Before Session 1: Prelecture and Checkpoint *Vectors and 2-D Kinematics*

UNIT 6 HOMEWORK AFTER SESSION ONE

- *Continue working the constant acceleration problems that you started in Unit 4 by adding to the solutions you started in the assignment for the last class. The Sample Problem shows how to do the algebra and substitution for each of the problems.*
- *Do the SmartPhysics online Homework for* Vectors and 2-D Kinematics
- *Work Supplemental Problems SP6-3 through SP6-4 shown below.*

(10 pts) **SP6-3)** A ball with a mass of 0.50 kg is thrown vertically upward from the ground with an initial speed of 19 m/s from a release point which is 2.5 m above the ground. Assume that any forces exerted on the ball by the air can be neglected **(a)** How long does it take the ball to reach its maximum altitude? **(b)** What is its maximum altitude? **(c)** Determine times at which the velocity the ball is +5.0 m/s and –5.0 m/s. (c) At what heights above the ground do these velocities occur **(e)** What is the force on the ball on its way up, at the top of its path, and on the way down? Be sure to specify both the magnitude and the direction of each force.

(10 pts) **SP6-4)** An astronaut stands on the steps of her spaceship that is resting on the surface of planet X and drops a rock from a height of 4.2 metres. The rock hits the surface in 0.85 s. **(a)** Determine the magnitude of the acceleration due to gravity on the surface. **(b)** If the rock experiences a gravitational force of 20.0 N close to the surface of the earth, what force does it experience when falling close to the surface of planet X.

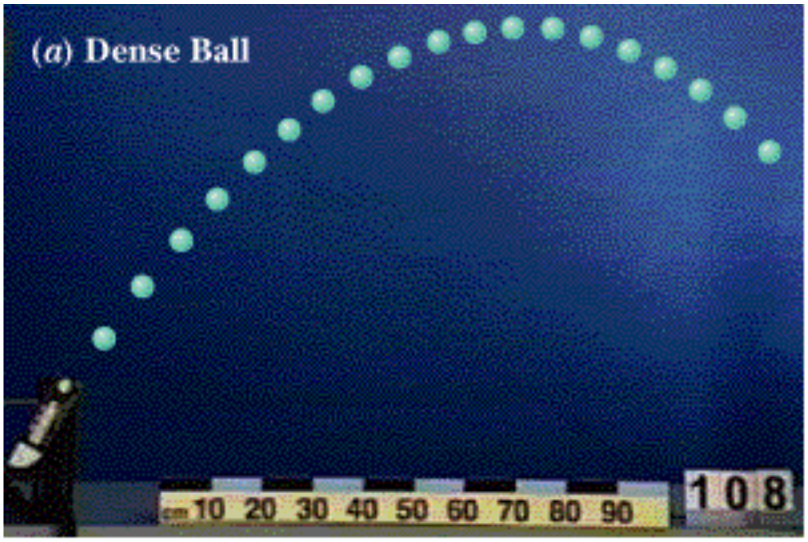
UNIT 6 HOMEWORK AFTER SESSION TWO

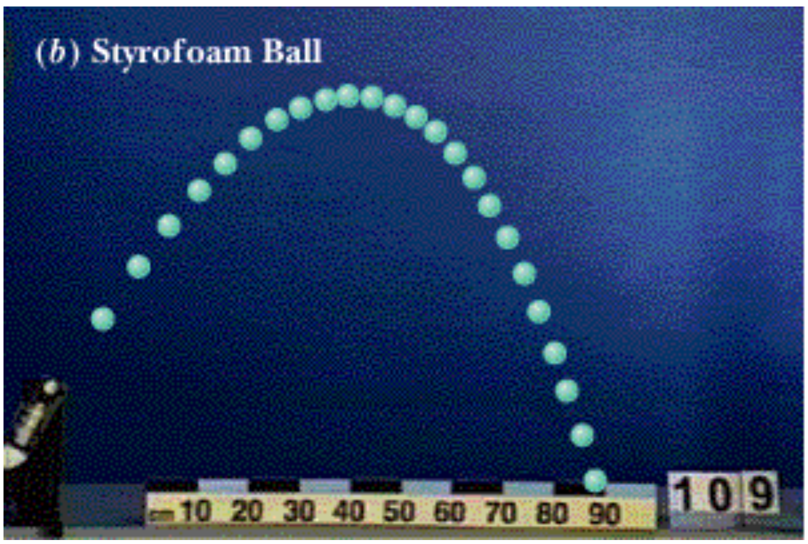
- *For the problems on the* CONSTANT ACCELERATION PROBLEM WORKSHEET,
  - Fill in the "Unit check" and estimation of "reasonableness" of the answer you got.
  - Complete part 5: d*escribe for each of these problems: (a) the source of the force that causes the acceleration (for example, in the first problem the Boeing 747 engines causes the acceleration force, (b) the magnitude of the force needed to cause the acceleration, and (c) indicate the direction of the acceleration on the diagram.*

This packet of problems should be turned in at the beginning of the first session of the next unit.

- *Work Supplemental Problem SP6-5 and SP6-6 shown below.*

(30 pts) **SP6-5)** Two small balls are launched at an angle of about 60 degrees with respect to the horizontal. See figures below. Measure the picture to find the co-ordinates of the ball every 1/15th second, that's every other one. (Use a mm scale and convert to actual real-life measurements.) You are to use mathematical modelling to find the equation that describes: (a) the horizontal motion x vs. t and (b) the equations that describe the vertical motion y vs. t. For simplicity you should set the origin at the location of the ball at time $t = 0$ seconds. Do (a) and (b) for both the dense ball and the Styrofoam ball. That means you'll have four graphs in all.

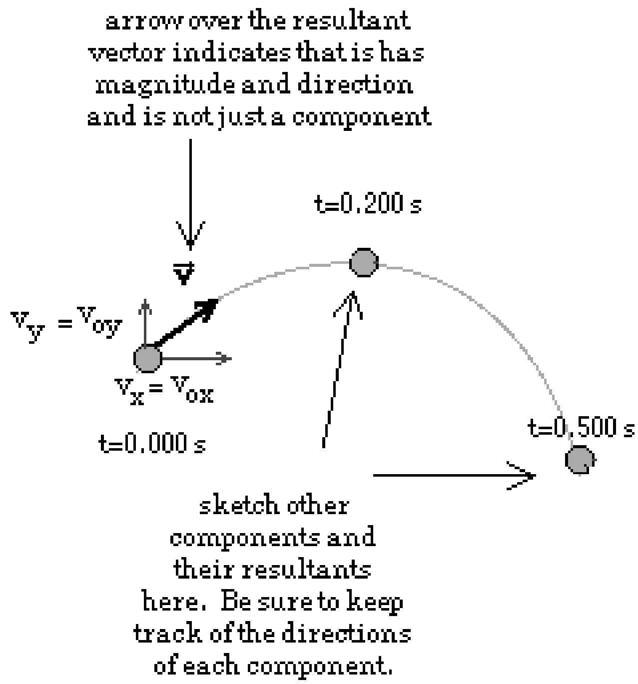




Submit your two models on WebCT. Write the answers to the following questions at the bottom:
(a) According to your horizontal model, what is the equation that describes the horizontal position of the ball, x, as a function of time. What is its horizontal acceleration, a_x? What is its initial horizontal velocity, v_{0x}? (b) According to your vertical model, what is the equation that describes the vertical position, y of the ball as a function of time. What is its vertical acceleration, $a_y = -g$? What is its initial velocity vertical, v_{0y}?
(c) Use the components v_{0x} and v_{0y} to compute the initial speed of the ball and to find its launch angle with respect to the horizontal.

(20 pts) **SP6-6)** Consider the motion you just analysed. (a) What is the acceleration that one would normally expect? How does your experimentally determined acceleration compare with it? If they are slightly different discuss why this might be the case. (b) Consider the equations you found and use the definition of instantaneous velocity and the process of differentiation (taking derivatives) to find an equation for the x-component of velocity, v_x, as a function of time and another equation for the y-component of velocity, v_y, vs. time. (c) Use these equations to compute the values of the x-and y-components of velocity at times t=0.000 seconds, at t=0.500 seconds and at t=0.200 seconds. (d) Draw a scale diagram showing the location of the ball at each of these times and draw the lengths of the component vectors for v_x and for v_y in each case at the location of the ball. Use diagrammatic

techniques to draw the resultant velocity vector, $\vec{v}$. Your diagram will look something like the sketch below, only more careful.



Be sure that the arrows representing the components have lengths proportional to the magnitudes of the velocities (i.e., the speeds) and have directions that are up or to the right if the velocities are positive and down or to the left when the velocities are negative).

UNIT 6 HOMEWORK AFTER SESSION THREE

(10 pts) For the following problem from Tipler&Mosca write out the solution so that your problem-solving logic is clear. Use the protocol established in the Unit 4 kinematics problems:

- Start with the necessary diagrams. (Draw a simplified diagram even if there's a picture.)
- Identify the known and unknown quantities.
- Write the needed equations.
- Solve the equations symbolically and then
- substitute the numbers.
- Check the units and reasonableness of the answer.

75 •• In Figure 3-35, what is the minimum initial speed of the dart if it is to hit the monkey before the monkey hits the ground, which is 11.2 m below the initial position of the monkey, if $x = 50$ m and $h = 10$ m? (Ignore any effects due to air resistance.)

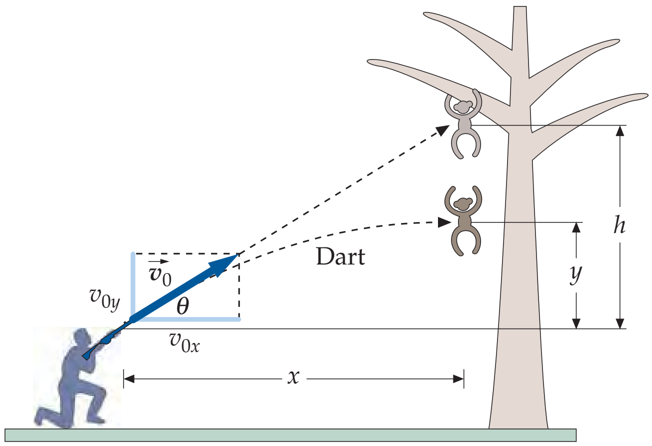


FIGURE 3-35 **Problem 75**

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Complete all Unit 6 entries in the Activity Guide.

➡**SmartPhysics:** *View the Prelecture* "Newton's Laws" *before the first class of next unit and answer the checkpoint questions.*