**Math 10A**
**Homework #1; Due Friday, 6/22/2018**
**Instructor: Roy Zhao**

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1. Let $A = \{1, 2, 3, 4, 5\}$ and $B = \{4, 5, 6\}$. Label each of the following as true or false.
   (a) $1 \in A$
   (b) $1 \in B$
   (c) $2 \notin A \cap B$
   (d) $7 \notin A \cup B$

2. Let $A$ be the set of animals, let $P$ be the set of plants, let $B$ be the set of birds and let $M$ be the set of mammals. Label each of the following as true or false.
   (a) $A \subseteq P$
   (b) $B \nsubseteq A$
   (c) $B \nsubseteq A - M$
   (d) $B \cup M \subseteq A$

3. State whether the following represent functions. If it is a function, find the domain and range.
   (a) The set of points $\{(5, 2), (7, 3), (1, 6), (6, 9)\}$.
   (b) $\{(x, y) | y \leq 4x + 3\}$
   (c) A circle of radius 4 with center $(2, 3)$
   (d) A upward-facing parabola with vertex $(0, 2)$
   (e) The line passing through $(4, 5)$ and $(-3, 5)$

4. True **FALSE** The horizontal line test is used to check whether a curve on a plane is a function.

5. Let $f(x) = x^2 + 1$ and let $g(x) = x - 2$. Compute each of the following:
   (a) $(g \circ f)(3)$
   (b) $(g - f)(3)$
   (c) $(g/f)(3)$

6. For each of the following, sketch the graph of a function $f : \mathbb{R} \to \mathbb{R}$ with the desired property.
   (a) $f$ is bijective;
   (b) $f$ is surjective, but not injective;
   (c) $f$ is injective, but not surjective;

(d) $f$ is neither injective nor surjective.

7. Find an inverse to the following functions. State the domain and range of the inverses.

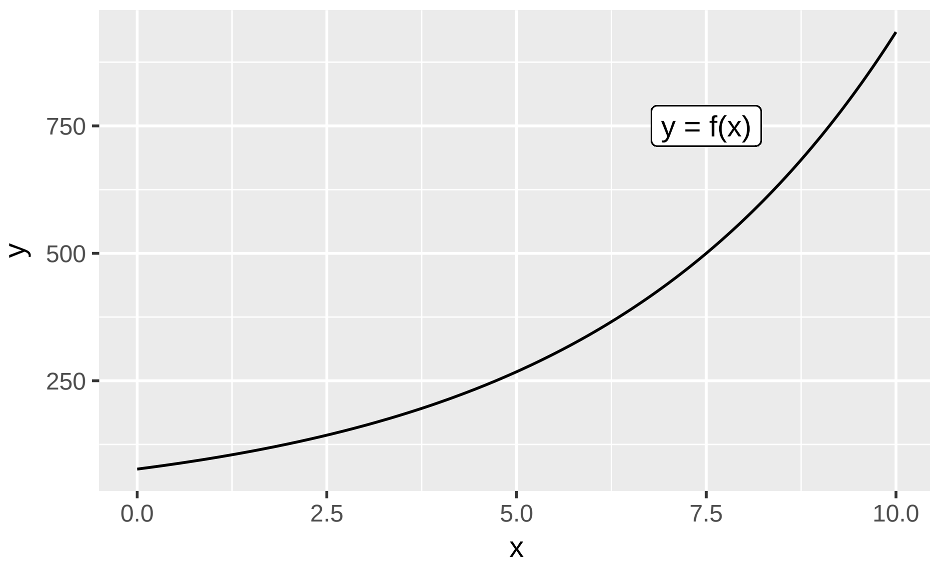
   (a) $f(x) = 3x + 1$

   (b) $f(x) = e^{2x+1}$

   (c) $y = (x - 2)^3 + 1$

   (d) $y = \frac{x}{x+1}$

8. Use the graph to estimate $f^{-1}(500)$.




9. Compute or simplify each of the following:

   (a) $9 \cdot 3^5$

   (b) $(2^1)^2$

   (c) $2^{(1^2)}$

   (d) $\ln(1)$

   (e) $\ln(e)$

   (f) $\ln(2) + \ln(1/2)$

   (g) $\cos(0)$

   (h) $\sin(\pi/4)$

   (i) $\cos(\pi/2)$

   (j) $\sin(-\pi/2)$

10. **TRUE** False If a function is both injective and surjective then it is invertible.

11. True **FALSE** If the function $f$ is not invertible, then there is definitely no solution to the equation $f(x) = 20$.

12. **TRUE** False If $f$ is an invertible function and $f(3) = 5$, then $f^{-1}(5) = 3$.

13. True **FALSE** If $f$ and $g$ are any functions, then $f \circ g = g \circ f$.

14. **TRUE** False The range of an invertible function $f$ is the domain of the inverse $f^{-1}$.

15. True **FALSE** If $f(x) = \sqrt{x}$, then the domain of $f^{-1}$ is all real numbers.

16. Sketch the following functions by appropriately shifting, stretching, or translating.
    (a) $f(x) = 3\cos(2x)$
    (b) $y = (x+1)^3 + 2$.
    (c) $y = (2x+1)^2 - 3$
    (d) $f(x) = |x-1|$
    (e) $f(x) = \sqrt{1-x}$

17. Find each of the following limits or explain why they don't exist.
    (a) $\lim_{n\to\infty} \frac{n^2+1}{2n}$
    (b) $\lim_{n\to\infty} e^n$
    (c) $\lim_{n\to\infty} \frac{\frac{1}{5+n} - \frac{1}{5}}{n}$
    (d) $\lim_{n\to\infty} \frac{2n^2+1}{4n^2-1}$
    (e) $\lim_{n\to\infty} \frac{|x|}{x^2}$
    (f) $\lim_{n\to\infty} \cos(x)$
    (g) $\lim_{n\to\infty} \sqrt{n+1} - \sqrt{n}$

18. True **FALSE** If $\lim_{n\to\infty}(a_n + b_n)$ exists, then $\lim_{n\to\infty} a_n$ and $\lim_{n\to\infty} b_n$ both exist.

19. Find each of the following limits or explain why they don't exist.
    (a) $\lim_{x\to 0} \frac{1}{x}$
    (b) $\lim_{x\to 1^+} \frac{1}{x^2-1}$
    (c) $\lim_{x\to 0} \sin(x)$
    (d) $\lim_{x\to 2} \frac{\sqrt{x+2}-2}{x-2}$

20. The function $f(x) = (x^2-9)/(x-3)$ is not defined at $x = 3$. Is there a way to define $f(3)$ so that $f$ is continuous everywhere? If so, how?

21. Sketch the graph of a function $f : [0,1] - \{1/2\} \to \mathbb{R}$ is continuous and there is no way to define $f(1/2)$ so that $f : [0,1] \to \mathbb{R}$ is continuous.

22. True **FALSE** If $f$ is defined at $x = 0$, then $\lim_{x\to 0} f(x) = f(0)$.

23. **TRUE** False If a function $f$ is continuous on the interval $(0,2)$, then $\lim_{a\to 1} f(a) = f(1)$.

24. True **FALSE** If $f$ and $g$ are continuous on the interval $(a, b)$, then $f/g$ is also continuous on the interval $(a, b)$.

25. True **FALSE** Let $f$ be a polynomial function. If $f(c) = 0$, then $f$ is discontinuous at $c$.

26. True **FALSE** If $f$ is discontinuous and $g$ is continuous, then $g \circ f$ is discontinuous.