AP Physics 1: Harmonic Motion: **Do Not Attempt While Operating Heavy Machinery**

1. Use your text book to review Coulombs Law, if necessary. A positive charge Q is placed midway between two identical positive charges, each with equal charge of q

q Q x q

a. What is the net force on Q at the mid point (assume gravity is negligible)?

Q is now displaced to the right, by an amount x, and released.

b. Is the resulting motion of Q simple harmonic motion? Explain.

c. Is the resulting motion periodic? Explain.

2. A mass M is attached to a horizontal spring on a frictionless surface, as shown in the left-hand diagram below. When set in motion the mass oscillates with a period of T0. What will be the period (in terms of T0) if the mass is set up as shown in each of the other diagrams? (Assume all springs are identical.)

A

M

M

C

3M

2M

B

3MM

E

M

D

3. Below is a position vs. time graph for the motion of a mass attached to an ideal spring on a frictionless horizontal surface. The mass is 765g.



a. What is the spring constant?

b. What is maximum speed of the mass?

c. How much mechanical energy is in the system?

d. Write an equation for velocity vs. time for this system.

e. What is the maximum acceleration of the mass?

f. At what time(s)does the object have maximum positive acceleration?

g. At what times does the object have zero acceleration?

h. What is the position of the object at t=7.7s?

4. Draw a picture of a giraffe riding a bicycle.

5. A 650g mass attached to a spring has a maximum speed of 1.2m/s and a maximum acceleration of 2.1m/s2.

a. Find the k value of the spring.

b. Find the amplitude of the motion.

c. Find the frequency of the motion.

d. At t=0s, **v**=-vmax. Sketch **x** vs t, **v** vs t and **a** vs t.

6. A 444g mass is oscillating on a spring with k=140N/m, on a horizontal frictionless surface. At an instant when the speed of the mass is 3.20m/s the spring stores 1.80J of energy.

a. Find the amplitude of the oscillation.

b. Determine the period of the oscillation.

c. Assuming the initial condition of the system is the mass moving left with zero acceleration, sketch the 3 graphs of motion.