

## MAT 21A, practice problems for Midterm 2

- Find the derivatives of the following functions:
  - $f(x) = \frac{\sin x}{\ln x}$
  - $f(x) = xe^{\cos x}$
  - $f(x) = e^{\ln(2+x) - \ln(1+x)}$ .
  - \*  $f(x) = (\sin x)^{\cos x}$
  - $\sqrt{\frac{x-1}{x+1}}$ .
- Find the derivative of  $y(x)$  using implicit differentiation, if
  - $3x^2 + 2y^2 = 10$
  - $\cos(x) + \cos(y) = 15$
  - $\frac{x}{y} - \frac{y}{x} = 1$
- Find the equation of the tangent line to the graph of  $f(x) = x^4e^{-x}$  at a point  $(1, e^{-1})$ .
- Find the maximal and minimal values of a given function on a given interval:
  - $f(x) = x + \sin x$ ,  $[0, 4]$
  - $f(x) = x^3 - 27x + 1$ ,  $[-5, 5]$
  - $\frac{\ln x}{x}$ ,  $[1, 2]$ .
- (ex. 11 on p.270) You are designing a rectangular poster to contain 50 square inches of printing with a 4-in. margin at the top and bottom and 2-in. margin at each side. What overall dimensions will minimize the amount of paper used?
- A ship is moving east with speed 1, another ship is moving north with speed 2. At some moment, their coordinates were  $(-1, 0)$  and  $(0, -1)$ , respectively. What will be the minimal distance between these ships?
- (ex. 58 on p. 275) The 800-room Mega Motel chain is filled to capacity when the room charge is \$50 per night. For each \$10 increase in the room charge, 40 fewer rooms are filled each night. What charge per room will result in the maximum revenue per night?