PHYSICS 501
3rd HOMEWORK-FALL 2019
Prof. V. Lempesis

1. In the field of atom cooling when we consider the interaction of atoms with a laser beam we find the concept of *scattering* or *dissipative* force. This force is given by:

$$\mathbf{F} = \frac{\hbar p}{\left(1+p\right)}\vec{\nabla}\Theta$$

where Θ is the phase of the laser electric field, $\hbar$ is the reduced Planck's constant ($h/2\pi$), while p is the so called *saturation parameter.* In the case where the beam is a plane wave $\Theta = kz$ (where k is the wave number equal to $2\pi/\lambda$, where λ is the laser wave length) and p is a constant. Calculate the quantity $\vec{\nabla}\cdot\mathbf{F}$.

(5 marks)

2. Find an equation in spherical coordinates of the sphere: $x^2 + y^2 + (z\text{-}1)^2 = 1$.

(5 marks)

3. Find the work done going around a unit circle in the xy-plane, going clockwise from 0 to $-\pi$, *against* a force field given by:

$$\mathbf{F} = -\mathbf{i}\frac{y}{x^2+y^2} + \mathbf{j}\frac{x}{x^2+y^2}.$$

Use cylindrical coordinates in your calculations. Solution based on Cartesians is not going to be accepted.

(5 marks)

4. Calculate the work you do in going **along a straight line** from point (1, 1) to point (3, 3). The force you exert is given by

$$\mathbf{F} = \mathbf{i}\left(x-y\right) + \mathbf{j}\left(x+y\right).$$

(5 marks)

Please send your answers in pdf form (typed or in clearly handwritten form) in my email address (vlempesis@ksu.edu.sa). Please use ONE file for your entire homework NOT one file per page. Please do not forget to put your name and your ID number on it AND on your file name.
Your deadline is on Wednesday Thursday 31st October 2019 at 23:59.