MA211: Assignment # 5

Required Reading.

- Sections 3.4 & 3.8.

Any problems marked with * require the use of maple. All other problems are to be done by hand. Any problems marked with # can be submitted for review by the grader.

1. Textbook §3.4: 16#, 30#, 35, 38
2. Textbook §3.8: 2, 6, 11*, 23, 27#, 37#, 43*, 47ab, 48ab, 49#, 57# (hint for 48: $\sin^2(\theta) = (1 - \cos(2\theta))/2$ and $\sin^3(\theta) = (3\sin(\theta) - \sin(3\theta))/4$.)
3. * Suppose a non-Hookean spring resists displacement with a non-constant spring coefficient. That is, the spring coefficient is not constant, but is larger the further away the spring is from equilibrium. So, replace the spring constant by ax^2.
   (a) If a mass is attached to this spring and both gravity and resistance are ignored, show that Newton's second law leads to
   $$mx''(t) = -ax^3 \quad .$$
   (b) Set $a/m = 1$. Suppose that the spring is initially displaced by d units and is motionless. Use Maple to solve the initial value problem.
   (c) Let the initial displacement be $d = 1$. Plot your solution for the first 5 periods. Using this plot (and possibly fsolve), show that the period is approximately $P = 7.416$.
   (d) Repeat this process and complete the following table. Give your answers to three decimal places.

d	1	2	3	4	5
P	7.416				

   (e) Use Maple's *pointplot* to plot the period versus d. If this were a Hookean spring, how would this plot be different? Explain why the results for this non-Hookean spring make sense physically.