Practice Problem Set #6

Question #1:

A point-particle of unit mass ($m = 1$) is constrained by some external system to follow the path

$$\vec{r}(t) = \left(\frac{1}{2}t^2 + 3t\right)\hat{i} + 2t^2\hat{j} - 7t\hat{k}, \tag{1}$$

as a function of time t.

a) Find an expression for the power supplied to the particle by the external system as a function of time.

b) What is the total work done by the external system on the particle between times $t = 0$ and $t = 1$?

Question #2: (Wolfson Ch. 6, Q. 84)

You push an object of mass m slowly, partway up a loop-the-loop track of radius R, starting from the bottom, and ending at a height $h < R$ above the bottom. The coefficient of friction between the object and the track is a constant μ. Show that the work you do against friction is $\mu mg\sqrt{2hR - h^2}$.

Question #3: (Wolfson Ch. 6, Q. 70)

A 1400-kg car ascends a mountain road at a steady 60km/h, against a 450-N force of air resistance. If the engine supplies energy to the drive wheels at the rate of 38kW, what is the slope angle of the road?