1. (Aug 29) review chapters 9 and 10

2. (Aug 31) section 13.3, problems 2(a), 3(a,f).
   Also special problem: Find the tangent plane to \( z = 1/(x^2 + y^2) \) at \( x = 1, y = 2 \). (Answer: \( z = \frac{3}{5} - \frac{2}{125} x - \frac{4}{125} y \)).

3. (Sept 5) section 13.4, problems 3a, 4a, 5a, 6(a,d).

4. (Sept 7) section 13.6, problems 2a, 3a, 4a, 5a, 6a, 12.

5. (Sept 12) special problem: The function \( x = u^3 - v^3, y = (u + v)^2 \) sends \((1,0)\) to \((1,1)\). Show there is an inverse function \( u = u(x, y), v = v(x, y) \) defined near \((1,1)\) and find all the partial derivatives at that point.
   (Answer: \( u_x = \frac{1}{3}, u_y = 0, v_x = -\frac{1}{3}, v_y = \frac{1}{2} \)).

6. (Sept 14) section 13.7 problems 5(a,g), 10.
   section 13.8 problems 1(a,d), 3, 6.

7. (Sept 19) Three problems on calculus of variations:
   (a) Find the function \( y = y(x) \) with \( y(0) = 0, y(1) = 0 \) which minimizes the integral
   \[
   I(y) = \int_0^1 ((y')^2 + 12xy)dx
   \]
   What is the minimum value of \( I(y) \)? (Ans: \( y = x^3 - x, I(y) = -\frac{4}{3} \))
   (b) A pendulum of mass \( m \) on a string of length \( \ell \) makes an angle \( \theta = \theta(t) \) with the verticle at time \( t \). The kinetic energy is \( T = \frac{1}{2}m\ell^2\theta'^2 \), the potential energy is \( V = mgl(1 - \cos \theta) \), and the Lagrangian is the difference \( L = T - V \). To find the motion we seek to minimize the action \( I(\theta) = \int_0^t L(\theta, \theta')dt \). What is the equation of motion we get from this formulation?
(c) Show that the Euler equation can be written in the form
\[ \frac{d}{dx}(F - y'F_{y'}) = F_x \]
and conclude that if \( F(x, y, y') \) does not explicitly depend on \( x \)
then \( F - y'F_{y'} = \) constant.

8. (Sept 21)
section 14.3 problems 1(a,h,k)
section 14.4 problems 4(a,d)

9. (Sept 26)
section 14.5 problems 1(a,d), 7(a)
section 14.6 problems 3b, 5d, 9c

**First exam:** The first exam is on Thursday, October 5. It will cover
Chapter 13 (except 13.5), the calculus of variations, and Chapter 14.
No laptops, calculators, note cards, scratch paper allowed. Only a pen
or pencil.

10. (Sept 28) section 15.2 problems 1f, 2a, 3a