Branch: IS (Makro)
Course: Physics
Teaching form: Classes
Semester: 2
Academic Year: 2018/2019

PRACTICE PROBLEMS - SET 3
MECHANICAL VIBRATIONS (OSCILLATIONS)

Problem #1.
An air-track glider is attached to a spring pulled at distance d = 20 cm to the right. Starting from released stage at $t = 0$ it subsequently makes $n = 15$ complete oscillations in time $t = 10\ s$. Determine the period of oscillation T and the object's maximum speed (velocity) υ, as well as its position and velocity υ at time $t = 0.8$ s?

Problem #2.
A red delicious apple floats in a barrel of water. If you lift the apple above its floating level by $h = 2.0\ cm$ and release it, it bobs up and down with a period of $T = 0.75\ s$. Assuming that the motion is simple harmonic, find the position x, velocity υ, and acceleration a of the apple at the times corresponding to 1/4 and ½ of period T.

Problem #3.
A student of mass $m = 83\ kg$ hangs from a bungee cord with a spring elastic constant $k = 270\ N/m$. He is pulled down to a point where the cord is longer by $l = 5.0\ m$ than its unstretched length, then released. What is a position of the student and what is his velocity after time $t = 2.0\ s$ later?

Problem #4.
A block of mass $m = 300\ g$ on long string of length $L = 30\ cm$ oscillates as a pendulum. It has a velocity υ = 0.25 m/s as it passes through the lowest point. What maximum deflection angle β does the pendulum reach?

Problem #5.
A bullet of mass m = 0.1 kg embeds itself in a block of mass $M = 10\ kg$, which is attached to a spring of elastic force constant $k = 10\ N/m$. If the initial velocity of bullet is $\upsilon_o = 1\ m/s$ determine the maximum compression of a spring and the time t for which the bullet-block system comes to rest?

Problem #6.
One block of mass $m_1 = 0.20\ kg$ traveling at velocity $\upsilon = 5\ m/s$ collides elastically with a second block of mass $m_1 = 0.80\ kg$ resting on a frictionless surface and connected to a spring with elastic force constant $k = 80\ N/m$. What is the angular velocity ω, period T, and the amplitude A of block's oscillations? Determine the respective values for the case when damping effects will appear with overall damping coefficient $\beta = 21/s$.

Problem #7.
A simple harmonic oscillator containing bullet of mass $m = 10\ kg$ and string of elastic constant $k = 50\ N/m$ was set in trembling. If the damping constant of resistance force $b = 0.30\ kg/s$ determine the time when the amplitude of oscillations will twicely decrease, as well as a number of full oscillations of this system at this time.

in some problems some additional assumption based on the general knowledge may be necessary