PHYS 2210 Fall 2010 Homework Set 5

Due at the start of class on **Sept 23, 2010**, Show all work!

1. (1 pt) Taylor 4.2, parts B and C only
2. (1 pt) A driver traveling downhill on a road with a 4.5 degree slope slams on his brakes and skids 30 m before hitting a parked car. An insurance investigator hires an expert who measures the coefficient of kinetic friction between the tires and road to be $\mu_k = 0.45$. Is the investigator correct to accuse the driver of traveling faster than the 25 MPH speed limit? Explain. (While there are many ways to solve this problem, please solve it using work and energy.)
3. (2 pt) Two diagrams, each representing a force field in the x-y plane, are shown in Figures 1 and 2. For each case, is it possible to draw a self-consistent set of equipotential contours for that situation?

   If so: Draw a representative set of equipotential contours for that situation. Each drawing should clearly show (1) the correct shape of the contour lines, (2) the correct relative spacing of the contours, and (3) label the regions that correspond to highest and lowest potential energy.

   If not: Explain why drawing such contours is impossible.
4. (2 pt) Recall that (i) potential energy functions can be defined only for conservative forces, and that (ii) a force is conservative if and only if the work done by that force along any closed path is zero. For which vector fields in Problem 3 can you identify a closed path over which $\oint \vec{F} \cdot d\vec{l} \neq 0$? For each such case, clearly indicate an appropriate path on the diagram. Explain your reasoning. Are your answers consistent with your answers in Problem 3?
5. (1 pt) For a arbitrary scalar function $f(x, y, z)$, evaluate the components of $\boldsymbol{\nabla} \times \boldsymbol{\nabla} f$ in Cartesian coordinates and show that the result is 0.
6. (3 pts) Taylor 4.36

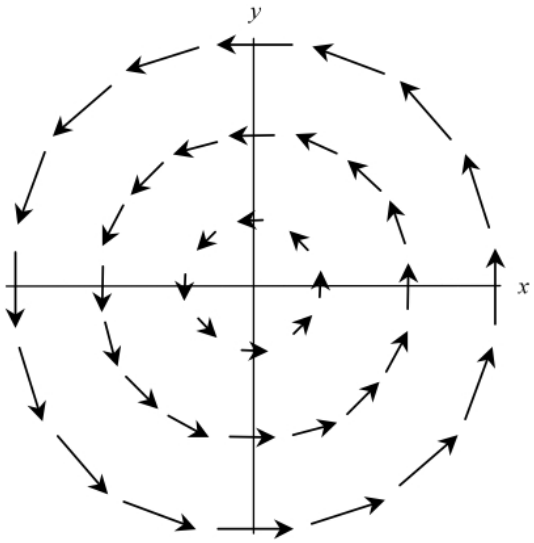

Figure 1: Case 1, Problems 3 and 4

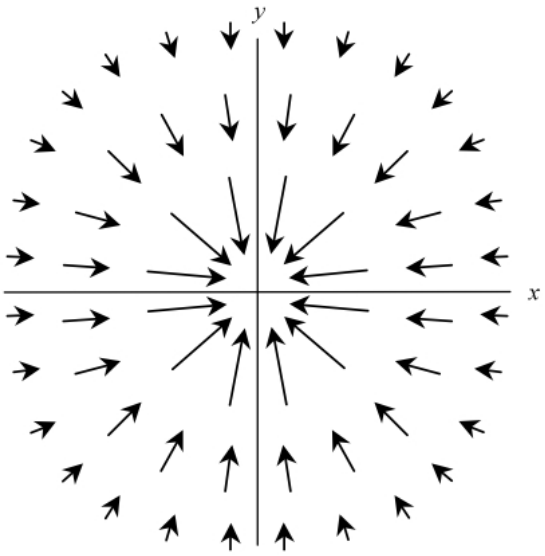

Figure 2: Case 2, Problems 3 and 4