

PHYS 3201 — Assignment #6

Due: 10/9/20

- Find the value of the constant c such that each of the following forces is conservative:
 - $\vec{F} = xy\hat{i} + cx^2\hat{j} + z^3\hat{k}$
 - $\vec{F} = (z/y)\hat{i} + c(xz/y^2)\hat{j} + (x/y)\hat{k}$
- A particle of mass m moving in three dimensions under the potential energy function $V(x, y, z) = \alpha x + \beta y^2 + \gamma z^3$ has speed v_0 when it passes through the origin.
 - What will its speed be if and when it passes through the point (1,1,1)?
 - If the point (1,1,1) is a turning point in the motion ($v = 0$), what is v_0 ?
 - What are component differential equations of motion of the particle? (It is not necessary to solve them.)
- A projectile is launched with velocity 100 m s^{-1} at 60° to the horizontal. Atmospheric drag is negligible. Find the maximum height attained and the range. What other angle of launch would give the same range? Find the time of flight in each of the 2 cases.
- The initial conditions for a 2-dimensional isotropic oscillator are as follows: $t = 0$, $x = A$, $y = 4A$, $\dot{x} = 0$, $\dot{y} = 3\omega A$ where ω is the angular frequency. Find x and y as functions of t . Show that the motion takes place entirely within a rectangle of dimensions $2A$ and $10A$. Find the inclination ψ of the elliptical path relative to the x -axis.
- A particle moving in a central field describes the spiral orbit $r = r_0 e^{k\theta}$. Show that the force law is inverse cube and that θ varies logarithmically with t .
- The orbit of a particle moving in a central field is a circle passing through the origin, namely $r = r_0 \cos \theta$. Show that the force law is inverse-fifth power.