

PHYS 251 HONOURS CLASSICAL MECHANICS - 2014

Readings and Homework Set 4

Readings: Chapter 5 (Pages 138 - 172)

Problems, due Sept. 26 in class:

1. Consider a particle of mass m moving according to a force

$$F(x) = kx^2 - \frac{1}{2}kx^3,$$

where k is a positive number.

- a) Find the fixed points.
- b) Discuss the stability of these fixed points.
- c) Find the linearized solutions about these fixed points.

2. Consider a ball rolling in the Earth's gravitational field on a surface whose potential energy is

$$V(q) = -q^6 + 5q^4 - 4q^2$$

- a) Draw a phase space diagram of the dynamics.
- b) Discuss the stability of the fixed points of the dynamics.
- c) Find the linearized solutions about the fixed points.

3. Textbook, Problem 4.17

4. Textbook, Problem 4.22

5. Textbook, Problem 4.34

- 6/7. In class I introduced the Born approximation and applied it to the case of an anharmonic oscillator with force

$$F = -m^2q - \lambda q^3,$$

where m and λ are constants, and λ is assumed to be very small (in class the constant m^2 was k - you can use either notation).

- a) In class I wrote down the formal solution for the first order Born approximation. Fill in the details and obtain the complete first order solution.
- b) Use the result of a) to determine the second order solution.

Note: Attempt this problem only after Tuesday's lecture.