

Solutions to Problems in Goldstein,  
*Classical Mechanics*, Second Edition

Homer Reid

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## Chapter 9

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### Problem 9.1

One of the attempts at combining the two sets of Hamilton's equations into one tries to take  $q$  and  $p$  as forming a complex quantity. Show directly from Hamilton's equations of motion that for a system of one degree of freedom the transformation

$$Q = q + ip, \quad P = Q^*$$

is not canonical if the Hamiltonian is left unaltered. Can you find another set of coordinates  $Q', P'$  that are related to  $Q, P$  by a change of scale only, and that are canonical?

Generalizing a little, we put

$$Q = \mu(q + ip), \quad P = \nu(q - ip). \quad (1)$$

The reverse transformation is

$$q = \frac{1}{2} \left( \frac{1}{\mu} Q + \frac{1}{\nu} P' \right), \quad p = \frac{1}{2i} \left( \frac{1}{\mu} Q - \frac{1}{\nu} P' \right).$$

The direct conditions for canonicity, valid in cases (like this one) in which the

# Goldstein Classical Mechanics Solutions Chapter 9

**Jicheng Xie**



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