2280-1
Review sheet
for exam 1.

Be able to explain
reasoning & concepts
as well as work problems

1^{st} order ODE's. Chapters 1.1-1.5, 2.1-2.3 (not 1.6, 2.4-2.6)

- Recognize and solve DE's and IVP's for
  - $\frac{dy}{dx} = f(x)$ §1.2 antidiff
  - $\frac{dy}{dx} = \frac{f(x)}{g(y)}$ §1.4 separable
  - $\frac{dy}{dx} + P(x)y = Q(x)$ §1.5 linear

- slope fields, $\exists!$ for IVP §1.3, 2.2
  phase portraits.
  - geometric meaning of $\frac{dy}{dx} = f(x,y)$ for the graph $y = y(x)$
  - sketch slope fields using isoclines
  - $\exists!$ thm for IVP
  - autonomous DE's $\frac{dy}{dx} = f(y)$
    - equilibrium sol'ns
    - phase portraits
    - stability

- applications & modeling
  - separable
    - exp growth & decay
    - Newton's law of cooling
    - Toricelli
    - logistic / doomsday ext/harvesting (§2.1)
    - acceleration with drag terms (§2.3)
  - linear
    - mainly mixing problems (§1.5)
    - also some of §2.3 models
    - if $P(x)$ is const, i.e.
      $y' + a_0 y = f$
      this theory connects to chapter 3 $y = y_P + y_H \cdots$
      use of e^{rt}, etc.

Higher order linear DE's (3.1-3.5)

- Why $L(y) := y^{(n)} + a_{n-1}(x)y^{(n-1)} + \cdots + a_1(x)y' + a_0(x)y$
  is called linear
  - Why the general sol'n to $L(y) = f$ is $y = y_P + y_H$; more general superposition
  - Dimension of sol'n space to $L(y) = 0$
    (and its relationship to $\exists!$ thm for IVP)
  - linear ind & dep of fns
    Wronskian matrix & determinant
- Solving $L(y) = 0$ if L has constant coeffs a_j
  e^{rx}, $p(r)$, real roots (distinct, repeated), complex roots (distinct & repeated)
  using complex exponentials, Euler, cos & sin addition angle formulas
- Mechanical vibrations
  - pendulum & spring models
  - simple harmonic motion (amp, phase, ang. freq, freq, period, etc. ABC triangle)
  - the three kinds of damping, and corresponding solution types.
- Finding particular sol'ns to $Ly = f$, using $y = y_P + y_H$ to solve IVP's.