

PHY 711 – Assignment #6

September 7, 2014

This exercise is designed to illustrate the differences between partial and total derivatives.

1. Consider an arbitrary function of the form $f = f(q, \dot{q}, t)$, where it is assumed that $q = q(t)$ and $\dot{q} \equiv dq/dt$.

(a) Evaluate

$$\frac{\partial}{\partial q} \frac{df}{dt} - \frac{d}{dt} \frac{\partial f}{\partial q}.$$

(b) Evaluate

$$\frac{\partial}{\partial \dot{q}} \frac{df}{dt} - \frac{d}{dt} \frac{\partial f}{\partial \dot{q}}.$$

(c) Evaluate

$$\frac{df}{dt}$$

(d) Now suppose that

$$f(q, \dot{q}, t) = q\dot{q}t, \quad \text{where} \quad q(t) = e^{-t/\tau}.$$

Here τ is a constant. Evaluate df/dt using the expression you just derived. Now find $f(t)$ and take its time derivative directly to check your previous results.