

# PHY 711 – Assignment #6

September 13, 2016

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

$$f(q, \dot{q}, t) = q\dot{q}^2 t^2, \quad \text{where} \quad q(t) = e^{-t/\tau}.$$

Here  $\tau$  is a constant. Evaluate  $df/dt$  using the expression you just derived. Now find the expression for  $f$  as an explicit function of  $t$  ( $f(t)$ ) and take its time derivative directly to check your previous results.