

## 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:
  - $f(x) = x + \sin x$ ,  $[0, 4]$
  - $f(x) = x^3 - 27x + 1$ ,  $[-5, 5]$
  - $\frac{\ln x}{x}$ ,  $[1, 2]$ .
- For a given function, determine the intervals where it is increasing/decreasing, and find points of local maximum/minimum. Then find the domain, vertical and horizontal asymptotes. Finally, sketch the graph of the function.
  - $f(x) = 2\sqrt{x} - x$
  - $f(x) = \frac{e^x}{x^2}$
  - $f(x) = x^4 - 4x$
  - $f(x) = \ln(x^2 - 3x + 2)$ .