Math 171 Written Homework 4 Name _____

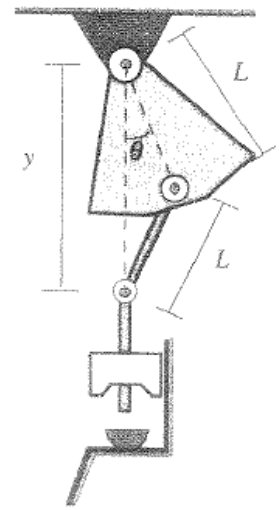
Sections 3.4-3.7

March 1, 2018

Credit given for work shown.

Problem 1. A mechanical punch used in an assembly line is driven by an oscillating cam as shown in the illustration. For each complete oscillation of the cam, the punch will move up and down twice.

a. Express the distance y as a function of the angle θ.



b. Assuming that the time dependence of the angle θ is given by the function

$$\theta(t) = \theta_0 \cos(\omega t),$$

express the distance y as a function of time t. What is the <u>stroke</u> of the punch? (The stroke is the maximum linear displacement)

c. Find the velocity of the vertical position of the punch as a function of time.

d. Find the acceleration of the vertical position of the punch as a function of time.

Problem 2. For in-class discussion:

Using a simple energy balance of input energy from the sun and energy lost form the earth due to radiation into space one find that the temperature of the earth, T is given by:

$$T = \left(\frac{(1-a)S}{\epsilon\sigma} \right)^{1/4}$$

where ϵ is the emissivity of the Earth's atmosphere, which represents the earth's tendency to emit radiation energy. This constant depends on cloud cover, water vapor as well as on greenhouse gas concentration in the atmosphere. σ is a physical constant (the Stephan-Boltzmann constant) which is fixed for the purpose of our discussion. S is the incoming radiation energy per unit area (also called the solar constant) and $0 \leq a \leq 1$ is the fraction of that energy reflected. a is also called the albedo and depends on cloud cover, and other aspects of the planet such as percent forest, snow, desert and ocean as well as the level of greenhouse gases.

a. Suppose that a depends on G the level of green house gases, and one has an estimate of da/dG. Use the chain rule to compute dT/dG.

b. If da/dG is negative, is dT/dG positive or negative?

c. Suppose that a is constant but ϵ depends on G. Assume that $\dfrac{d\epsilon}{dG}$ is given. Determine the rate change of temperature with respect to the level of greenhouse gases in this case.

d. Suppose that both a and ϵ depend on G. Find $\dfrac{dT}{dG}$ in this more general case. (Hint: the quotient rule as well as the chain rule will be needed in this case.)