

Solve the following equations for x .

1. $x^3 + 3x^2 - 4x = 0$

2. $12x^2 - 4x^3 - x^4 = 0$

3. $x - \frac{24}{x+2} = 3$

4. $x - \frac{9}{x} = 0$

5. $\frac{4}{x^2} - \frac{3}{x} = 1$

6. $x + \frac{6}{x-1} = -5$

For each of the following functions, determine the domain. Find any x or y -intercepts and locate any vertical or horizontal asymptotes. Sketch the graphs of the functions.

7. $y = \frac{1}{2x-6}$

8. $y = \frac{x+1}{x-1}$

9. $y = \sqrt{2x-4}$

10. $y = \frac{x}{x^2-9}$

11. $y = \frac{2x^2}{x^2-2x}$

12. $y = \sqrt{25-x^2}$

13. $y = \frac{x^2}{x+1}$

14. $y = \sqrt{9-x}$

15. $y = \frac{x^2+1}{x^2-4x+3}$

16. Suppose an enzyme satisfies the equation

$$V = \frac{20[S]}{10 + [S]}.$$

- a. Sketch a graph of this function for $0 \leq [S] \leq 100$. Find any horizontal asymptotes.
- b. Determine the linear equation for $x = 1/[S]$ and $y = 1/V$, then create the Lineweaver-Burk plot. Find the intercepts on the x and y axes. What is the slope for this line?

17. The growth of a culture of yeast is empirically shown to satisfy the equation

$$P(t) = \frac{10 + 0.2t^2}{1 + 0.001t^2}.$$

where t is in hours and P is the density of the population (number of yeast/cc).

- a. Find the density of the yeast culture at $t = 0$ and 10 hours.
- b. Sketch a graph of $P(t)$ for $t \geq 0$. Show any asymptotes.

18. Consider a weak acid with $K_a = 0.0001$.

- a. Find the $[H^+]$ for a 0.1N solution of this acid.
- b. Let x be the normality of the weak acid. Sketch a graph of the $[H^+]$ for $0 \leq x \leq 1$.

19. **Eutrophication** During an algae bloom, a pond becomes eutropic with oxygen levels dropping to near zero at the bottom because of decaying organic matter. Suppose that the level of O_2 dissolved in the water varies with the depth from the surface according to the function:

$$P(y) = 3\sqrt{9 - y},$$

where y is the depth in meters from the surface and P is in mmHg of dissolved O_2 .

- a. Find the domain for $P(y)$ and sketch a graph of this function.
- b. If fish need at least 6 mmHg of dissolved O_2 , then how deep can the fish survive.