# Math-UA 121: Worksheet Two

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## Section 1.5 - Continuity

1. Use the Intermediate Value Theorem to show that the equation had at least one real root.
   (a) $\cot x = x$
   (b) $x^4 + x - 3 = 0$
   (c) $\sqrt{5}x = 1 - x$.

2. (a) For what values of $a$ and $b$ is the following function continuous on $(-\infty, \infty)$. $f(x) = \begin{cases} \dfrac{x^2-9}{x-3}, x < 3 \\ ax^2 - bx + 3, 3 < x < 4 \\ 2x - 2a + b, x \geq 4 \end{cases}$

   (b) Find the value of $c$ (if it exists) that make $f$ continuous everywhere. $f(x) = \begin{cases} cx + 1, x \leq 3 \\ cx^2 - 1, x > 3 \end{cases}$

   (c) Suppose $f(x) = \begin{cases} \sin(x), x \leq c \\ a + bx, x > c \end{cases}$ where $a, b, c$ are constants. If $c$ and $b$ are given, find all values of $a$ such that $f$ is continuous at the point $x = c$.

## Section 1.4 - Limits Involving Infinity

**Evaluate the limit, if it exists**.

3. $\lim_{x\to\infty} \cos(\frac{1}{x})$

4. (a) $\lim_{x\to 2^-} \frac{x^2+x}{x-2}$
   (b) $\lim_{x\to 2^+} \frac{x^2+x}{x-2}$
   (c) $\lim_{x\to 2} \frac{x^2+x-6}{x-2}$

5. $\lim_{t\to\infty} \frac{\sqrt{t}-4}{t+47}$

6. $\lim_{x\to\infty} \frac{x^2+2x-7}{x^2+9}$

7. $\lim_{x\to-\infty} \frac{3x^3+4x-7}{x^3}$

8. $\lim_{x\to\infty} \frac{\cos^2(x)}{x^2}$

9. $\lim_{x\to-\frac{\pi}{2}} \cot(x)$

10. (a) $\lim_{x\to a} \sqrt{x^2}$, where $a < 0$
    (b) $\lim_{x\to a} \sqrt{x^2}$, where $a > 0$

11. $\lim_{x\to 5^-} \frac{x-4}{\sqrt{4x^2+5}}$

**Find the horizontal and vertical asymptotes of the function, if they exist**.

12. $f(x) = x + 4$

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

14. $f(x) = \frac{x-67}{x+57}$

15. $f(x) = \frac{x^2-2x+7}{\sqrt{x^5+7x-2}}$

16. $f(x) = \frac{x^3+3x+2}{x^3+27}$

17. $f(x) = \frac{x^7+x^5+90x^2+86}{x^6+4x^3+2x^3+x}$

18. $f(x) = \frac{x^3+2x+7}{7x^6+2x+9}$

19. $f(x) = \frac{x-4}{\sqrt{2x^2+5x+2}}$