FlinnPREP™ for Practice Exam 2
Untimed Free Response

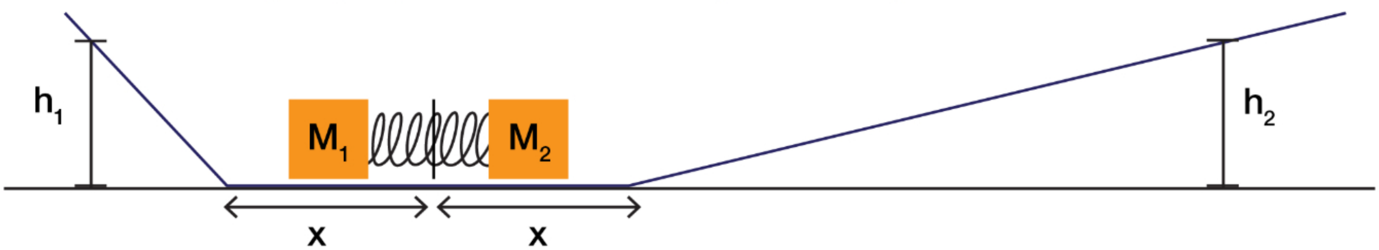
1. You and your lab students are provided one mass (defined as M_A), a string *l* meters in length and a spring with spring constant *k*.
   a. Determine other materials you will need to find the periods of a mass/spring system and a pendulum using the materials provided. (2)

   b. Suppose, using the same mass, students are to construct a mass/spring system and pendulum with identical periods. Assuming no friction in the spring and no air resistance, derive a relationship for the necessary spring constant in terms of M_A, l and *g* (acceleration due to gravity). (2)

   c. Based on the relationship derived in part b, the lab group is now instructed to construct a pendulum with an identical period when the mass/spring system utilizes a 10 N/m spring and M_A of 1 kg. How should they construct the pendulum to mimic the period, assuming g = 10 m/s^2? (2)

   d. Suppose students are instructed to construct the same 1 meter pendulum so its peak velocity is 2 m/s as it oscillates. How should the students set up the pendulum to ensure that this occurs? Assume no air resistance, and describe any additional materials necessary to ensure accuracy. (6)

2. Two blocks of unknown mass m_1 and m_2 are made of the same material. The blocks are attached by a massless spring and sit on a frictionless surface. The spring is released, and each block moves away from the other and slides up a ramp. Block m_1 is observed to slide up the left ramp and reach a height of h_1. Block m_2 is observed to slide up the right ramp, which is not identical to the left ramp and reaches a height of h_2.



   a. In terms of the given information and fundamental constants, find the ratio of m_1/m_2. (4)

   b. The experiment is repeated so that m_1 is secured to the surface and can't move. Compared to the original measured value of h_2, the new value of h_2 will be:

   _____ lower _____ higher _____ unchanged. Justify your response. (2)

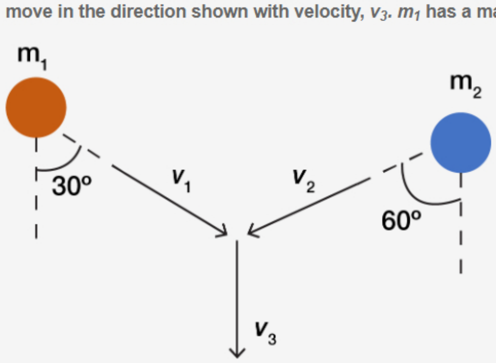
   c. Suppose a small amount of friction was present between the track and blocks, but was ignored by the experimenters. How would ratio m_1/m_2 found in part a be affected?

   _____ m_1/m_2 determined in part a is lower than the actual value.
   _____ m_1/m_2 determined in part a is higher than the actual value.
   _____ m_1/m_2 determined in part a is unaffected.

   Justify your choice. (3)

   d. Two new blocks of mass m_1 = 0.5 kg and m_2 = 3 kg are placed on the frictionless track between the spring. The spring is compressed 0.02 m, and m_1 moves off at 2 m/s. Find the *k* value of the spring. (3)

3. The following figure is a view from above of two balls traveling toward each other on a frictionless surface. They collide in a perfectly inelastic collision and move in the direction shown with velocity, v_3. m_1 has a mass of 150 g and has a speed of v_1 = 7.0 m/s. The mass of m_2 is 75 g.



   a. What is the speed at v_3? (2)

a. What is the speed at v_2? (2)

b. Calculate the speed after the collision at v_3. (2)

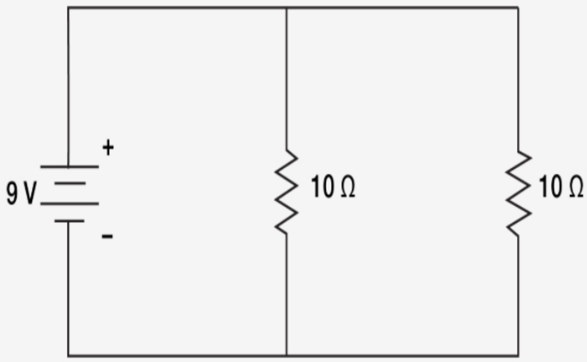
c. How much kinetic energy was lost as a result of the collision? (3)

4. A bored individual decides they want to see how well they can catch a grape in their mouth. They buy some seedless grapes from the local store and see that four are identical in shape and size. Each grape has a mass of 5 grams. Assume there is no air resistance where the grape drops will take place.

a. Determine the impulse of a grape being released 1 meter above the person's tongue. (2)

b. Create a mathematical model that predicts the impulse delivered to the individual's tongue as a function of height, assuming this person wants to catch a grape from heights of 20, 45 and 80 meters from his tongue. Write a paragraph detailing how you approached developing the mathematical model, and describe what the slope and *y*-intercept mean in the context of this situation. (5)

5. A parallel DC circuit is shown in the following image.



a. Determine the current through each resistor.

b. Describe two different ways one could increase the current flowing through the first resistor while maintaining the total resistance of the DC parallel circuit.

Finished

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