Momentum and Energy Review Problems
Physics
December 5, 2017

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1. A tugboat pulls a ship with a constant net horizontal force of 5.00×10^3 N and causes the ship to move through a harbor. How much work is done on the ship if it moves a distance of 3.00 km? **1.50×10^7 J**

3. A shopper in a supermarket pushes a cart with a force of 35 N directed at an angle of 25° downward from the horizontal. Find the work done by the shopper on the cart as the shopper moves along a 50.0 m length of aisle. **1.6×10^3 J**

4. If 2.0 J of work is done in raising a 180 g apple, how far is it lifted? **1.1 m**

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1. Calculate the speed of an 8.0×10^4 kg airliner with a kinetic energy of 1.1×10^9 J. **1.7×10^2 m/s**

4. Two 3.0 g bullets are fired with speeds of 40.0 m/s and 80.0 m/s, respectively. What are their kinetic energies? Which bullet has more kinetic energy? What is the ratio of their kinetic energies? **2.4 J, 9.6 J; the bullet with the greater speed; 1 to 4**

5. A car has a kinetic energy of 4.32×10^5 J when traveling at a speed of 23 m/s. What is its mass? **1.6×10^3 kg**

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3. A 2.1×10^3 kg car starts from rest at the top of a driveway that is sloped at an angle of 20.0° with the horizontal. An average friction force of 4.0×10^3 N impedes the car's motion so that the car's speed at the bottom of the driveway is 3.8 m/s. What is the length of the driveway? **5.0 m**

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3. A 40.0 kg child is in a swing that is attached to ropes 2.0 m long. Find the gravitational potential energy associated with the child relative to the child's lowest position under the following conditions:

A. when the ropes are horizontal
B. when the ropes make a 30.0° angle with the vertical
C. at the bottom of the circular arc

A. 785 J; B. 105 J; C. 0 J

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2. A 755 N diver drops from a board 10.0 m above the water's surface. Find the diver's speed 5.00 m above the water's surface. Then find the diver's speed just before striking the water. **9.9 m/s; 14.0 m/s**

4. An Olympic runner leaps over a hurdle. If the runner's initial vertical speed is 2.2 m/s, how much will the runner's center of mass be raised during the jump? **0.25 m**

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1. A 1.0×10^3 kg elevator carries a maximum load of 800.0 kg. A constant frictional force of 4.0×10^3 N retards the elevator's motion upward. What minimum power, in kilowatts, must the motor deliver to lift the fully loaded elevator at a constant speed of 3.0 m/s? **65 kW**

2. A car with a mass of 1.50×10^3 kg starts from rest and accelerates to a speed of 18.0 m/s in 12.0 s. Assume that the forces of resistance remains constant at 400.0 N during this time. What is the average power developed by the car's engine? **2.39×10^4 W (23.9 kW)**

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1. A 0.50 kg football is thrown with a velocity of 15 m/s to the right. A stationary receiver catches the ball and brings it to rest in 0.020 s. What is the force exterted on the ball by the receiver? **3.8×10^2 N to the left**

2. An 82 kg man drops from rest on a diving board 3.0 m above the surface of the water and comes to rest 0.55 s after reaching the water. What is the net force on the diver as he is brought to rest? **1.1×10^3 upward**

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1. A 63.0 kg astronaut is on a spacewalk when the tether line to the shuttle breaks. The astronaut is able to throw a spare 10.0 kg oxygen tank in a direction away from the shuttle with a speed of 12.0 m/s, propelling the astronaut back to the shuttle. Assuming that the astronaut starts from rest with respect to the shuttle, find the astronaut's final speed with respect to the shuttle after the tank is thrown. **1.90 m/s**

2. An 85.0 kg fisherman jumps from a dock into a 135.0 kg rowboat at rest on the west side of the dock. If the velocity of the fisherman is 4.30 m/s to the west as he leaves the dock, what is the final velocity of the fisherman and the boat? **1.66 m/s to the west**