HW_7
_Potential_Energy_and_Conservation_of_Energy_Ch_8

Problems: 19, 21, 25, 27, 29, 31, 33, 37, 41, 47, 61, 71, 75, 83, Total = 14

19. Using values from **Table 8.2**, how many DNA molecules could be broken by the energy carried by a single electron in the beam of an old-fashioned TV tube? (These electrons were not dangerous in themselves, but they did create dangerous X-rays. Later-model tube TVs had shielding that absorbed X-rays before they escaped and exposed viewers.)

21. A camera weighing 10 N falls from a small drone hovering $20\,\text{m}$ overhead and enters free fall. What is the gravitational potential energy change of the camera from the drone to the ground if you take a reference point of (a) the ground being zero gravitational potential energy? (b) The drone being zero gravitational potential energy? What is the gravitational potential energy of the camera (c) before it falls from the drone and (d) after the camera lands on the ground if the reference point of zero gravitational potential energy is taken to be a second person looking out of a building $30\,\text{m}$ from the ground?

25. A force $F(x) = \left(-5.0x^2 + 7.0x\right)\text{N}$ acts on a particle. (a) How much work does the force do on the particle as it moves from $x = 2.0\,\text{m}$ to $x = 5.0\,\text{m}$? (b) Picking a convenient reference point of the potential energy to be zero at $x = \infty$, find the potential energy for this force.

27. The potential energy function for either one of the two atoms in a diatomic molecule is often approximated by $U(x) = -a/x^{12} - b/x^6$ where x is the distance between the atoms. (a) At what distance of seperation does the potential energy have a local minimum (not at $x = \infty$)? (b) What is the force on an atom at this separation? (c) How does the force vary with the separation distance?

29. A particle of mass $2.0\,\text{kg}$ moves under the influence of the force $F(x) = \left(-5x^2 + 7x\right)\text{N}$. If its speed at $x = -4.0\,\text{m}$ is $v = 20.0\,\text{m/s}$, what is its speed at $x = 4.0\,\text{m}$?

31. A boy throws a ball of mass $0.25\,\text{kg}$ straight upward with an initial speed of $20\,\text{m/s}$ When the ball returns to the boy, its speed is $17\,\text{m/s}$ How much much work does air resistance do on the ball during its flight?

33. Using energy considerations and assuming negligible air resistance, show that a rock thrown from a bridge 20.0 m above water with an initial speed of 15.0 m/s strikes the water with a speed of 24.8 m/s independent of the direction thrown. (*Hint:* show that $K_\text{i} + U_\text{i} = K_\text{f} + U_\text{f}$)

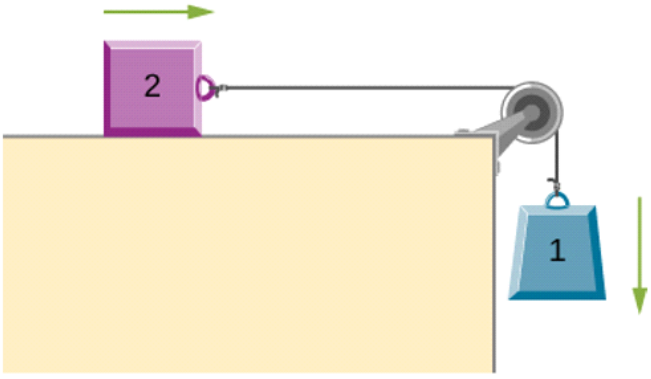
37. Assume that the force of a bow on an arrow behaves like the spring force. In aiming the arrow, an archer pulls the bow back 50 cm and holds it in position with a force of $150\,\text{N}$. If the mass of the arrow is $50\,\text{g}$ and the "spring" is massless, what is the speed of the arrow immediately after it leaves the bow?

41. A baseball of mass 0.25 kg is hit at home plate with a speed of 40 m/s. When it lands in a seat in the left-field bleachers a horizontal distance 120 m from home plate, it is moving at 30 m/s. If the ball lands 20 m above the spot where it was hit, how much work is done on it by air resistance?

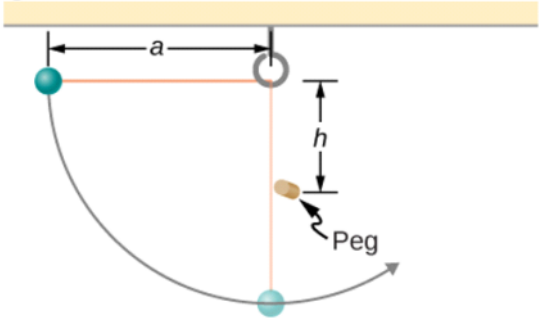
47. A particle of mass 4.0 kg is constrained to move along the x-axis under a single force $F(x) = -cx^3$, where $c = 8.0\,\text{N/m}^3$. The particle's speed at A, where $x_A = 1.0\,\text{m}$, is 6.0 m/s. What is its speed at B, where $x_B = -2.0\,\text{m}$?

61. (a) How high a hill can a car coast up (engines disengaged) if work done by friction is negligible and its initial speed is 110 km/h? (b) If, in actuality, a 750-kg car with an initial speed of 110 km/h is observed to coast up a hill to a height 22.0 m above its starting point, how much thermal energy was generated by friction? (c) What is the average force of friction if the hill has a slope of $2.5°$ above the horizontal?

71. Block 2 shown below slides along a frictionless table as block 1 falls. Both blocks are attached by a frictionless pulley. Find the speed of the blocks after they have each moved 2.0 m. Assume that they start at rest and that the pulley has negligible mass. Use $m_1 = 2.0\,\text{kg}$ and $m_2 = 4.0\,\text{kg}$.



75. Shown below is a small ball of mass m attached to a string of length a. A small peg is located a distance h below the point where the string is supported. If the ball is released when the string is horizontal, show that h must be greater than $3a/5$ if the ball is to swing completely around the peg.



83. In an amusement park, a car rolls in a track as shown below. Find the speed of the car at *A*, *B*, and *C*. Note that the work done by the rolling friction is zero since the displacement of the point at which the rolling friction acts on the tires is momentarily at rest and therefore has a zero displacement.