

**PY211 Spring 2020 Problem Set 5**  
**Due: Friday, 6 March 2020 at 5:00 pm**

**Student Name** \_\_\_\_\_

**Discussion Session** \_\_\_\_\_

Print the homework and work on the problems in the area allocated. You may add additional paper if needed. Use enough space to be clear in what you are doing; write comments and explanations and draw helpful diagrams. Staple your pages. Don't hand in a sheet with messy edges torn from a spiral bound notebook. Try not to use a calculator.

**Clearly indicate your final answers and make sure your answers include units!**

**Problem 1 [10 pts]** A 20.0 kg child plays on a swing having support ropes that are 2.0 m long. A friend pulls her back until the ropes are  $45.0^\circ$  from the vertical and releases her from rest.

a) What is the potential energy for the child just as she is released, compared with the potential energy at the bottom of the swing?

b) How fast will she be moving at the bottom of the swing?

c) How much work does the tension in the ropes do as the child swings from the initial position to the bottom?

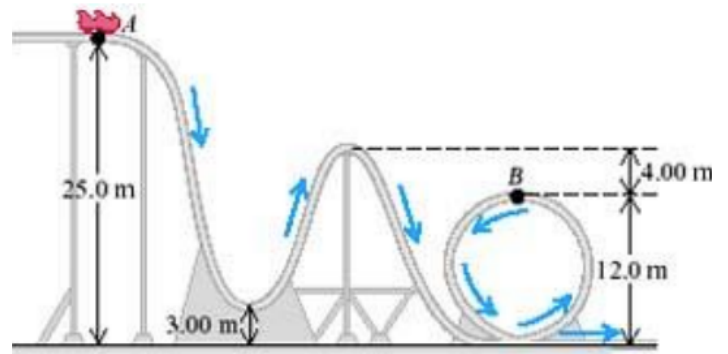
**Problem 2[10pts]** A spring of negligible mass has force constant  $k = 2500 \text{ N/m}$ .

a) How far must the spring be compressed for an amount  $5.0 \text{ J}$  of potential energy to be stored in it?

b) You place the spring vertically with one end on the floor. You then drop a book of mass  $2.0 \text{ kg}$  onto it from a height of  $0.800 \text{ m}$  above the top of the spring. Find the maximum distance the spring will be compressed.

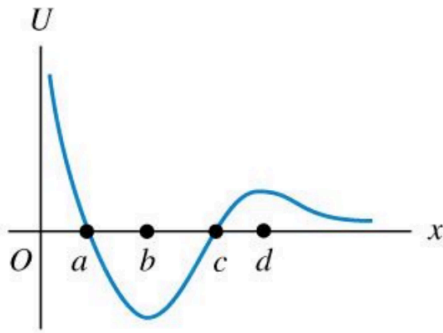
**Problem 3 [10pts]** A 350 kg roller coaster starts from rest at point A and slides down the frictionless loop-the-loop shown in the accompanying figure.

a) How fast is this roller coaster moving at point B?



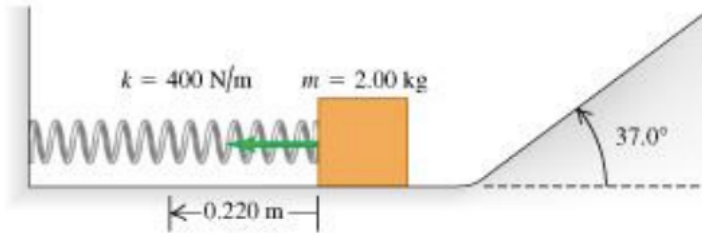
b) How hard does it press against the track at point B?

**Problem 4 [10 pts]** A marble moves along the  $x$ -axis. The potential-energy function is shown in the figure. Explain your answers.



- a) At which of the labeled  $x$ -coordinates is the force on the marble zero?
- b) Which of the labeled  $x$ -coordinates is a position of stable equilibrium?
- c) Which of the labeled  $x$ -coordinates is a position of unstable equilibrium?

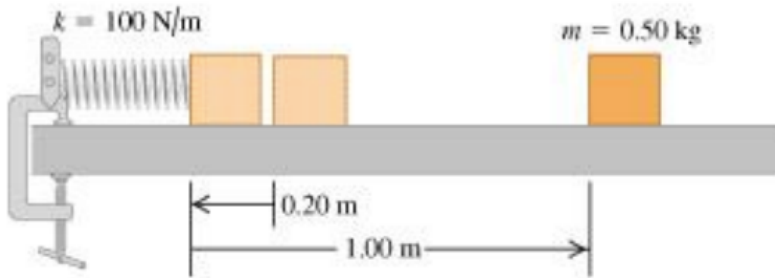
**Problem 5 [10 pts]** A 2.00-kg block is pushed against a spring with negligible mass and force constant  $k = 400 \text{ N/m}$ , compressing it 0.220 m. When the block is released, it moves along a frictionless, horizontal surface and then up a frictionless incline with slope  $37.0^\circ$ .



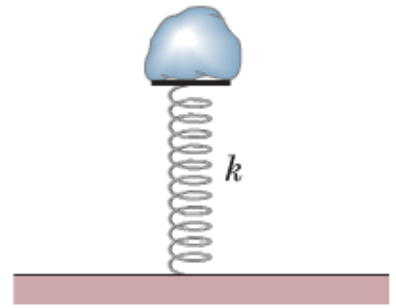
a) What is the speed of the block as it slides along the horizontal surface after having left the spring?

b) How far does the block travel up the incline before starting to slide back down?

**Problem 6 [10 pts]** A block with mass  $0.50\text{ kg}$  is forced against a horizontal spring of negligible mass, compressing the spring a distance of  $0.20\text{ m}$  (the figure). When released, the block moves on a horizontal tabletop for  $1.00\text{ m}$  before coming to rest. The spring constant  $k$  is  $100\text{ N/m}$ . What is the coefficient of kinetic friction  $\mu_k$  between the block and the tabletop?



**Problem 7 [10pts]** The figure shows an 8.00 kg stone at rest on a spring. The spring is compressed 10.0 cm by the stone.  
(a) What is the spring constant?



(b) The stone is pushed down an additional 30.0 cm and released. What is the elastic potential energy of the compressed spring just before that release?

(c) Briefly describe the transformation of energy from when the stone is released to when it reaches its maximum height.

(d) What is that maximum height, measured from the release point?  
Express your answers as decimal numbers with units, do your work symbolically first, showing your steps clearly, use  $g = 10 \text{ m/s}^2$  when calculating final values.