

161s07	Midterm 2	Exam Time: Thursday 4/5, 8:00 - 9:30
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Name:	Student No.:
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**Instructions:**

- Answer ALL questions from Section A
- You may use a handwritten sheet of notes. Calculators are NOT permitted.
- Read all questions carefully
- Unless explicitly told otherwise, you should explain all your answers fully.
- Do NOT separate the pages of your exam.

Problem	Points	Score
A1	12	<input type="text"/>
A2	16	<input type="text"/>
A3	4	<input type="text"/>
A4	12	<input type="text"/>
A5	10	<input type="text"/>
A6	10	<input type="text"/>
A7	10	<input type="text"/>
A8	10	<input type="text"/>
A9	12	<input type="text"/>
A10	4	<input type="text"/>
Total	100	<input type="text"/>

Name:

**Section A:** Answer ALL questions.

**Problem A1:** [12 pts] In each case, find  $\frac{dy}{dx}$ .

(a)  $y = \frac{xe^{-x}}{1+x^2}$

(b)  $y = (\sin x)^x$

(c)  $xy^3 = 4$

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**Problem A2:** [16 pts] Find the following integrals.

(a)  $\int \frac{3}{1+x^2} - \frac{1}{x^2} dx$

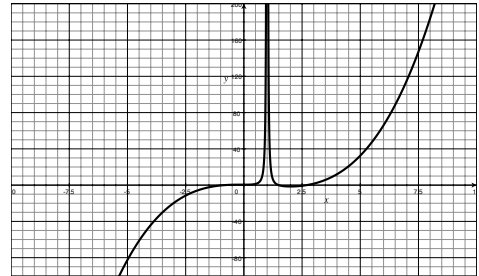
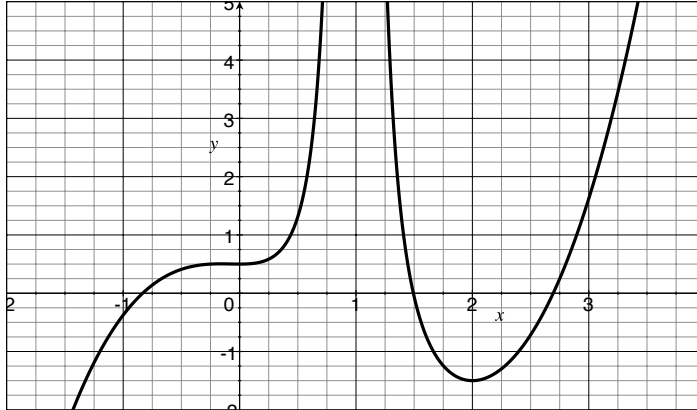
(b)  $\int \frac{\sin(\ln x)}{x} dx$

(c)  $\int_1^2 x^3 - e^x dx$

(d)  $\int_1^4 \frac{1}{1+\sqrt{u}} dx$

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**Problem A3:** [4 pts] Two graphs of a function  $f(x)$  are given below on axes with different scales.



(a) What are the critical values of  $f(x)$ ?

(b) Put the following  $x$ -values in order of increasing values of  $f'(x)$ .  $x = -\frac{1}{2}, 0, \frac{3}{2}, 3$ .

(c) At which of the following values is  $f''(x)$  positive?  $x = -1, \frac{1}{2}, 2, 3$ .

(d) Is  $\int_2^3 f(x)dx$  positive or negative?

Name:

**Problem A4:** [12 pts] Find the following limits:

(a)  $\lim_{x \rightarrow \infty} \frac{2x^3 - 3x^2 + 6}{(x + 2)^3}$

(b)  $\lim_{x \rightarrow 0} x^{\sin x}$

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**Problem A5:** [10 pts] Ann is standing on a muddy field. Three kilometers due east is a road running north-south. Five kilometers down the road (north) is a farm. She can walk over the field at  $2 \text{ km/h}$  and along the road at  $5 \text{ km/h}$ . If she walks to the road and then along the road by the fastest route, where does she join the road?

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**Problem A6:** [10 pts] A rocket is fired directly up from a resting position at ground level on a planet where the acceleration due to gravity is  $4 \text{ m/s}^2$ . For the first 5 seconds its acceleration is given by  $a(t) = 6t \text{ m/s}$ . After 5 seconds, its fuel supply runs out and it accelerates according to gravity. How high does it get?

Name:

**Problem A7:** [10 pts] A vertical wall  $2\text{ m}$  high casts a shadow from the sun onto a flat field. At 6:00 pm, the shadow is  $4\text{ m}$  long and growing at a rate of  $3\text{ m/hour}$ . At what rate is the angle the sun makes with the ground changing at 6:00pm?

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**Problem A8:** [10 pts] A car has velocity  $v(t) = \frac{3}{t+1} - 2$

(a) Find the net change in position over the interval  $0 \leq t \leq 2$ .

(b) Find the total distance traveled over the interval  $0 \leq t \leq 2$ .

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**Problem A9:** [12 pts] Consider the function  $f(x) = x^3 - 6x^2 + 9x + 3$

(a) Find and classify all the critical points of  $f(x)$ .

(b) Find the absolute maximum and absolute minimum values that  $f(x)$  takes on the interval  $[0, 2]$ .

(c) On what interval(s) is  $f(x)$  concave up? Give your answer in interval notation.

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**Problem A10:** [4 pts] A differentiable function  $f(x)$  satisfies

$$f(x + y) = f(x) + f(y) + f(x)f(y)$$

for all  $x, y$ . If  $f(0) = 0$ ,  $f(2) = 5$  and  $f'(0) = 3$ , find  $f'(2)$ .