PHY 107: Spring 2021

Assessment

Due May 19 at 11 p.m.

INSTRUCTION

- You must mention your full name and student ID on the first page (at the top).
- You must answer all the questions.
- Your score relies on how well you tackle the given problems.
- You must show complete work and include proper units.
- You must draw a free-body diagram where necessary.
- Use $g = 9.8\ m/s^2$ if needed.

NOTES - - - - - - - - - - - - - - - - - -
Each submission will be carefully examined and students will lose points if there is high degree of similarity in the submission of students.

Thus, pls, submit your own work.

Good luck!
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Problem 1

i) Write the governing equation for simple harmonic motion. (Explain each variable in the equation) [1]

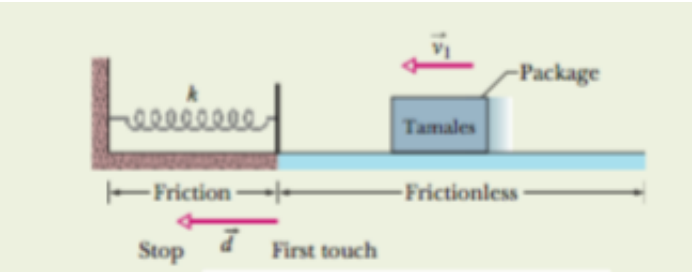
ii) The function $x = (5\ m)\ cos[(2\pi\ rad/s)t\ +\ \pi/4\ rad]$ gives the simple harmonic motion of a body. At t = 3 s, what are the (a) displacement, (b) velocity, (c) acceleration, and (d) phase of the motion? Also, what are the (e) frequency and (f) period of the motion? $[1+1+1+1+0.5+0.5]$

Problem 2

i) What is a conservative force and how can we identify a conservative force? [0.5+0.5]

ii) There are two cases that we have studied about how to compute the work done on a system due to an external force. Explain these two cases in words and equations. [1+1]

iii) A 5 kg package of tamales (see the figure below) slides along a floor with speed v_1 = 4 m/s. It then runs into and compresses a spring, until the package momentarily stops. Its path to the initially relaxed spring is frictionless, but as it compresses the spring, a kinetic frictional force from the floor, of magnitude 14 N, acts on the package. If k = 7 000 N/m, by what distance d is the spring compressed when the package stops? What makes up the system in this problem and state a reasonable assumption about this system?



[2+0.5+0.5]

Problem 3

a) Write a vector equation to define torque. (State the meaning of each variable) [1]
b) Write an equation for Newton's second law for rotational motion. (State the meaning of each variable) [1]
c) Calculate the rotational inertia of a wheel that has a kinetic energy of 24 400 J when rotating at 602 rev/hr. [2]
d) If a 50 N.m torque on a wheel causes angular acceleration 25 rad/s^2, what is the wheel's rotational inertia? [2]

Problem 4

i) State the conservation of kinetic energy. [1]

ii) A 5.20 g bullet moving at 672 m/s strikes a 700 g wooden block at rest on a frictionless surface. The bullet emerges, traveling in the same direction with its speed reduced to 428 m/s. (a) What is the resulting speed of the block? (b) What is the speed of the bullet - block center of mass? [3+2]

Problem 5

i) The angular position of a point on a rotating wheel is given by $\theta = 5 + 2t^2 + 4t^3$, where θ is in radians and t is in seconds. (a) What is its angular velocity at $t = 4$ s? (b) Calculate its angular acceleration at $t = 2$ s. [1+1]

ii) An astronaut is being tested in a centrifuge. The centrifuge has a radius of 2 m and, in starting, rotates according to $\theta = 0.6t^2$, where t is in seconds and θ is in radians. When t = 8 s, what are the magnitudes of the astronaut's (a) tangential acceleration, and (b) radial acceleration? [2+2]