Physics 201 Examples 6

Feb 6, 2013

1. The hammer throw is a track-and-field event in which a 7.3-kg ball (the "hammer"), starting from rest, is whirled around in a circle several times and released. It then moves upward on the familiar curving path of projectile motion. In one throw, the hammer is given a speed of 29 m/s. For comparison, a .22 caliber bullet has a mass of 2.6 g and, starting from rest, exits the barrel of a gun with a speed of 410 m/s. Determine the work done to launch the motion of (a) the hammer and (b) the bullet.

(a) 3.1 kJ
(b) 220 J

2. A bicyclist rides 5.0 km due east, while the resistive force from the air has a magnitude of 3.0 N and points due west. The rider then turns around and rides 5.0 km due west, back to her starting point. The resistive force from the air on the return trip has a magnitude of 3.0 N and points due east. (a) Find the work done by the resistive force during the round trip. (b) Based on your answer to part (a), is the resistive force a conservative force? Explain.

(a) -30 kJ
(b) No

3. The motor of a ski boat generates an average power of 7.50×10^4 watts when the boat is moving at a constant speed of 12 m/s. When the boat is pulling a skier at the same speed, the engine must generate an average power of 8.30×10^4 watts. What is the tension in the tow rope that is pulling the skier?

670 newtons

4. Suppose that in Figure 6.2 (see page 161 in the book) that 1100 J of work are done by the force $\vec{F}$ (magnitude = 30.0 N) in moving the suitcase a distance of 50.0 m. At what angle θ is the force oriented with respect to the ground?

42.8°

5. A water slide is constructed so that swimmers, starting from rest at the top of the slide, leave the end of the slide traveling horizontally. As Figure 1 shows, one person hits the water 5.00 meters from the end of the slide in a time of 0.500 seconds after leaving the slide. Ignoring friction and air resistance, find the height H in the drawing.

6.33 meters

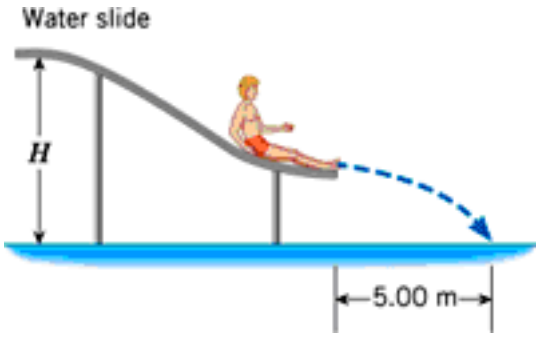

Figure 1: Problem 6.77

6. A 7420-kilogram satellite has an elliptical orbit, as in Figure 2. The point on the orbit that is farthest from the earth is called the apogee and is at the far right side of the drawing. The point on the orbit that is closest to the earth is called the perigee and is at the left side of the drawing. Suppose that the speed of the satellite is 2820 m/s at the apogee and 8450 m/s at the perigee. Find the work done by the gravitational force when the satellite moves from (a) the apogee to the perigee and (b) the perigee to the apogee.

(a) 2.35×10^{11} joules
(b) -2.35×10^{11} joules

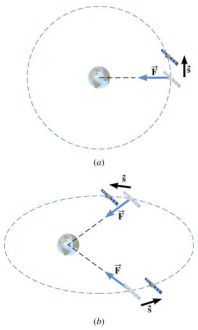

Figure 2: Problem 6.18

7. A sled is being pulled across a horizontal patch of snow. Friction is negligible. The pulling force points in the same direction as the sled's displacement, which is along the $+x$ axis. As a result, the kinetic energy of the sled increases by 38%. By what percentage would the sled's kinetic energy have increased if this force had pointed 62° above the $+x$ axis?

18%

8. A 47.0-gram golf ball is driven from the tee with an initial speed of 52.0 m/s and rises to a height of 24.6 meters. (a) Neglect air resistance and determine the kinetic energy of the ball at its highest point (b) What is its speed when it is 8.0 meters below its highest point?

(a) 52.2 kJ
(b) 48.8 m/s

9. Figure 3 shows a skateboarder moving at 5.4 m/s along a horizontal section of a track that is slanted upward by 48° above the horizontal at its end, which is 0.40 meters above the ground. When she leaves the track, she follows the characteristic path of projectile motion. Ignoring friction and air resistance, find the maximum height H to which she rises above the end of the track.

0.60 meters

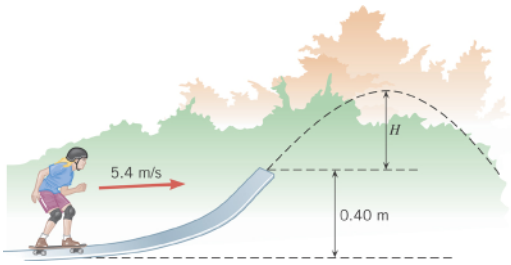

Figure 3: Problem 6.44

10. A student, starting from rest, slides down a water slide. On the way down, a kinetic frictional force (a nonconservative force) acts on her. The student has a mass of 83.0 kilograms and the height of the water slide is 11.8 meters. If the kinetic frictional force does -6500 joules of work, how fast is the student going at the bottom of the slide?

8.64 m/s

11. You are working out on a rowing machine. Each time you pull the rowing bar (which simulates the oars) toward you, it moves a distance of 1.2 meters in a time of 1.5 seconds. The readout on the display indicates that the average power you are producing is 82 watts. What is the magnitude of the force that you exert on the handle?

100 newtons

12. The brakes of a truck cause it to slow down by applying a retarding force of 3000 newtons to the truck over a distance of 850 meters. What is the work done by this force on the truck? Is the work positive or negative? Why?

-2.6×10^6 joules

13. A slingshot fires a pebble from the top of a building at a speed of 14.0 m/s. The building is 31.0 meters tall. Ignoring air resistance, find the speed with

(a) 28.3 m/s
(b) same
(c) same

which the pebble strikes the ground when the pebble is fired (a) horizontally, (b) vertically straight up, and (c) vertically straight down.

14. A horizontal disk with mass 2.0 kg has a radius of 0.10 m. Around the circumference is a string that runs over a pulley supporting a 0.25 kg mass. From rest, how long does it take the mass to fall 1.0 m? Use the conservation of energy to solve this problem.

1.0 s

15. Suppose we have a sphere, a hollow ball, a ring, and a disk. They all have the same mass (5.0 kg) and the same radius (0.2 m). How long does it take each to roll down a 5.0 m plane inclined at 5°?

(a) Sphere: 4.05 s
(b) Disk: 4.19 s
(c) Hollow Ball: 4.42 s
(d) Ring: 4.84 s