Physics 161, Homework 7

Due 12:00 pm, Friday, April 11; No Exceptions

Lubna Rana, Sections 0201-0206

Read Chapter 8, Sections 8.1-8.7 Make sure you do <u>all</u> the example problems in the chapter.

Short Answer Questions S1, S2, S3 ; Problems P1; , P2 = S & B Ch 8, P 20; P3 = S & B Ch 8, P39; P4 = S & B, P 70, P5, P6

Remember, Exam II on Monday, April 14. New Material: Chapter 5, Ch 6 (Sections 6.1, 6.2), Ch 7 (Sec 7.1-7.5), Ch 8 (Sections 8.1-8.4).

Special Note: Please always:

1). PRINT your name and SECTION NUMBER CLEARLY on the front page of your HW. <u>Failure to do so will now cost you points.</u>

2). STAPLE all your pages. It is <u>your responsibility</u> to make sure that your hw gets submitted in one piece.

3). DO ALL THE PROBLEMS IN ORDER.

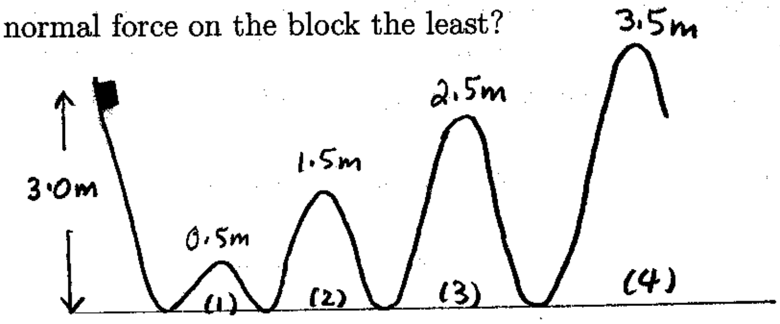
4). Show <u>complete work and write logically consistent explanations</u> for all questions and problems to receive credit.

5). Write units next to all dimensionful quantities.

Short Answer Questions:

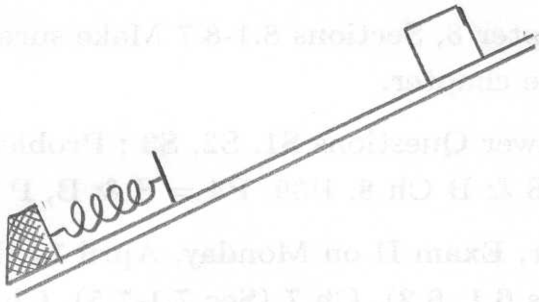
S1).. In fig S(1), a small, initially stationary block is released on a frictionless ramp at a height of 3.0 m. Hill heights along the ramp are as shown. The hills have identical circular tops (assume that the block does not fly off any hill). a). Which hill is the first the block cannot cross? b). What does it do after failing to cross that hill? On which hilltop is c). the centripetal acceleration of the block greatest? d). On which hilltop is the normal force on the block the least?

fig S1.



S2). An initially stationary block is released at time t_0 to slide down a frictionless ramp to an (essentially) massless spring which it reaches at time t_1 and then compresses until the maximum compression is reached at time t_2. From t_0 to t_2 what happens to a). the kinetic energy of the block; b). the gravitational potential energy of the block-Earth system; and c). the elastic potential energy of the spring.

fig S2.



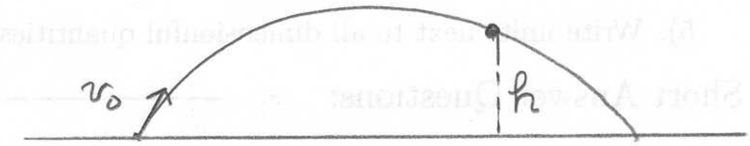
S3). Figure S3 shows the trajectory of a baseball moving under the sole influence of gravity.

a). If the ball is thrown with an initial speed v_0, find the speed of the ball when its at point B a height h above the ground. Does your answer depend on the angle θ at which the ball is thrown? (*Hint: Use energy conservation*).

b). What additional information (if any) would you need to solve this problem using the kinematic equations only (i.e., material we learnt in chapters 2-4) ?

c). If given the additional data, what information can the kinematic equations give us that the energy relationships are not so well suited to provide?

fig S3



Problems:

P1). Would you expect it to take more, less or the same amount of energy to (a) lift 10 people in an elevator to the top of a 4 strory building (like the Physics building) or (b) light a 100-Watt light bulb for an hour. (*Note: For part b, you can calculate exactly how much energy it takes. For part (a), make reasonable estimates for the mass of the people and the height of the building.*).

P2). Serway & Beichner, Chapter 8, Problem 20.

P3). Serway & Beichner, Chapter 8, Problem 39

P4). Serway & Beichner, Chapter 8, Problem 70

P5). A samll block of mass m slides without friction along the loop-the-loop track shown in Figure P5. The block starts from point P a distance h above the bottom of the loop.

a). What is the kinetic energy of the block when it reaches the top of the loop.

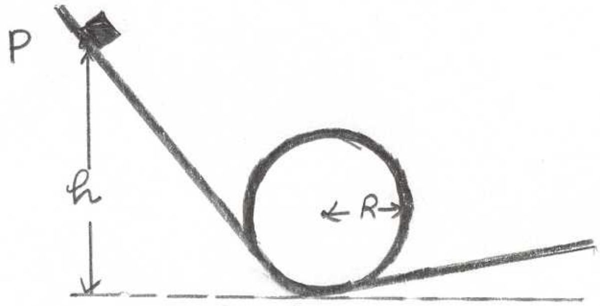


Fig P5.

b). What is its acceleration at the top of the loop assuming it stays on the track?

c). What is the least value of h for which the block will reach the top of the loop without leaving the track.

P6). Let's go back to the pendulum again. We'll now use the energy conservation ideas to answer some questions we left unanswered before. So, let the pendulum bob be released from rest at an initial angle θ_0.

a). Draw a free body diagram of the pendulum bob at an arbitrary angle θ. Use N2 (Newton's second law) to find an expression for the tension in the string.

b). What happens to the tension as the angle decreases from $\theta = \theta_0$ to $\theta = 0$? Where is the tension maximum?

c). Use conservation of energy methods to find the tangential speed v of the pendulum bob as a function of θ.

d). Using your result from part (c) above, write down an expression for the radial acceleration of the pendulum bob as a function of θ. Make sure that the expression you get gives the right result when you plug in $\theta = \theta_0$.

e). If $\theta_0 = 90^0$, what is v at the bottom of the swing?