

**~~Problem 1: Estimation (see section 1.10 in course notes)~~**

~~In a recent publication of Nature, Australian scientists determined that during the last ice age (22,000 to 19,000 years ago) the sea level reached its low point, 425 to 440 feet below the present level due to the change of sea water to glacial ice.~~

- ~~a) What approximate volume of ice would this correspond to?~~
- ~~b) If this additional ice were evenly divided between the polar ice caps, estimate how far the northern hemisphere ice sheet would extend southward.~~

**~~Problem 2: Kinematics (see chapter 2 in course notes)~~**

~~Two stones are released from rest at a certain height, one after the other.~~

- ~~a) Will the difference in their speeds increase, decrease, or stay the same?~~
- ~~b) Will their separation distance increase, decrease, or stay the same?~~
- ~~c) Will the time interval between the instants at which they hit the ground be smaller than, equal to, or larger than the time interval between the instants of their release?~~

**~~Problem 3: Radians and Estimation (see section 1.11 in course notes)~~**

- ~~a) Hold a dime at arm's length. What angle in radians is subtended by the diameter of the dime?~~
- ~~b) Using your result from part a), estimate the length of the infinite corridor at MIT. In order to do this, choose a reference height at one end of the corridor and estimate its height. Then go to the other end of the corridor and measure what fraction of the diameter of the dime corresponds to your reference height. You can now calculate the length of the corridor by using similar triangles. The length is published by MIT. Can you find the published value?~~
- ~~c) Now use your dime and wait until the moon is out (the moon is new on Sept. 14 so you need to make a measurement as quickly as possible on the quarter moon) to try and estimate the angular diameter of the moon. If you could not measure the moon, recall that during a total eclipse, the moon is almost exactly the same angular diameter as the sun. If it takes the sun two minutes to set (ignore atmospheric distortions), what is the angular diameter of the moon? Once you have this estimate, what additional information would you need in order to estimate the mass of the moon? Make some estimates regarding these additional quantities and then estimate the mass of the moon. Look up the actual value and compare it with your estimate. How did you do?~~

## Problem 2

a) The speed of both stones along an axis pointing downwards will increase linearly with time according to:

$$v_1 = g(t - t_1) \quad v_2 = g(t - t_2)$$

where  $t_1$  and  $t_2$  are the release times.

Then  $v_1 - v_2 = g(t_2 - t_1)$  is constant.

b) The distance travelled by the two stones from the starting point along the downward axis is:

$$s_1 = \frac{1}{2} \cdot g(t - t_1)^2 \quad s_2 = \frac{1}{2} \cdot g(t - t_2)^2$$

so that their distance will increase linearly in time according to:  $s_1 - s_2 = \frac{1}{2} \cdot g(t_1^2 - t_2^2 + 2t(t_1 - t_2))$

c) As the time the stones will employ to fall is the same, the time interval at which they hit the ground will be  $t_1 - t_2$ . More formally supposing the ground to be at a distance  $s_0$  from the release point the hitting times for the two stones will be:

$$t_{H1} = t_1 + \sqrt{\frac{2s_0}{g}} \quad t_{H2} = t_2 + \sqrt{\frac{2s_0}{g}}$$