

# Math 203, Spring 2026 — Homework 4

Tim Chumley

Due March 6

**Instructions.** This problem set contains problems from Week 4 of class. The problem numbers refer to the PDF version of our textbook, *Apex Calculus*, by Gregory Hartman.

**Problem 1.** Make a sketch by hand of each of the graphs of following functions. Use CalcPlot3d to sketch the graph as a check of your work (but no need to turn in the CalcPlot3d output).

a.  $f(x, y) = 3 - (x^2 + y^2)$

b.  $f(x, y) = (x - 1)^2 + (y - 1)^2$

c.  $f(x, y) = -1 + \sqrt{x^2 + y^2}$

d.  $f(x, y) = -\sqrt{(x - 1)^2 + (y - 1)^2}$

**Problem 2.** Make a contour plot for each of the following functions using the given  $c$  values. Make sure each curve is labeled with its corresponding  $c$  value. Use CalcPlot3d to sketch the graph of the function (but no need to turn in the output).

a.  $f(x, y) = 4x + 2y, c = -2, 0, 2$

b.  $f(x, y) = x - y^2, c = -2, 0, 2$

c.  $f(x, y) = y^2, c = 0, 1, 2$

**Problem 3.** Compute  $f_x, f_{xx}, f_{xy}, f_y, f_{yy},$  and  $f_{yx}$  for each function below.

a.  $f(x, y) = x^4y^3 + 5x^3y^2 - 8x^2y + 7xy^3$

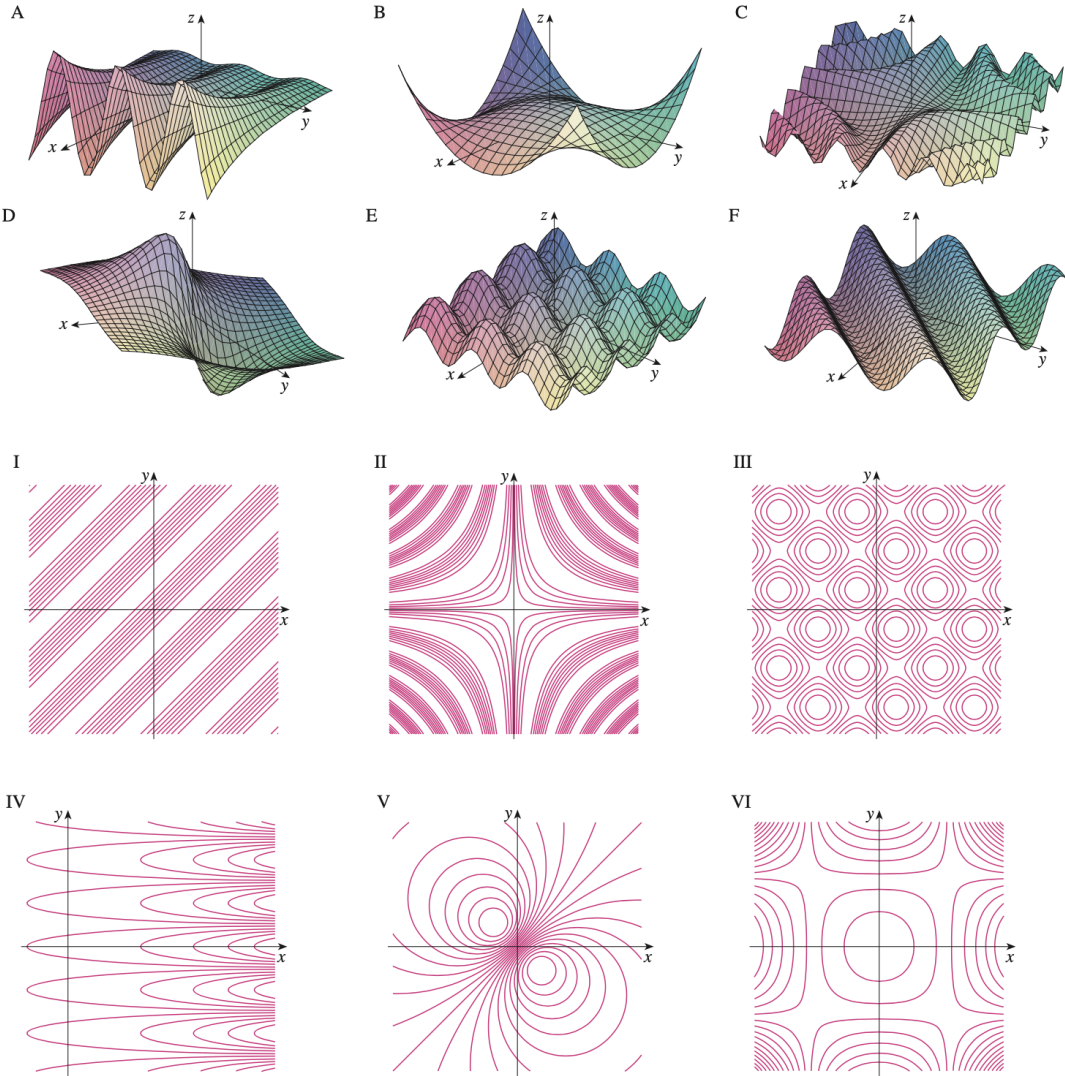
b.  $f(x, y) = 3 \sin(2x) \cos(5y)$

**Problem 4.** Compute  $f_x, f_{xx}, f_{xy}, f_y, f_{yy},$  and  $f_{yx}$  for each function below.

a.  $f(x, y) = y^2e^{3x}$

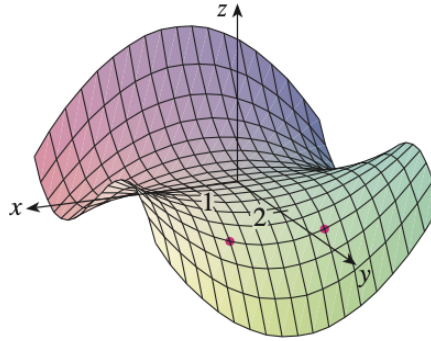
b.  $f(x, y) = e^{x^2+y^3}$

**Problem 5.** Shown below are 6 graphs of functions and their corresponding contour plots. Match them and organize your answer using a two column table in the given format.



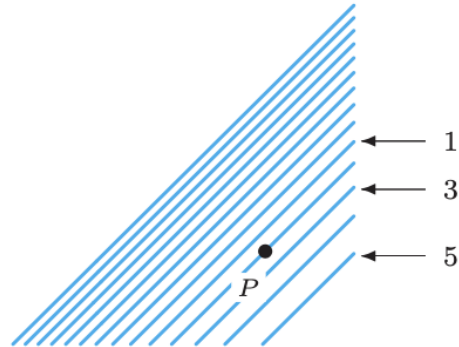
Graph	Contour plot
A	
B	
C	
D	
E	
F	

**Problem 6.** The figure below shows the graph of a function  $f(x, y)$ . The points  $(1, 2, f(1, 2))$  and  $(-1, 2, f(-1, 2))$  on its graph are each marked with a red dot. Determine the signs (positive, negative, or zero) of each partial derivative listed below and fill in the table.



Derivative	Sign
$f_x(1, 2)$	
$f_y(1, 2)$	
$f_{xy}(1, 2)$	
$f_x(-1, 2)$	
$f_y(-1, 2)$	
$f_{xx}(-1, 2)$	
$f_{yy}(-1, 2)$	
$f_{xy}(-1, 2)$	

**Problem 7.** The figure below shows a contour plot of  $f(x, y)$ . Determine the signs (positive, negative, or zero) of each partial derivative listed below and fill in the table.



Derivative	Sign
$f_x(P)$	
$f_y(P)$	
$f_{xx}(P)$	
$f_{yy}(P)$	
$f_{xy}(P)$	

**Problem 8.** If you liked the problems above or want more practice, our textbook has more great problems. Many odd-numbered ones have solutions in the back. Here are some that I recommend (as optional, not to be turned in):

- Section 12.1: 2, 4, 6, 7, 9, 10, 11, 13, 15, 16, 22
- Section 12.3: 3, 5, 7, 9-25 odd

Feel free to try others, including the problems in the main sections, which include full explanations.