1} = 4^{x-1}$

$2^{3x+1} = \left(2^2\right)^{x-1}$
$2^{3x+1} = 2^{2x-2}$
$3x+1 = 2x-2$
$x = -3$

Example 3: Solve: $25^{x+4} = 125^{2x-9}$
Since 125 cannot easily be written as a power of 25, we re-write both as powers of 5:
$25^{x+4} = 125^{2x-9}$
$\left(5^2\right)^{x+4} = \left(5^3\right)^{2x-9}$
$5^{2x+4} = 5^{6x-54}$
$2x+4 = 6x-54$
$-4x = -58$
$x = 14.5$

Example 4: Solve: $\sqrt{32}^{\,x} = 2^{x+8}$
Recall that $\sqrt[n]{x} = x^{1/n}$.

$\sqrt{32}^{\,x} = 2^{x+8}$
$\left(32^{\frac{1}{2}}\right)^x = 2^{x+8}$
$\left(2^5\right)^{\frac{x}{2}} = 2^{x+8}$
$\frac{5x}{2} = x+8$
$\frac{3x}{2} = 8$
$x = \frac{16}{3}$

Practice: pg. 69 #1, 2, 5, 9, 10