T6: EXPONENTIAL EQUATIONS

(Exponential Equations)

Example Notes

- get same BASE
- then only work out the exponents

① $3^{x} = 3^{5}$

$x = 5$

$3^5 = 3^5$ ✓

② $6^{3-2x} = 6^{-x}$

$3 - 2x = -x$

$+2x \quad +2x$

$3 = x$

Check

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

$6^{3-6} = 6^{-3}$

$6^{-3} = 6^{-3}$ ✓

③ $8^{x-1} = 2^{x+2}$

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

$3(x-1) = x+2$

$3x - 3 = x + 2$

$-x \quad -x$

$2x - 3 = 2$

$+3 \quad +3$

$2x = 5$

$x = 2.5$

Check

$3(2.5-1) \quad 2.5+2$

$3(1.5)$

$2^{4.5} = 2^{4.5}$ ✓

④ $144^{2x+1} = 12^{5x-1}$

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

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

$4x + 2 = 5x - 1$

$-4x \quad -4x$

$1 + 2 = x - 1 + 1$

$3 = x$

$12^{14} = 12^{14}$ ✓

⑤ $4^{m+1} = 32$

$2^{2(m+1)} = 2^{5(m+7)}$

$2(m+1) = 5(m+7)$

$2m + 2 = 5m + 35$

$-2m \quad -2m$

$2 = 3m + 35$

$-35 \quad -35$

$-33 = 3m$

$\frac{-33}{3} = \frac{3m}{3}$

$-11 = m$

$2^{-20} = 2^{-20}$ ✓

⑥ $5^{4x} \cdot 5^{-x+1} = 5^{18}$

$5^{4x+(-x+1)} = 5^{18}$

$5^{3x+1} = 5^{18}$

$3x + 1 = 18$

$-1 \quad -1$

$\frac{3x}{3} = \frac{17}{3}$

$x = 5\frac{2}{3}$

$5^{18} = 5^{18}$ ✓

(7) $243 \cdot 3^{2x+5} = 1$

simplify → $3^{5} \cdot 3^{2x+5} = 3^{0}$

$3^{5+2x+5} = 3^{0}$

Solve for x → $2x + 10 = 0$

$-10 \quad -10$

$\frac{2x}{2} = \frac{-10}{2}$

$\boxed{x = -5}$

(8) $\frac{4}{256^{3x}} = 16^{2x}$

simplify → $\frac{4^{1}}{4^{4(3x)}} = 4^{2(2x)}$

simplify → $\frac{4^{1}}{4^{12x}} = 4^{4x}$

$4^{1-12x} = 4^{4x}$

Solve for x → $1 - 12x = 4x$

$+12x \quad +12x$

$\frac{1}{16} = \frac{16x}{16}$

$\boxed{\frac{1}{16} = x}$

(9) $\frac{1}{216} = 6^{5x} \cdot 6^{2x+1}$

$\frac{1}{6^{3}} = 6^{5x+2x+1}$

reciprocal

$6^{-3} = 6^{7x+1}$

Solve for x → $-3 = 7x + 1$

$-1 \quad -1$

$\frac{-4}{7} = \frac{7x}{7}$

$\boxed{-\frac{4}{7} = x}$