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Homework H02

MATH 3110/5110 (Barsamian)

Due at start of class Fri Jan 21, 2022

Problem:	1	2	3	4	5	Total	Rescaled
Your Score:							
Possible:	20	20	20	20	20	100	10

There is a large collection of *Suggested Exercises*. (These exercises are not to be turned in and are not graded, but you should write solutions for as many of them as possible and keep your solutions in a notebook for study.)

1.3 # 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13

The five problems presented below are your *Homework Assignment* to be turned in.

To learn the skills for doing the *Suggested Exercises* and *Homework Assignment*, read Section 1.3 of the textbook, watch Videos 1.3a and 1.3b, and read the Notes for those videos.

[1] In this problem, you will write about the *Natural Logarithm* function, $y = \ln(x)$.

- (a) What is the *domain*? (Circle the correct answer: \mathbb{R} \mathbb{R}^{nonneg} \mathbb{R}^+)
- (b) What is the *range*? (Circle the correct answer: \mathbb{R} \mathbb{R}^{nonneg} \mathbb{R}^+)
- (c) Put symbols in the two blanks in order to make a valid *function diagram*, or *arrow diagram* for $y = \ln(x)$.
 $\ln : \underline{\hspace{2cm}} \rightarrow \underline{\hspace{2cm}}$
- (d) Make a large, neat graph of $y = \ln(x)$. (You're welcome to use a computer-generated graph, such as from Desmos.) On your graph, put (x, y) coordinates on the point with $x = 1$ and the point with $x = e$.
- (e) Use your graph to explain why $y = \ln(x)$ is injective and surjective. (This is not a proof. Just explain.)
- (f) What is the *inverse function* for $y = \ln(x)$? What is the *domain* and *range* of the inverse function?

[2] Define sets $A = \mathbb{R} - \{5\}$ and $B = \mathbb{R} - \{1\}$, and define function $f: A \rightarrow B$ by the formula

$$f(x) = \frac{x - 7}{x - 5}$$

- (a) Make a large, neat graph of $f(x)$. (You can use a computer-generated graph if you want.) Use your graph to explain why $f(x)$ is bijective. (This is not a proof. Just explain.)
- (b) Prove that $f(x)$ is bijective.
- (c) Find a formula for the *inverse function* f^{-1} . Show all steps clearly.
- (d) What is the *domain* and *range* of the inverse function?

For the next three problems, we are working with functions $f: S \rightarrow T$ and $g: T \rightarrow V$.

We know that the composition $g \circ f$ is a function with domain S and range V . That is, $g \circ f: S \rightarrow V$.

[3] (Similar to 1.3#6) Prove: If both f and g are injective, then $g \circ f$ is injective.

[4] (Similar to 1.3#8) Prove: If both f and g are both bijective, then $(g \circ f)^{-1} = f^{-1} \circ g^{-1}$.

[5] (Similar to 1.3#11) Prove or disprove: If $g \circ f$ is injective, then both f and g must be injective.