Solving Equations

Emphasis solving Exponential Equations

Solve each of the following Exponential Equations:

1. $5^{3-2x} = 5^{-x}$

Same base of 5, so exponents are =

$3 - 2x = -x$

$+2x \quad +2x$

$3 = x$

2. $3^{2a} = 3^{-a}$

Same base $\Rightarrow$ exponents =

$2a = -a$

$+a \quad +a$

$\frac{3a}{3} = \frac{0}{3}$

$a = 0$

3. $4^{2p} = 4^{-2p-1}$

Same base $\Rightarrow$ exponents =

$2p = -2p - 1$

$+2p \quad +2p$

$\frac{4p}{4} = \frac{-1}{4}$

$p = -\frac{1}{4}$

4. $6^{-2x} = 6^{2-3x}$

Same base $\Rightarrow$ exponents =

$-2x = 2 - 3x$

$+3x \quad +3x$

$x = 2$

5. $8^{x-1} = 2^{x+2}$

Rewrite 8 as 2^3

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

$\Rightarrow 3x - 3 = x + 2$

$-x + 3 \quad -x + 3$

$\frac{2x}{2} = \frac{5}{2}$

$x = \frac{5}{2}$

6. $144^{2x+1} = 12^{5x-1}$

Rewrite 144 as 12^2

$(12^2)^{2x+1} = 12^{5x-1}$

$\Rightarrow 2(2x+1) = 5x - 1$

$4x + 2 = 5x - 1$

$-4x + 1 \quad -4x + 1$

$3 = x$

7. $5^{3x+1} = 25^{x+1}$

Rewrite 25 as 5^2

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

$\Rightarrow 3x + 1 = 2x + 2$

$-2x - 1 \quad -2x - 1$

$x = 1$

8. $4^{-x+1} = 2^{2x}$

Rewrite 4 as 2^2

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

$\Rightarrow -2x + 2 = 2x$

$+2x \quad +2x$

$\frac{2}{4} = \frac{4x}{4}$

$x = \frac{1}{2}$

9. $64^a = 8^{a+2}$

Rewrite 64 as 8^2

$(8^2)^a = 8^{a+2}$

$\Rightarrow 2a = a + 2$

$-a \quad -a$

$a = 2$

10. $2^{m+1} = 16^{m+7}$

Rewrite 16 as 2^4

$2^{m+1} = (2^4)^{m+7}$

$\Rightarrow m + 1 = 4m + 28$

$-m - 28 \quad -m - 28$

$\frac{-27}{3} = \frac{3m}{3}$

$m = -9$

11. $36^{2x} = 216^{x-1}$

$36 = 6^2$ & $216 = 6^3$

$(6^2)^{2x} = (6^3)^{x-1}$

$\Rightarrow 4x = 3x - 3$

$-3x \quad -3x$

$\boxed{x = -3}$

12. $3^{a-7} = 27^{2a}$

$27 = 3^3$

$3^{a-7} = (3^3)^{2a}$

$\Rightarrow a - 7 = 6a$

$-a \quad -a$

$\frac{-7}{5} = \frac{5a}{5}$

$\boxed{a = \frac{-7}{5}}$

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

$\left(\frac{1}{3}\right)^{-1} = 3$ OR $3^{-1} = \frac{1}{3}$

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

$\Rightarrow -x - 2 = x - 1$

$+x + 1 \quad +x + 1$

$\frac{-1}{2} = \frac{2x}{2}$

$\boxed{x = \frac{-1}{2}}$

14. $\left(\frac{1}{2}\right)^{x} = 2^{x+3}$

$\left(\frac{1}{2}\right)^{-1} = 2$

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

$\Rightarrow -x = x + 3$

$-x \quad -x$

$\frac{-2x}{-2} = \frac{3}{-2}$

$\boxed{x = \frac{-3}{2}}$

15. $8^{x-1} = 2^{x+2}$

Rewrite 8 as 2^3

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

$\Rightarrow 3x - 3 = x + 2$

$-x + 3 \quad -x + 3$

$\frac{2x}{2} = \frac{5}{2}$

$\boxed{x = \frac{5}{2}}$

16. $8^{5x} = 16^{3x+4}$

$8 = 2^3$ & $16 = 2^4$

$(2^3)^{5x} = (2^4)^{3x+4}$

$\Rightarrow 15x = 12x + 16$

$-12x \quad -12x$

$\frac{3x}{3} = \frac{16}{3}$

$\boxed{x = \frac{16}{3}}$

17. $81^{2x+1} = 9^{5x-1}$

Rewrite 81 as 9^2

$(9^2)^{2x+1} = 9^{5x-1}$

$\Rightarrow 4x + 2 = 5x - 1$

$-4x + 1 \quad -4x + 1$

$\boxed{3 = x}$

18. $16^{x+1} = 4^{4x+1}$

Rewrite 16 as 4^2

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

$\Rightarrow 2x + 2 = 4x + 1$

$-2x - 1 \quad -2x - 1$

$\frac{1}{2} = \frac{2x}{2}$

$\boxed{x = \frac{1}{2}}$

19. $4^{x+2} = 64$

Rewrite 64 as 4^3

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

$\Rightarrow x + 2 = 3$

$-2 \quad -2$

$\boxed{x = 1}$

20. $3^{x-2} = 81$

Rewrite 81 as 3^4

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

$\Rightarrow x - 2 = 4$

$+2 \quad +2$

$\boxed{x = 6}$