University of California, Berkeley
Physics H7A Fall 1998 (*Strovink*)

PROBLEM SET 2

1. Calculate the following centripetal accelerations as fractions or multiples of g (= 9.8 m/sec^2):

(a.) The acceleration toward the earth's axis of a person standing on the earth at 45° latitude.

(b.) The acceleration of the moon toward the earth.

(c.) The acceleration of an electron moving around a proton at a speed of 2×10^6 m/sec in a circular orbit of radius 0.5 Angstroms (1 Angstrom = 10^{-10} m).

(d.) The acceleration of a point on the rim of a bicycle wheel of 26 in diameter, traveling at a constant speed of 25 mph.

2. K&K problem 1.17 "A particle moves in a plane...".

3. K&K problem 1.20 "A particle moves outward along...".

4. At t=0 an object is released from rest at the top of a tall building. At the time t_0 a second object is dropped from the same point.

(a.) Ignoring air resistance, show that the time at which the objects have a vertical separation l is given by

$$t = \frac{l}{gt_0} + \frac{t_0}{2}.$$

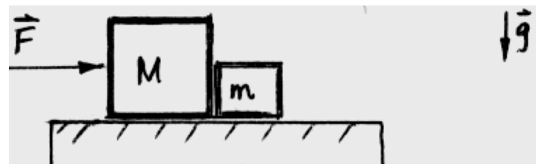
How do you interpret this result for $l < gt_0^2/2$?

(b.) The above formula implies that there is an optimum value of t_0 such that the separation l reaches some specified value l_0 at the earliest possible value of t. Calculate this optimum value of t_0 and interpret the result.

5. K&K problem 1.21 "A boy stands at the peak...".

6. K&K problem 2.1 "A 5-kg mass moves under the...".

7. In the figure, two blocks are in contact on a table. The coefficient of sliding friction between the blocks and the table is μ. A force **F** is applied to M as shown and the blocks begin to slide. Find the contact force between the two blocks. Is it the same if the force is applied to m instead of M? Does the contact force depend on μ?



8. K&K problem 2.5 "The Atwood's machine shown in...".

9. In the figure, the pulley axle has no friction and the pulley and cords have no mass. As the system is studied for various values of the external applied upward force **F**, it is found that there are regimes (ranges of |**F**|) for which

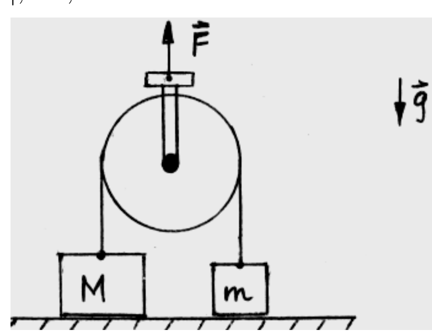
(i) Neither block moves.

(ii) Only the small block with mass m ($m < M$) moves.

(iii) Both blocks move.

(a.) Find the values of |**F**| which define the transitions between regimes (i) and (ii), and between regimes (ii) and (iii).

(b.) Find the accelerations of the masses within the regimes (b) and (c), expressed as functions of |**F**|, M, and m.



10. K&K problem 2.6 "In a concrete mixer...".