PHYS 419: Classical Mechanics, Assignment 6
Due 10/19/07

1. Show that
   (a) \( \nabla r^n = nr^{n-1} \mathbf{\hat{r}} \)
   (b) \( \nabla f(r) = \mathbf{\hat{r}} \frac{df}{dr} \)
   (c) \( \nabla^2 \ln r = \frac{1}{r^2} \)

2. Taylor: Problem 4.32.

3. Taylor: Problem 4.36.

4. Use the partial fraction decomposition to calculate the integral
   \( \int \frac{x^2 + x - 2}{3x^3 - x^2 + 3x - 1} \, dx \)

5. A particle moves over the semicircle of radius 1 starting at the point (1,0) while subject to the force \( \mathbf{F} = e^y \mathbf{\hat{x}} + xe^y \mathbf{\hat{y}} \). Calculate first the work performed using explicit line integration. Next, find a shortcut way for getting the answer.

6. Taylor: Problem 4.44.


8. Two bodies of masses \( m_1 \) and \( m_2 \) slide freely on a horizontal frictionless track and are connected by a spring with a force constant \( k \).
   (a) Derive a single Newton equation describing the motion of this system in terms of the expansion of the spring \( \zeta \) from the equilibrium length \( l \).
   (a) Solve this equation and find the frequency of the oscillatory motion of the system.

9. Review problems 8, 9, and 12 of Assignment 0. Do not submit solutions.