# Logarithmic Equations

*Solve each equation. Check for extraneous solutions where required.*

**Section A — Fundamental Skills**

1. $\log_2(\sqrt{8}) = x$
2. $\log_2(32) = x$

**Section B — Change of Base / Variable Base**

3. $\log_{64}(x) = \frac{2}{3}$
4. $\log_x(9) = \frac{2}{3}$
5. $\log_x(36) = 2$
6. $\log_{\frac{1}{3}}(27) = x$

**Section C — Log Laws (Product & Quotient)**

7. $\log_3(3x) - \log_3(4) = \log_3(12)$
8. $\log_3(x + 25) - \log_3(x - 1) = 3$
9. $\log_4(3x - 2) - \log_4(4x + 1) = 2$
10. $\log_3(7) + \log_3(x + 2) = \log_3(6)$

**Section D — Quadratic Structure**

11. $\log_4(x - 5) + \log_4(x - 2) = 1$
12. $\log(2x + 3) + \log(x + 2) - 1 = 0$
13. $\log_{49}(x + 4) + \log_{49}(x - 2) = \frac{1}{2}$
14. $\log(x + 2) + \log(x - 7) = 2\log(x - 4)$

**Section E — Mixed Bases / Advanced Manipulation**

15. $\log_5(9x - 2) - \log_5(x) = \log_{25}(4)$
16. $\log_2(x) = 2 + \log_4(x - 3)$
17. $\log_{16}(x + 4) + \log_{16}(x - 4) = \log_4(3)$
18. $\log_2(1 - x) - \log_2(3 - x) = -0.5\log_2(4)$
19. $\log(\sqrt{x + 4}) - \log(\sqrt{x - 4}) = \log(3)$

**Section F — Multi-Base & Higher Structure**

20. $\log_2(x) + \log_4(x) + \log_{16}(x) = 21$
21. $\log_3(x) + \log_{243}(x^5) + 3 = 0$
22. $\log_2(x^2 - 2) - 1 = \log_2\left(\frac{1}{2}x + 5\right)$