

## Problem Set 9 – due November 19 – 10 points per problem

1. The Hamiltonian of a freely falling body is  $H(z, p) = p^2/2m + mgz$ . Solve this problem by finding a canonical transformation to new coordinates  $(Q, P)$  where the new Hamiltonian is  $K(Q, P) = P$ .
2. Which of the following transformations are canonical?
  - (a)  $Q = 1/p, P = q^2p$
  - (b)  $Q = 1/p, P = qp^2$
  - (c)  $Q = C(p + i\omega q), P = C(p - i\omega q), C = \text{constant}$
  - (d)  $Q = q \cos \alpha - p \sin \alpha, P = q \sin \alpha + p \cos \alpha$

For those that are canonical, find a generating function.

3. Goldstein, Chapter 9, Exercise 31, page 427.
4. Goldstein, Chapter 9, Exercise 39, page 429.