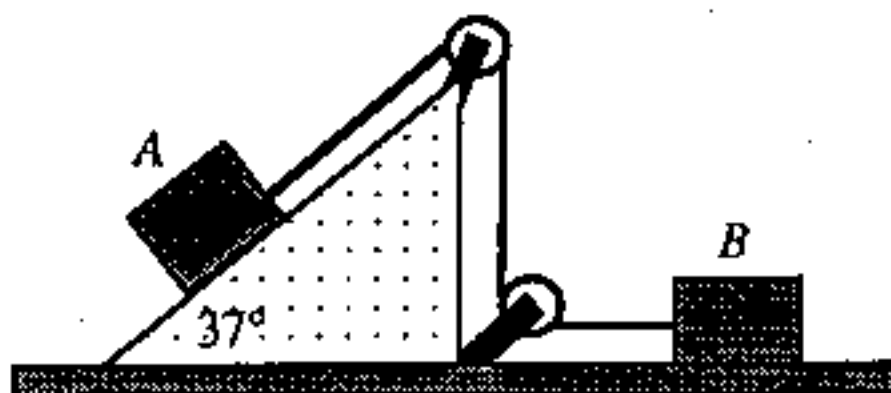


### Problem #1

Two blocks, each having mass 20 kg, rest on frictionless surfaces, as shown in the figure below. Assuming the pulleys to be light and frictionless, compute

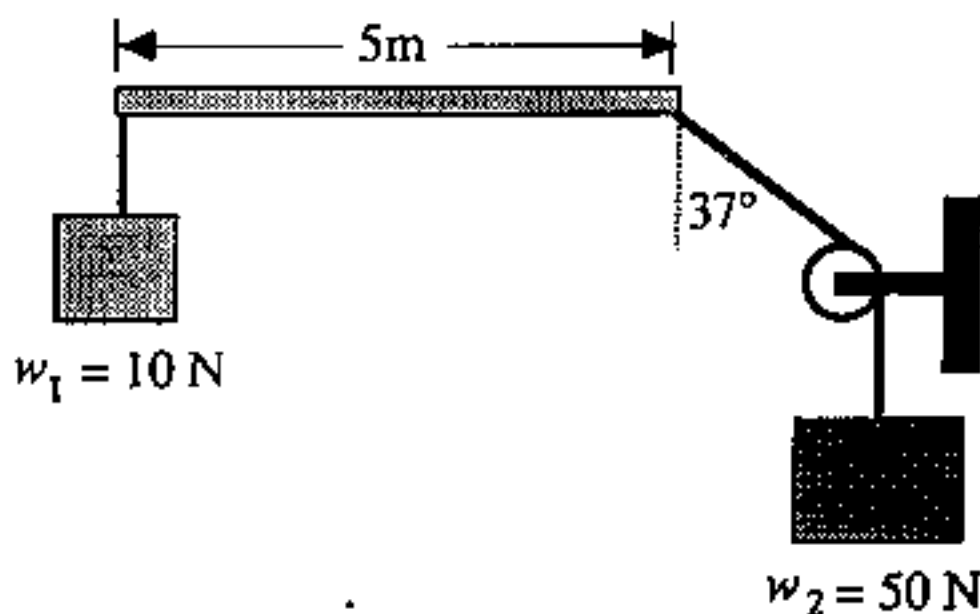
- (a) the time required for block A to move 1 m down the plane, starting from rest; (8%)  
(b) the tension in the cord connecting the blocks. (8%)



### Problem #2

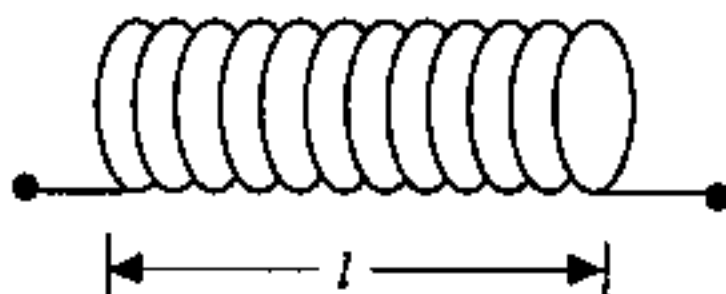
A single additional force is to be applied to the bar in the figure below to maintain it in equilibrium in the position shown. The weight of the bar can be neglected.

- (a) What are the  $x$ - and  $y$ -components of the required force? (4%)  
(b) What is the tangent of the angle that the force must make with the bar? (4%)  
(c) What is the magnitude of the required force? (4%)  
(d) Where should the force be applied? (4%)



### Problem #3

A solenoid made of close-packed coil was shown in figure below, where the total length of the coil wire is  $W$ , and the length of the solenoid is  $l$ . Find out its self-inductance  $L$  in terms of  $W$  and  $l$ . (16%)

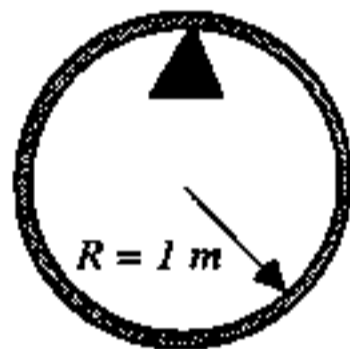


**Problem #4**

- (a) A capacitor made of two parallel metallic plates (area  $A$ , separation  $d$ ) with a dielectric material (dielectric constant  $\kappa$ ) filled in the gap between the plates. Find out the ratio of the induced dielectric surface charge density to the free charge density on the plates when a dc voltage  $V$  is applied by a battery on the capacitor. (8%)
- (b) If the resistivity of the dielectric is  $\rho$ , find out the variation of voltage across the plates as a function of time  $t$  after the battery is removed from the capacitor at time  $t = 0$ . (8%)

**Problem #5**

A ring of radius 1 m is suspended from a peg, as shown in the figure below. Determine its period of oscillation. (10%)



**Problem #6**

A converging lens of 24-cm focal length is to be used to form a real image of an object. Where should the object be placed if an image to be 4 times as large as the object is desired? (8%)

**Problem #7**

Write down the expressions of the following famous physics formulae:

- (a) period of a simple pendulum (3%)
- (b) Charles' law (3%)
- (c) Gauss' law (3%)
- (d) Biot-Savart law (3%)
- (e) Bragg's law (3%)
- (f) Rayleigh's criterion. (3%)

Also write down the definition of physical quantities appearing in your answer and describe the applications of each formula by one sentence.