

## HOMEWORK SET 10: SIMPLE HARMONIC MOTION

Due Friday, October 6, 2023

**PROBLEMS FROM TM5**

1) 3-1. A simple harmonic oscillator consists of a 100-g mass attached to a spring whose force constant is  $10^4$  dyne/cm. The mass is displaced 3 cm and released from rest. Calculate

- a) the natural frequency  $\nu_0$  and the period  $\tau_0$ ,
- b) the total energy, and
- c) the maximum speed.

2) 3-3. The oscillator of Problem 3-1 is set into motion by giving it an initial velocity of 1 cm/s at its equilibrium position. Calculate

- a) the maximum displacement and,
- b) the maximum potential energy.

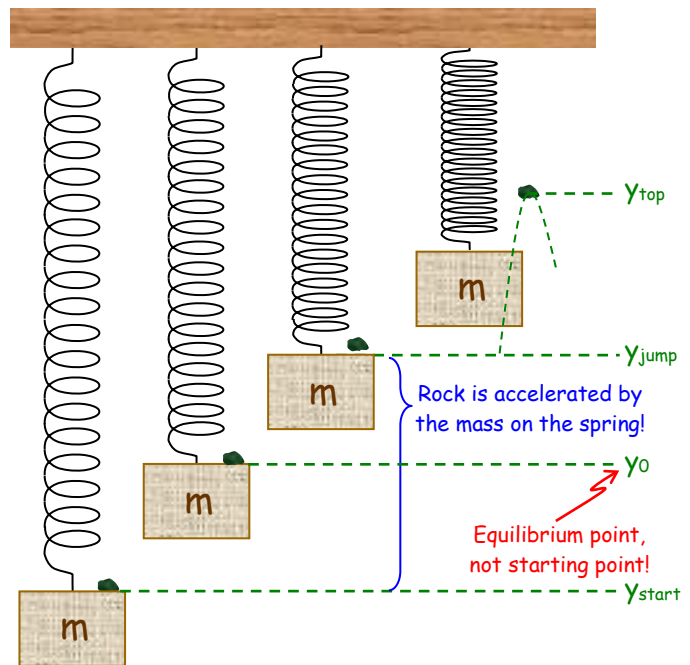
3) A block suspended from a spring is oscillating vertically with a frequency of 4 Hz and an amplitude of 7 cm. A very small bit of rock is placed on top of the oscillating block just as it reaches its lowest point. Assume that the rock has no effect on the oscillation.

- a) At what distance above the block's equilibrium position does the rock lose contact with the block?  
(HINT: WHAT FORCE PUSHES THE ROCK UP? HOW IS THIS FORCE RELATED TO THE SPRING? DRAW THE FBD FOR THE ROCK AND INCLUDE THE ACCELERATION DUE TO THE "LAUNCHER"; FOR SHM,  $\ddot{y} = -\omega^2 y$ .)
- b) What is the speed of the rock when it leaves the block?  
(HINT: WHAT FORCE ACCELERATES IT AND GOES TO ZERO WHEN IT LEAVES THE BLOCK? WHAT SPEED WAS THE "LAUNCHER" GOING? REMEMBER THE CRANE LIFTING THE BRICKS HW 01.1)
- c) What is the greatest distance above the block's equilibrium position reached by the rock?

**cgs Units:**  
 Length: cm  
 Mass: g  
 Time: s

Force: dyne =  $\frac{g \cdot cm}{s^2}$   
 $1 N = 1 \times 10^5 d$

Energy: erg = dyne·cm =  $\frac{g \cdot cm^2}{s^2}$   
 $1 J = 1 \times 10^7 erg$



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