

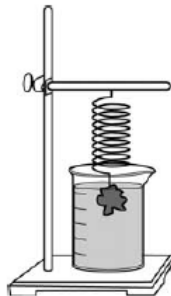
## 2002 AP<sup>®</sup> PHYSICS B FREE-RESPONSE QUESTIONS

6. (10 points)

In the laboratory, you are given a cylindrical beaker containing a fluid and you are asked to determine the density  $\rho$  of the fluid. You are to use a spring of negligible mass and unknown spring constant  $k$  attached to a stand. An irregularly shaped object of known mass  $m$  and density  $D$  ( $D \gg \rho$ ) hangs from the spring. You may also choose from among the following items to complete the task.

- A metric ruler
- A stopwatch
- String

(a) Explain how you could experimentally determine the spring constant  $k$ .



(b) The spring-object system is now arranged so that the object (but none of the spring) is immersed in the unknown fluid, as shown above. Describe any changes that are observed in the spring-object system and explain why they occur.

(c) Explain how you could experimentally determine the density of the fluid.

(d) Show explicitly, using equations, how you will use your measurements to calculate the fluid density  $\rho$ . Start by identifying any symbols you use in your equations.

Symbol	Physical quantity