Name:	Signature:
Surname:	Number:

KOÇ UNIVERSITY

College of Sciences

PHYS 101 General Physics 1

Fall Semester 2017

Final Exam

December 28, 2017 Thursday, 08:30-10:10

Please read.

- Count to make sure that there are 5 pages in this question booklet
- Check your **name, number, on front page, and student ID on each page.**.
- This examination is conducted with closed books and notes.
- Put all your personal belongings underneath your seat and make sure that pages of books or notebooks are not open.
- Absolutely no talking or exchanging anything (like rulers, erasers) during the exam.
- You must show all your work to get credit; you will not be given any points unless you show the details of your work (this applies even if your final answer is correct).
- Write neatly and clearly; unreadable answers will not be given any credit.
- If you need more writing space, use the backs of the question pages and put down the appropriate pointer marks.
- Make sure that you include units in your results.
- Make sure that you label the axis and have units in your plots.
- You are allowed to use calculators during this exam.
- Turn off your mobile phones, and put away.
- You are not allowed to leave the class during the first 15 minutes, and last 15 minutes.
- Write your final answers into the boxes. No points will be given to unjustified answers. Incomplete calculations will not be graded.

P101_Index:

1	2	3	4	Total

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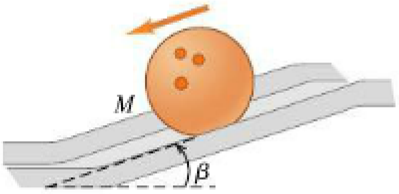
Q1-(25 pts) A spherical bowling ball with mass M and radius R rolls down a ramp that is inclined at an angle β to the horizontal. (For the bowling ball $I_{cm} = \frac{2}{5}MR^2$).



a) Assume β is small and the ball rolls without slipping. What are the ball's accelaration and the magnitude of the friction force on the ball?

b) Assume μ_s is the coefficient of static friction between the ramp and the ball. Find out an expression for the maximum angle β for which the ball will roll without slipping.

Solution continues on the back side of the page **Yes** □ **No** □

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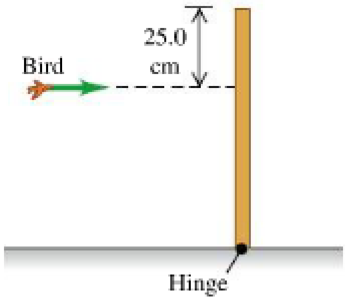
Q2-(25 pts) A 460.0 g bird is flying horizontally at 2.30 m/s, not paying much attention, when it suddenly flies into a stationary vertical bar, hitting it 25.0 cm below the top as shown in the figure. The bar is uniform, 0.780 m long, has a mass of 2.50 kg, and is hinged at its base. The collision stuns the bird so that it just drops to the ground afterward (but soon recovers to fly happily away). Assume g=9.8 m/s^2



a) What is the angular velocity of the bar just after it is hit by the bird?

b) What is the angular velocity of the bar just as the bar reaches the ground?

Solution continues on the back side of the page **Yes** □ **No** □

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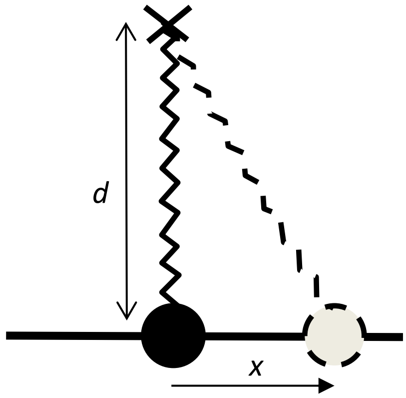
Q3-(25 pts) A small bead of mass m can move on a fixed horizontal wire without friction as in the figure. The bead is connected to an ideal spring of spring constant k, and the other end of the spring is connected to a fixed point at a perpendicular distance d from the wire. Unstretched length of the spring is very small, and can be taken to be zero.



a) What is the period of oscillations of the bead around its equilibrium position?

b) What is the amplitude of the simple harmonic motion if we give the bead an initial velocity of v_0 at its equilibrium position?

c) Find the position of the bead as a function of time, $x(t)$, for the case in part b.

Solution continues on the back side of the page **Yes** □ **No** □

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Q4-(25 pts) In this problem, you will explore what would happen if the attractive gravitational force was $F = \frac{Hm_1m_2}{r^3}$, H being a given constant, r the distance between objects, m_1 and m_2 masses of the objects (i.e. we have the third power of the distance instead of the second power). Consider a planet of mass M and radius R, and assume that the force is the same for spherical bodies and point particles.

a) What is the orbital period of a small satellite on a circular orbit of radius $2R$?

b) What is the gravitational potential energy of the satellite in part a?

c) What is the minimum initial velocity needed to escape the surface of this planet and never return? This is called the escape velocity.

Solution continues on the back side of the page **Yes** □ **No** □