

PHYSICS 331 ADVANCED CLASSICAL MECHANICS  
Problem Set 11

*Problem 1*

Thornton and Marion: Chapter 5, Problem 7.

- (a) Calculate the gravitational potential due to a thin rod of length  $\ell$  and mass  $M$  at a distance  $R$  from the centre of the rod and in a direction perpendicular to the rod.
- (b) Take the answer that you obtained in part (a) and examine the limiting behaviour for large  $R$ . Specifically, verify that  $\Phi \rightarrow \frac{GM}{R}$  for large  $R$ . Can you see *why* we should arrive at this result for large  $R$ ? NB: This is a valuable means of checking your answer to part (a). If you see the anticipated limiting behaviour, then you probably calculated correctly.
- (c) Next, use your answer to determine an approximate potential very close to the rod, i.e. for  $R \ll \ell$ . From this approximation, determine the gravitational field near the rod. Use Gauss' law to check this result.

*Problem 2*

Thornton and Marion: Chapter 5, Problem 13.

You will find it more pleasant to use Gauss' law to solve this problem—rather than performing the integral directly.

*Other Things*

Don't forget that you have a journal assignment as well. Submit your comments about the reading via email. Mention what parts you understand, what parts you don't, what seems interesting to you—and what doesn't, along with any other comments that you feel are relevant for the reading. Focus your comments on the reading from sections 5.3–5.5.