The problems in this review are designed to help prepare you for your upcoming exam. Questions pertain to material covered in the course and are intended to reflect the topics likely to appear in the exam. Keep in mind that this worksheet was created by CARE tutors, and while it is thorough, it is not comprehensive. In addition to exam review sessions, CARE also hosts regularly scheduled tutoring hours.

Tutors are available to answer questions, review problems, and help you feel prepared for your exam during these times:

Session 1: Mar 26, 7-8:30pm Justin and Jose  
Session 2: Mar 28, 7-8:30pm Cindy and Houd

Can’t make it to a session? Here’s our schedule by course:

https://care.engineering.illinois.edu/tutoring-resources/tutoring-schedule-by-course/

Solutions will be available on our website after the last review session that we host, as well as posted in the Zoom chat 30 minutes prior to the end of the session.

Step-by-step login for exam review session:

1. Log into Queue @ Illinois
2. Click “New Question”
3. Add your NetID and Name
4. Press “Add to Queue”
5. Join the Zoom link in the staff message

Please do not log into the Zoom call without adding yourself to the queue

Good luck with your exam!
1. Find $f'(x)$ given that $f(x) = \sqrt[4]{\arctan(x^9)}$

2. Suppose that $A$ represents the number of grams of a radioactive substance at time $t$ seconds. Given that $\frac{dA}{dt} = -0.125A$, how long does it take 12 grams of the substance to be reduced to 4 grams?

3. A streetlight is mounted at the top of a tall pole with $H = 16.5$ ft. Jennifer’s height is $h = 5.5$ ft tall. She walks away from the pole with a speed of 8 ft/s along a straight path. How quickly is the length of her shadow on the ground increasing when she is 15 ft from the pole?
4. The top of a ladder slides down a vertical wall at a rate of 8 m/s. At the moment when the bottom of the ladder is 4 meters from the wall, it slides away from the wall at a rate of 15 m/s. How long is the ladder?

5. Find the absolute minimum y-value of the given function:

\[ y = \frac{2x}{\sqrt{x - 81}} \]
6. A farmer wishes to fence off three identical adjoining rectangular pens as in the diagram shown, but only has 600 feet of fencing available. Determine the values for $x$ and $y$ which will maximize the total area enclosed by these three pens.
7. Find \( \frac{dy}{dx} \) given the following:

\[
\sin(x^2 + y^3) = 5y + 8x
\]

It is okay to leave your answer in terms of both x and y.

8. Evaluate the following derivatives:

(a) \( \frac{d}{dx} \cos(x) \)

(b) \( \frac{d}{dx} \csc(x) \)

(c) \( \frac{d}{dx} \tan(x) \)

(d) \( \frac{d}{dx} \arcsin(x) \)

(e) \( \frac{d}{dx} \ln(x) \)
9. A function \( f(x) \) has the first derivative

\[
f'(x) = e^{0.5x}(10x - 60)
\]

(a) Upon which interval is \( f(x) \) increasing?

(b) Upon which interval is the graph of \( f(x) \) concave down?

10. Fill in the missing information for the following two theorems.

(a) **Mean Value Theorem** Let \( f \) be a function that satisfies the following two hypotheses:

1. \( f \) is ____________________________on the closed interval \([a, b]\)
2. \( f \) is ____________________________on the open interval \((a, b)\)

Then there is a number \( c \) in \((a, b)\) such that ____________________________

(b) **Rolle's Theorem** Let \( f \) be a function that satisfies the following three hypotheses

1. \( f \) is ____________________________on the closed interval \([a, b]\)
2. \( f \) is ____________________________on the open interval \((a, b)\)
3. ____________________________

Then there is a number \( c \) in \((a, b)\) such that ____________________________