

APPM 2350—Exam 2

Friday, June 24th 1pm-2:35pm 2022

This exam has 4 problems. Show all your work and simplify your answers. Answers with missing or insufficient justification will receive no points. You are allowed one 8.5×11-in page of notes (ONE side). You may NOT use a calculator, smartphone, smartwatch, the Internet or any other electronic device.

Problem 1 (30 pts)

Consider the function

$$f(x; y) = \frac{p_x}{y}$$

- (a) Graph the level curve of $f(x; y)$ that passes through the point $(0; 2)$. Label the value of f along the curve.
- (b) On the same graph as part (a) graph the level curve where $f(x; y) = 1$. Label the value of f along this curve.
- (c) On the same graph as part (a), graph one level curve where $f(x; y) < 0$. Label the value of f along this curve.
- (d) At the point $(1; 1)$, give a vector that points in the direction in the domain where this function *decreases* fastest.
- (e) Sketch the vector you found in part (d) starting at $(1; 1)$ on your graph from part (a).
- (f) Use a *2nd order* (i.e. *quadratic*) Taylor approximation centered at $(1; 1)$ to approximate $\frac{\sqrt{1.8}}{1.5}$
You can leave your answer as an unsimplified sum and/or difference of terms.

Problem 2 (22 pts) The temperature (in degrees Farenheit) in a region in space is given by

$$T(x; y; z) = \frac{1}{2}x^2 + \frac{1}{2}xyz$$

A particle is moving in this region and its position at time t is given by

$$\mathbf{r}(t) = 2 \cos(t) \mathbf{i} + e^{9-t} \mathbf{j} \quad \text{221}$$

Problem 4 (20 pts)

A mother puts her child on an amusement park ride that takes the child along a path in the xy -plane described by the equation $x^2 - 2x = 4y - y^2$. While the child is on the ride, the mother stands at the location $(x; y) = (0; 0)$.

- (a) Use Lagrange multipliers to find the minimum and maximum distances from the mother to the child during the ride.
- (b) Give the $(x; y)$ coordinates of the child at the minimum and maximum distances.

End Of Exam
