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***Physics Dept.***

**final Exam Physics 236 2nd semester**

Q1: A simple pendulum, consisting of a 100-gram bob at the end of a string of length L = 1 m,is hanging straight down in equilibrium. Another 100-gram mass moving horizontally at a speed of +2 m /s hits the bob of the pendulum at t = 0 and sticks to it, which starts the pendulum swinging.

(a) Calculate the angular frequency ω.

(b) Use the conservation of momentum to find the initial linear velocity, $\dot{s }$(0), of the pendulum bob, and from this find the initial angular velocity $\dot{θ}(0) =\dot{s }(0)/L $.

(c) From the information above, and assuming that the angular displacement as a function of time is of the form $θ\left(t\right)= θ\_{0 }\cos((ωt+φ))$, from the initial conditions find the constants $θ\_{0 }$and $φ$.

**Q2:** A damped oscillator with mass 2 kg has the equation of motion

$$2\ddot{x}+12\dot{x}+50x=0$$

where x is the displacement from equilibrium, measured in metres.

(a) What are the damping constant and the natural angular frequency for this oscillator?

(b) What type of damping is this? Is the motion still oscillatory and periodic? If so, what is the oscillation period?

(c) For what value of the damping constant would this system, if displaced, return as quickly as possible to equilibrium? What would the equation of motion then be?

(d) If an applied force of the form $F=10 \cos(5t)$ , Find the steady state solution.

Q3:The following two waves in a medium are superposed:

$$y\_{1}\left(x,t\right)=(0.35m)\sin((3πt-10πx+\frac{π}{4}))$$

$$y\_{2}\left(x,t\right)=(0.35m)\sin((2πt-8πx+\frac{π}{2}))$$

 (x in meters and t in seconds)

a) What are the phase velocities of the two waves?

b) Write an equation for the combined disturbance.

c) What is its group velocity?

d) In the combined disturbance, what is the distance between points of zero amplitude?

****Q4: Q1: Tow different mass are hanging of a springs as shown:

A) Show that the equations of motion of the tow masses.

$$\frac{m}{2 }\ddot{x}\_{1}= -kx\_{1}-k(x\_{1}-x\_{2})$$

$$m\ddot{x}\_{2}=-k(x\_{2}-x\_{1})$$

B) Find the normal frequencies.

C) Find the normal modes.