

## Calculus — Homework 9 (Spring 2024)

1. Find a normal vector and a tangent vector at the point  $\vec{p}$ . Write an equation for the tangent line and an equation for the normal line.
  - (a)  $x^2 + xy + y^2 = 3$ ;  $\vec{p} = (-1, -1)$ .
  - (b)  $(y - x)^2 = 2x$ ;  $\vec{p} = (2, 4)$ .
  - (c)  $x^5 + y^5 = 2x^3$ ;  $\vec{p} = (1, 1)$ .
2. Find an equation for the tangent plane at the point  $\vec{p}$  and scalar parametric equations for the normal line.
  - (a)  $z = (x^2 + y^2)^2$ ;  $\vec{p} = (1, 1, 4)$ .
  - (b)  $xy^2 + 2z^2 = 12$ ;  $\vec{p} = (1, 2, 2)$ .
  - (c)  $z = \sin x + \sin y + \sin(x + y)$ ;  $\vec{p} = (0, 0, 0)$ .
3. Find the point(s) of the surface at which the tangent plane is horizontal.
  - (a)  $z = 4x + 2y - x^2 + xy - y^2$ .
  - (b)  $z = xy$ .
4. Find the local extreme values.
  - (a)  $f(x, y) = x^2 + xy + y^2 - 6x + 2$ .
  - (b)  $f(x, y) = x \sin y$ .
  - (c)  $(x - 3) \ln(xy)$ .
5. Find the absolute extreme values taken on by  $f$  on the set indicated.
  - (a)  $f(x, y) = 2x^2 + y^2 - 4x - 2y + 2$ ;  $0 \leq x \leq 2, 0 \leq y \leq 2x$ .
  - (b)  $f(x, y) = (x - 3)^2 + y^2$ ;  $0 \leq x \leq 4, x^2 \leq y \leq 4x$ .
  - (c)  $f(x, y) = (x - 1)^2 + (y - 1)^2$ ;  $x^2 + y^2 \leq 4$ .