ILLINOIS

Center for Academic Resources in Engineering (CARE)
Peer Exam Review Session

Math 241 − Calculus III

Midterm 2 Worksheet

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: April 11, 4-5:30pm Pieter and David   Session 2: April 12, 7:30-9pm Nidhi and Danny

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. Calculate the following derivatives:

(a) Find $\frac{\mathrm{d}f}{\mathrm{d}t}$ for $f(x,y) = xe^{xy}$, $x(t) = t^2$, $y(t) = \frac{1}{t}$

(b) Find f_t for $f(x,y) = 2xy$, $x(s,t) = st$, $y(s,t) = s^2t^2$

2. The vector field $\vec{F} = \langle 2xy + 2x + y^2, 2xy + 2y + x^2 \rangle$ is conservative. Find a potential function f for $\vec{F}$ (a function with $\nabla f = \vec{F}$)

3. A tiny spaceship is orbiting a path given by $x^2 + y^2 = 4$. The solar radiation at a point (x, y) in the plane is $f(x, y) = xy + 2y$.

   Use the method of *Lagrange multipliers* to find the maximum value and minimum value of solar radiation experienced by the tiny spaceship in its orbit.

4. Let $r(t) = \langle \sin(t), \cos^2 t \rangle, 0 \le t \le 2\pi$. Which graph below represents this curve?

A

B

C

D
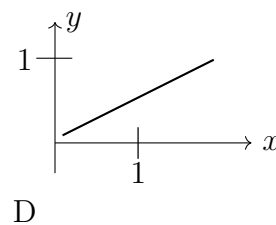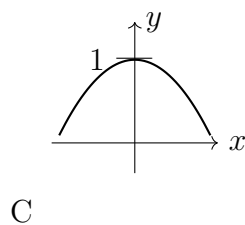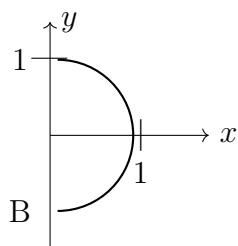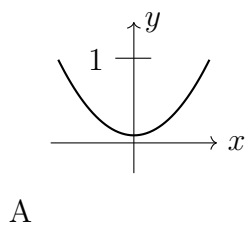
5. Let f(x,y) be a differentiable function on the disk $D = x^2 + y^2 \leq 400$, where:

(a) $f(x, y) = 19$ for every point on the boundary of the disk $x^2 + y^2 = 400$
(b) $f(0,0) = 7$
(c) $f(x, y)$ has only one critical point which is at (-1,2)

   Decide which statement is true:

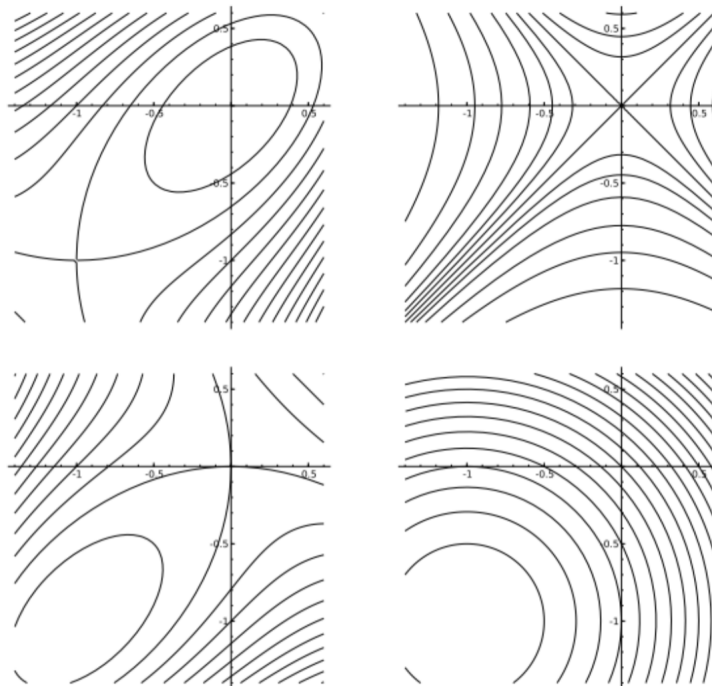A) $f(-1, 2) > 7$
B) $\boxed{f(-1, 2) < 7}$
C) $f(-1, 2) = 7$
D) Not enough information is given

6. Consider the function $f(x, y) = x^3 + y^3 + 3xy$

(a) The critical points of f are $(0,0)$ and $(-1,-1)$. Classify them into local minima, local maxima and/or saddle points

(b) Based on your answer in (a), identify the correct contour diagram of f

7. What is the partial derivative of $f(x, y, z) = e^x \sin(yz) z^3 \ln(y)$ with respect to x.