



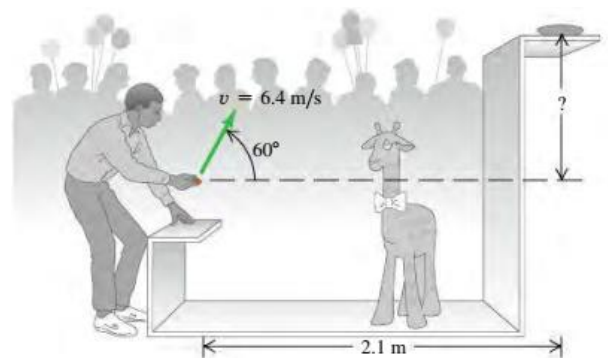
Applied Physics

PH-101 Fall 2024

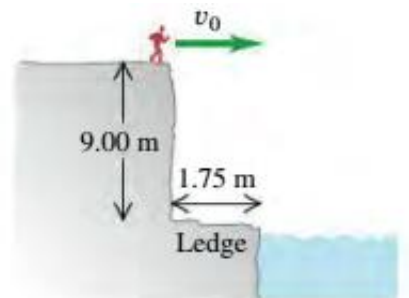
Assignment 2; Chapter 2-3

Deadline of submission: 02.10.2024

Q1. In a carnival booth, you can win a stuffed giraffe if you toss a quarter into a small dish. The dish is on a shelf above the point where the quarter leaves your hand and is a horizontal distance of 2.1 m from this point (**Fig.**). If you toss the coin with a velocity of 6.4 m/s at an angle of 60° above the horizontal, the coin will land in the dish. Ignore air resistance. (a) What is the height of the shelf above the point where the quarter leaves your hand? (b) What is the vertical component of the velocity of the quarter just before it lands in the dish?



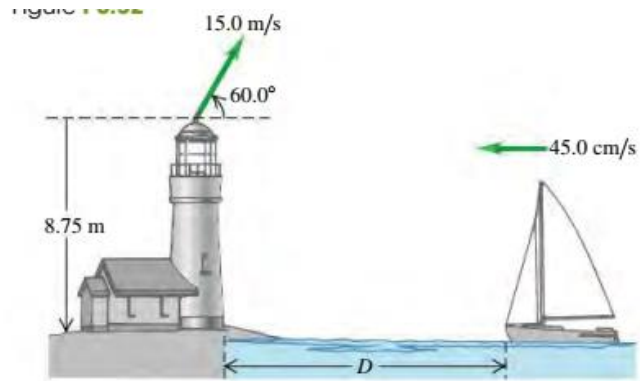
Q2. A daring 510-N swimmer dives off a cliff with a running horizontal leap, as shown in **Fig.** What must her minimum speed be just as she leaves the top of the cliff so that she will miss the ledge at the bottom, which is 1.75 m wide and 9.00 m below the top of the cliff?



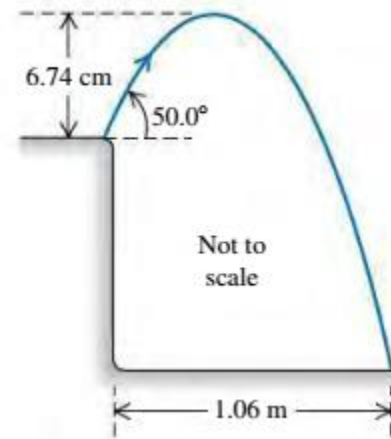
Q3. A man stands on the roof of a 15.0-m-tall building and throws a rock with a speed of 30.0 m/s at an angle of 33.0° above the horizontal. Ignore air resistance. Calculate (a) the maximum height above the roof that the rock reaches; (b) the speed of the rock just before it strikes the ground; and (c) the horizontal range from the base of the building to the point where the rock strikes the ground. (d) Draw $x-t$, $y-t$, v_x-t , and v_y-t , graphs for the motion.

Q4. Our balance is maintained, at least in part, by the endolymph fluid in the inner ear. Spinning displaces this fluid, causing dizziness. Suppose that a skater is spinning very fast at 3.0 revolutions per second about a vertical axis through the center of his head. Take the inner ear to be approximately 7.0 cm from the axis of spin. (The distance varies from person to person.) What is the radial acceleration (in m/s^2 and in g 's) of the endolymph fluid?

Q5. An important piece of landing equipment must be thrown to a ship, which is moving at 45.0 cm/s , before the ship can dock. This equipment is thrown at 15.0 m/s at 60.0° above the horizontal from the top of a tower at the edge of the water, 8.75 m above the ship's deck (**Fig.**). For this equipment to land at the front of the ship, at what distance D from the dock should the ship be when the equipment is thrown? Ignore air resistance.



Q6. A grasshopper leaps into the air from the edge of a vertical cliff, as shown in **Fig.** Find (a) the initial speed of the grasshopper and (b) the height of the cliff.



Q7. A firefighting crew uses a water cannon that shoots water at 25.0 m/s at a fixed angle of 53.0° above the horizontal. The firefighters want to direct the water at a blaze that is 10.0 m above ground level. How far from the building should they position their cannon? There are *two* possibilities; can you get them both? (*Hint:* Start with a sketch showing the trajectory of the water.)

Q8. A dockworker applies a constant horizontal force of 80.0 N to a block of ice on a smooth horizontal floor. The frictional force is negligible. The block starts from rest and moves 11.0 m in 5.00 s . (a) What is the mass of the block of ice? (b) If the worker stops pushing at the end of 5.00 s , how far does the block move in the next 5.00 s ?

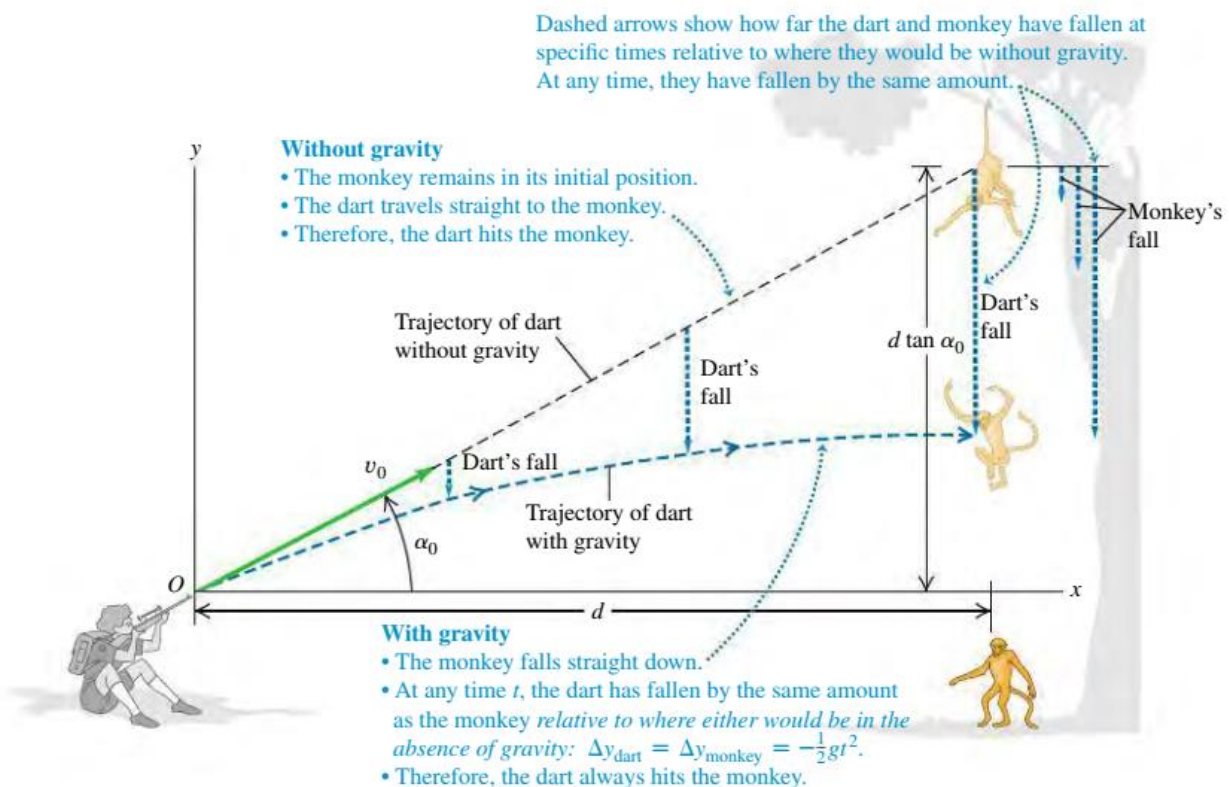
Q9. A small rock is thrown vertically upward with a speed of 22.0 m/s from the edge of the roof of a 30.0-m -tall building. The rock doesn't hit the building on its way back down and lands on the street below. Ignore air resistance. (a) What is the speed of the rock just before it hits the street? (b) How much time elapses from when the rock is thrown until it hits the street?

Q10. A brick is dropped (zero initial speed) from the roof of a building. The brick strikes the ground in 1.90 s. You may ignore air resistance, so the brick is in free fall. (a) How tall, in meters, is the building? (b) What is the magnitude of the brick's velocity just before it reaches the ground? (c) Sketch a_y - t , v_y - t , and y - t graphs for the motion of the brick.

Q11. You throw a small rock straight up from the edge of a highway bridge that crosses a river. The rock passes you on its way down, 6.00 s after it was thrown. What is the speed of the rock just before it reaches the water 28.0 m below the point where the rock left your hand? Ignore air resistance.

Q12. A ball starts from rest and rolls down a hill with uniform acceleration, traveling 200 m during the second 5.0 s of its motion. How far did it roll during the first 5.0 s of motion?

Q13. A monkey escapes from the zoo and climbs a tree. After failing to entice the monkey down, the zookeeper fires a tranquilizer dart directly at the monkey (**Fig.**). The monkey lets go at the instant the dart leaves the gun. Show that the dart will *always* hit the monkey, provided that the dart reaches the monkey before he hits the ground and runs away.



Q14. A model of a helicopter rotor has four blades, each 3.40 m long from the central shaft to the blade tip. The model is rotated in a wind tunnel at 550 rev/min. (a) What is the linear speed of the blade tip, in m/s? (b) What is the radial acceleration of the blade tip expressed as a multiple of g ?

Q15. At its Ames Research Center, NASA uses its large “20-G” centrifuge to test the effects of very large accelerations (“hypergravity”) on test pilots and astronauts. In this device, an arm 8.84 m long rotates about one end in a horizontal plane, and an astronaut is strapped in at the other end. Suppose that he is aligned along the centrifuge’s arm with his head at the outermost end. The maximum sustained acceleration to which humans are subjected in this device is typically 12.5g. (a) How fast must the astronaut’s head be moving to experience this maximum acceleration? (b) What is the *difference* between the acceleration of his head and feet if the astronaut is 2.00 m tall? (c) How fast in rpm (rev/min) is the arm turning to produce the maximum sustained acceleration?