- On the front of your blue book print (1) your name, (2) your student ID number, (3) your discussion section number, and (4) a grading table.
- Show all work in your blue book and BOX IN YOUR FINAL ANSWERS where appropriate.
- Please start each problem on a new page. There are a total of seven problems on both sides of this paper and a total of 100 points.
- NO books, notes, crib sheets, calculators or any other electronic devices are allowed.

Only the final answer will be graded for problems 1 and 2. No justification is needed.

1. (20 points, 4 points each) Determine whether the following statements are True or False.
   (a) If an object moves with the same average velocity over every time interval, then its average velocity equals its instantaneous velocity at any time.
   (b) If $f'(x) = g'(x)$ for all real number x, then $f(x) = g(x)$.
   (c) The sinusoidal function $y = -3\sin(4x) + 5$ completes 4 cycles in the interval $[0, 2\pi]$.
   (d) For sufficiently large values of x, $f(x) = 1000x^3 + 345x^2 + 17x + 394$ is less than $g(x) = 0.01x^4$.
   (e) If $\lim_{x\to 3} f(x) = 7$ and $g(3) = 4$, then $\lim_{x\to 3}(f(x) + g(x)) = 11$.

2. (30 points, 6 points each) Choose A, B, C, D, or E for each of the following questions.
   (a) Which of the following functions have an inverse?

   (I) $\cos x$ with domain $[0, 1]$ (II) $e^{-(x-1)}$ (III) $(x-2)^2$ with domain $(-\infty, 1]$

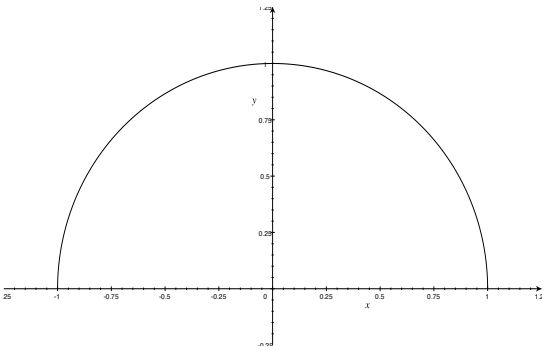
   A) II only **B)** I and II only **C)** I and III only **D)** III only **E)** I, II and III

   (b) Which of the following functions are increasing functions?

   (I) the derivative of an increasing function (II) the derivative of a concave up function
   (III) the inverse of an increasing function (IV) the inverse of a concave up function

   A) I and III only **B)** II and III only **C)** II and III only **D)** I and IV only **E)** III and IV only

   (c) The graph of a function $g(x)$ is given below. Which of the following statements about its derivative $g'(x)$ are true?



   (I) $g'(0) = 0$. (II) $g'(x)$ is an odd function.
   (III) $g'(x)$ is decreasing over $(-1, 1)$. (IV) $g'(x)$ has vertical asymptotes at $x = \pm 1$.

   A) I only **B)** I and II only **C)** I and III only **D)** II and III only **E)** I, II, III and IV

(d) Which of the following statements are true?

(I) If $f(x)$ is not continuous at $x = a$, then it is not differentiable at $x = a$.
(II) If $f(x)$ is not differentiable at $x = a$, then it is not continuous at $x = a$.
(III) If $f(x)$ is differentiable at $x = a$, then it is continuous at $x = a$.

A) II only **B)** I and II only **C)** I and III only **D)** III only **E)** I, II and III

(e) Consider the logarithmic function $f(x) = c\ln(kx)$, where $c < 0$ and $k > 0$ are constants. The graph of $f(x)$ is
A) increasing and concave up. **B)** decreasing and concave up. **C)** increasing and concave down. **D)** decreasing and concave down.

Show your reasoning clearly for problems 3–7. A correct answer with no supporting work may receive no credit while an incorrect answer with some correct work may receive partial credit.

3. (10 points) Consider the piecewise function $f(x)$ defined below. Can you find a value for b such that $f(x)$ is continuous at $x = 2$. If yes, find this value. If not, explain why.

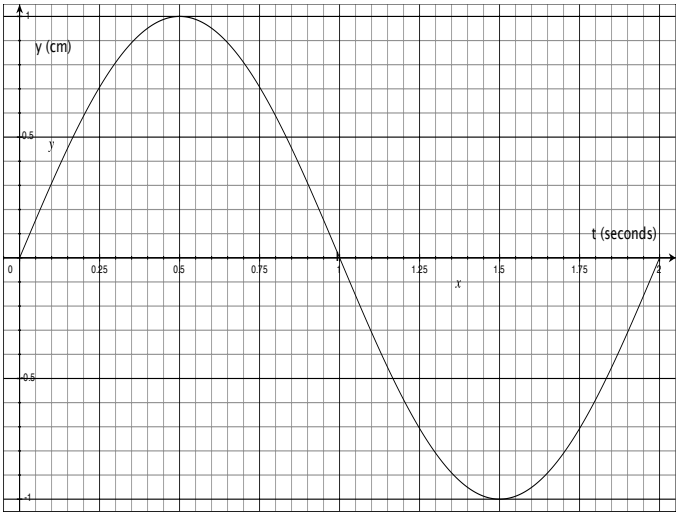
$$f(x) = \begin{cases} \cos\left((x-1)\frac{\pi}{2}\right)\frac{x-2}{|x-2|}, & \text{for } x \neq 2 \\ b, & \text{for } x = 2. \end{cases}$$

4. (8 points) Use the Intermediate Value Theorem to show that the equation $e^x = x + 2$ has a solution on the interval [0,2].

5. (10 points) $g(x) = \dfrac{1}{1-x}$. Using the definition of a derivative, find $g'(x)$.

6. (10 points) What is the y–intercept of the tangent line to $m(x) = \dfrac{5x^3+1}{x}$ at $x = -1$?

7. A block attached to the end of a spring is moving vertically along the y–axis around $y = 0$. The graph below shows its y–coordinate as a function of time t.



(a) (3 points) When (over what time interval(s)) is this block above $y = 0$?
(b) (3 points) When (over what time interval(s)) is this block moving upward?
(c) (6 points) Is $\left.\dfrac{\mathrm{d}^2y}{\mathrm{d}t^2}\right|_{t=0.5}$ positive or negative? What are its units? What is its practical meaning?