PHYS-3202 Homework 1 Due 21 Sept 2022

This homework is due to `https://uwcloud.uwinnipeg.ca/s/4tyDmt9EEN2RgCy` by 10:59PM on the due date. Your file(s) must be in PDF format; they may be black-and-white scans or photographs of hardcopies (all converted to PDF), PDF prepared by LaTeX, or PDF prepared with a word processor *using an equation editor*.

1. **Vector Identity**

   Using vector triple-product identities, write $(\vec{a} \times \vec{b}) \cdot (\vec{c} \times \vec{d})$ in terms of the dot products $\vec{a} \cdot \vec{c}$, $\vec{b} \cdot \vec{c}$, $\vec{a} \cdot \vec{d}$, and $\vec{b} \cdot \vec{d}$

2. **Force From Velocity** *inspired by Fowles & Cassiday*

   An object of mass m moves in one dimension with velocity given by $v = \alpha/x$ for α a positive constant.

   (a) Find the force on the object as a function of position using Newton's second law.

   (b) Is this force conservative? If so, find the potential energy.

   (c) Finally, find the position as a function of time, assuming that the object is initially at the origin.

3. **A Special Case of Circular Motion**

   Consider a particle of mass m that experiences a force $\vec{F} = B\vec{v} \times \hat{k}$, where B is a constant and $\vec{v}$ is (as usual) the velocity. Assume that the particle moves entirely in the (x, y) plane.

   (a) What is the power done by this force on the particle?

   (b) Find $\ddot{x}$ and $\ddot{y}$ in terms of $\dot{x}$ and $\dot{y}$.

   (c) Show that circular motion $x = R\cos(\omega t), y = R\sin(\omega t)$ for some particular constant ω satisfies these equations and find ω.