PHYS 3344
Fall 2017
TE Coan
Due: 11 Oct '17 12:00 pm

Homework 5

1. Given $\mathbf{F}_1 = 2xz\mathbf{i} + y\mathbf{j} + x^2\mathbf{k}$, and $\mathbf{F}_2 = y\mathbf{i} - x\mathbf{j}$, which $\mathbf{F}$, if either, is conservative? Show your work and box your answer.

2. Show that

$$\mathbf{F} = y^2 z \sinh(2xz)\mathbf{i} + y\cosh(2xz)\mathbf{j} + y^2 x \sinh(2xz)\mathbf{k}$$

is conservative and find a scalar potential U such that $\mathbf{F} = -\nabla U$. Box that answer.

3. Show that if the vectors $\mathbf{a}$ and $\mathbf{b}$ are the sides of a triangle, then $\frac{1}{2}|\mathbf{a} \times \mathbf{b}|$ is the area of the triangle.

4. This is one we talked about in class. Consider a planet orbiting the fixed sun. Earth will do. Let the plane of the planet's orbit be the xy plane and place the sun at the origin. Go ahead and label the planet's position using polar coordinates (r, ϕ).

a) Show that the planet's angular momentum has magnitude $l = mr^2\omega$, where $\omega = \dot{\phi}$ is the planet's angular velocity about the sun.

b) Now show that the rate at which the planet "sweeps out area" (as in Kepler's second law) is $dA/dt = \frac{1}{2}r^2\omega$ and hence that $dA/dt = l/2m$, i.e., Kepler's second law.