

Mathematical Modeling  
Worksheet 1  
Some problems in Navigation

This week's assignment is perhaps a little easier than most (except for the last part!), but it is good practice as we begin. Remember the work you hand in on Tuesday can be considered a draft, so it may not be perfect, but you may be asked to present at the board at any point. Note that even if you do not have a solution you may be required to go to the board and work through a solution, with poking and prodding from your classmates.

The questions.

1) At 1400 hours GMT (Greenwich Mean Time) on March 21st, the navigator on a ship crossing the Atlantic Ocean observes that the sun is due south and is at an altitude of 30 degrees. What is the ship's approximate latitude and longitude? Why may this result be in error?

2) The vertical sextant angle of a lighthouse, height  $H$  meters (i.e. the angle between the sea level and the top of the lighthouse) is observed to be  $\theta^\circ$ . How can the distance between ship and lighthouse be determined? How will the determination of this distance be affected by errors of measurement in  $H$  and  $\theta$ ?

3) An aircraft with unlimited fuel passes over Greenwich ( $0^\circ\text{W}$ ,  $52^\circ\text{N}$ ) on a compass bearing of  $80^\circ$ . The pilot maintains this compass bearing until the earth has been circumnavigated. Assuming that the earth is a perfect sphere, what will be the aircraft's latitude when it is next due north of Greenwich?