

Last/Family Name: \_\_\_\_\_

First/Given Name: \_\_\_\_\_

Student ID Number: \_\_\_\_\_

Instructor (circle):      Hambrook (MW 3:25)      Zeng (MW 9:00)

Honor Pledge: "I affirm that I will not give or receive any unauthorized help on this exam, and that all work will be my own."

You must write out and sign the honor pledge for your examination to be valid.

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Signature: \_\_\_\_\_ Date: \_\_\_\_\_

Instructions:

- Time: 75 minutes.
- Write in pen or pencil.
- No notes, textbooks, phones, calculators, or other electronic devices.
- Show your work and justify your answers. You will not receive full credit for a correct answer if insufficient work is shown or insufficient justification is given. Clearly circle or label your final answers.

QUESTION	VALUE	SCORE
1	15	
2	10	
3	10	
4	15	
5	15	
6	10	
TOTAL	75	

1. (15 points) Consider the function  $f$  with

$$f(x) = \frac{\ln x}{x^2}, \quad f'(x) = \frac{1 - 2 \ln x}{x^3}, \quad f''(x) = \frac{6 \ln x - 5}{x^4}.$$

(a) Find the domain of  $f$ .

(b) List all  $x$ - and  $y$ -intercepts of  $f$ .

(c) List all vertical asymptotes of  $f$  or explain why none exist.

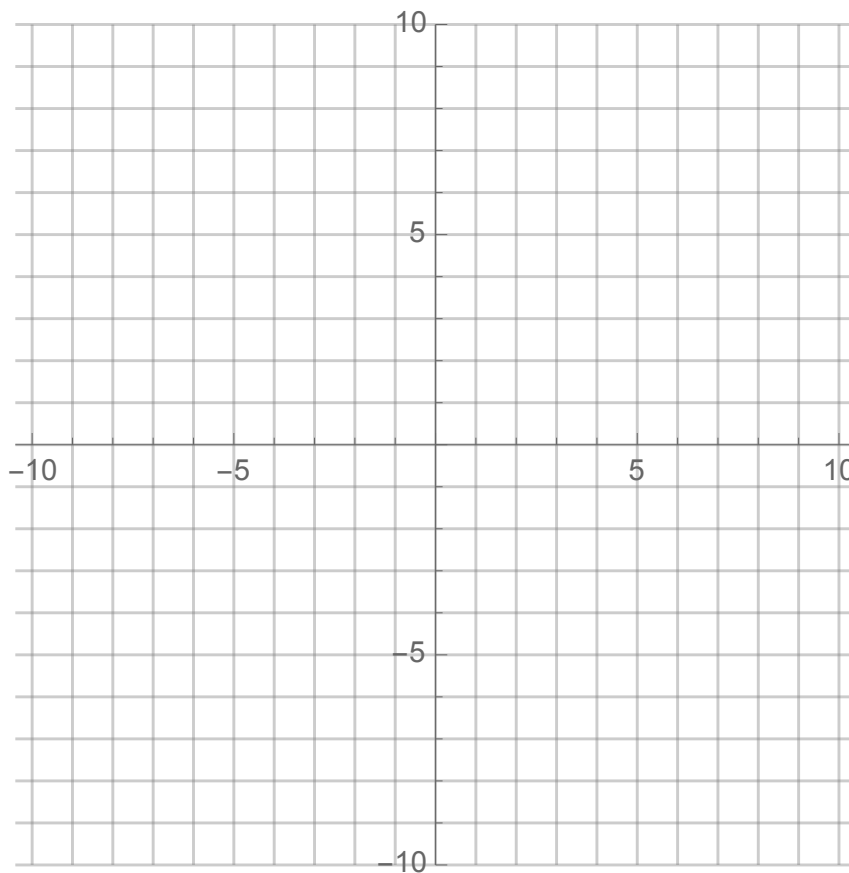
(d) List all horizontal asymptotes of  $f$  or explain why none exist.

(e) On what intervals is  $f(x)$  increasing? decreasing?

(f) On what intervals is  $f(x)$  concave up? concave down?

2. (10 points) Sketch the graph of a function  $g(x)$  that satisfies the following properties:

- $g$  is continuous at all points of its domain
- $x$ -intercepts:  $-3, 2$
- $y$ -intercept:  $-2$
- $\lim_{x \rightarrow 3^-} g(x) = \infty$  and  $\lim_{x \rightarrow 3^+} g(x) = \infty$
- $\lim_{x \rightarrow -\infty} g(x) = 5$  and  $\lim_{x \rightarrow \infty} g(x) = 5$
- increasing on  $(-\infty, -6) \cup (-1, 3)$
- decreasing on  $(-6, -1) \cup (3, \infty)$
- concave up on  $(-\infty, -7) \cup (-3, 3) \cup (3, \infty)$
- concave down on  $(-7, -3)$



**3. (10 points)** Find the area of the largest rectangle which has two vertices on the  $x$ -axis and two vertices on the graph of the function  $y = 8 - x^2$  with  $-\sqrt{8} \leq x \leq \sqrt{8}$ .

**4. (15 points)**

- (a) Estimate the area under the graph  $y = \sqrt{x}$  between  $x = 0$  and  $x = 8$  by using a Riemann sum with four intervals of equal width and right endpoints.

- (b) Find a number  $U$  such that

$$\int_{\pi/2}^{\pi} e^{2\sin x} dx \leq U.$$

Use the comparison properties of the integral to justify your answer.

**5. (15 points)**

(a) Evaluate

$$\frac{d}{dx} \int_x^{e^x} \frac{t^2 + 1}{\sqrt{t + 1}} dt$$

(b) Evaluate

$$\int_1^5 \frac{x^3 e^x + \sqrt{x} e^{2x}}{\sqrt{x} e^x} dx$$

**6. (10 points)** A particle is moving with the given acceleration, velocity, and position data. Find the position function  $s(t)$  of the particle.

$$a(t) = 3 \cos(t) - 2 \sin(t), \quad v(\pi) = 2, \quad s(0) = 3.$$