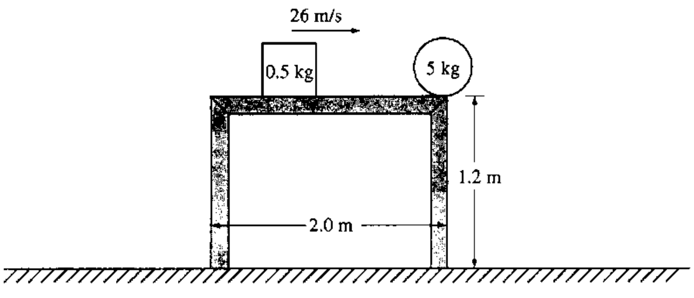
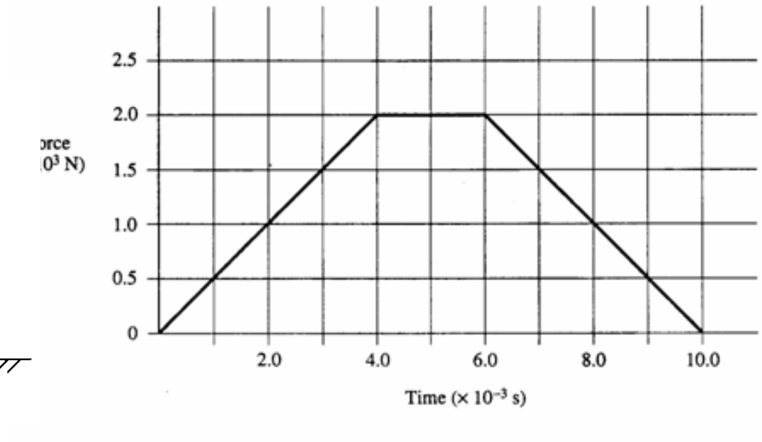
Name:________________________________




12. A 5-kilogram ball initially rests at the edge of a 2-meter-long, 1.2-meter-high frictionless table, as shown above left. A hard plastic cube of mass 0.5 kilogram slides across the table at a speed of 26 meters per second and strikes the ball, causing the ball to leave the table in the direction in which the cube was moving. The figure above right shows a graph of the force exerted **on the ball** by the cube as a function of time.

a. Determine the total impulse given to the ball.

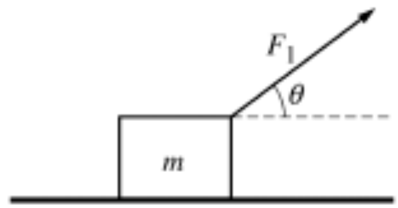
b. Determine the horizontal velocity of the ball immediately after the collision.

c. Determine the following for the cube immediately after the collision.

i. Its speed

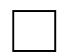
ii. Its direction of travel (right or left), if moving

d. Is the impulse on the cube positive or negative, what is the value? How do you know?




2. A block of mass m=10kg is pulled along a rough horizontal surface by a constant applied force of magnitude $F_1$ = 50N that acts at an angle $\theta$=30º to the horizontal, as indicated above. The coefficient of friction is 0.1.

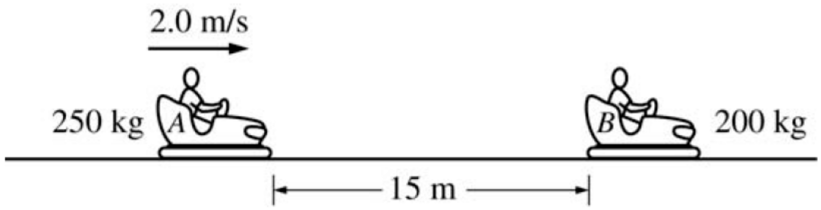
a. On the figure below, draw and label a free-body diagram showing all the forces on the block.



b. Find the normal force exerted by the surface on the block.

c. Find the acceleration of the block.

d. After a few seconds at that acceleration another mass was place on the block. On the axes below, sketch graphs of the speed *v* and displacement *x* of the block as functions of time *t*.


2008B1. (10 points)

Several students are riding in bumper cars at an amusement park. The combined mass of car *A* and its occupants is 250 kg. The combined mass of car *B* and its occupants is 200 kg. Car *A* is 15 m away from car *B* and moving to the right at 2.0 m/s, as shown, when the driver decides to bump into car *B,* which is at rest.

(a) Car *A* accelerates at 1.5 $m/s^2$ to a speed of 5.0 m/s and then continues at constant velocity until it strikes car ***B.*** Calculate the total time for car *A* to travel the 15 m.

(b) After the collision, car *B* moves to the right at a speed of 4.8 m/s.

i. Calculate the speed of car *A* after the collision.

ii. Indicate the direction of motion of car *A* after the collision.

To the left ____________ To the right _______ None; car *A* is at rest.

(c) Is this an elastic collision? ________Yes No

Justify your answer.

5. A car and a truck are both travelling at the speed limit of 60 $\text{km h}^{-1}$ but in opposite directions as shown. The truck has **twice** the mass of the car.

The vehicles collide head-on and become entangled together.

(a) During the collision, how does the force exerted by the car on the truck compare with the force exerted by the truck on the car? Explain.

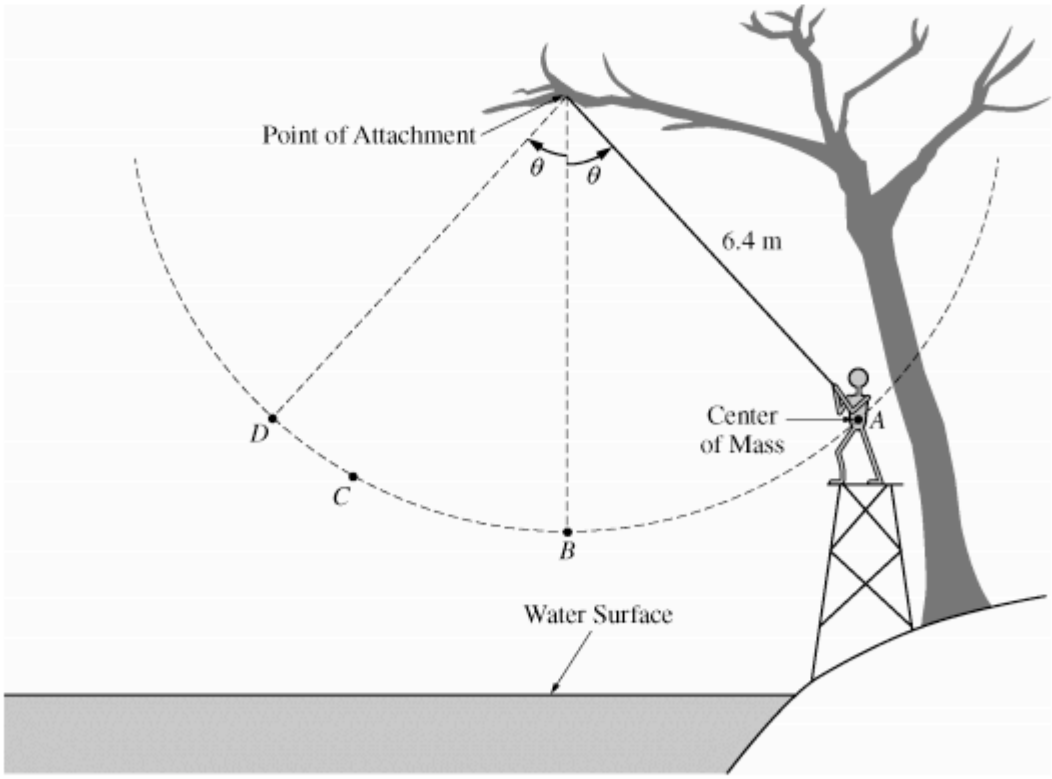
(b) In what direction will the entangled vehicles move after collision or will they be stationary? Support your answer, referring to a physics principle.

(c) Determine the speed (in $\text{km h}^{-1}$) of the combined wreck immediately after the collision.

(d) How does the acceleration of the car compare with the acceleration of the truck during the collision? Explain.

(e) Both the car and truck drivers are wearing seat belts. Which driver is likely to be the more severely jolted in the collision? Explain. *[2]*

(f) The total kinetic energy of the system decreases as a result of the collision. Is the principle of conservation of energy violated? Explain. *[1]*




1. (15 points)

Starting from rest at point *A*, a 50 kg person swings along a circular arc from a rope attached to a tree branch over a lake, as shown in the figure above. Point *D* is at the same height as point *A*. The distance from the point of attachment to the center of mass of the person is 6.4 m. Ignore air resistance and the mass and elasticity of the rope.

(a) The person swings two times, each time letting go of the rope at a different point.

i. On the first swing, the person lets go of the rope when first arriving at point *C*. Draw a <u>solid</u> line to represent the trajectory of the center of mass after the person releases the rope.

ii. A second time, the person lets go of the rope at point *D*. Draw a <u>dashed</u> line to represent the trajectory of the center of mass after the person releases the rope.

(b) The center of mass of the person standing on the platform is at point *A*, 4.1 m above the surface of the water. Calculate the gravitational potential energy when the person is at point *A* relative to when the person is at the surface of the water.

(c) The center of mass of the person at point *B*, the lowest point along the arc, is 2.4 m above the surface of the water. Calculate the person's speed at point *B*.

(d) Suppose that the person swings from the rope a third time, letting go of the rope at point *B*. Calculate *R*, the horizontal distance moved from where the person releases the rope at point *B* to where the person hits the water.

(e) If the person does not let go of the rope, how does the magnitude of the person's momentum $p_C$ at point *C* compare with the magnitude of the person's momentum $p_B$ at point *B* ?

____ $p_C > p_B$ ____ $p_C < p_B$ ____ $p_C = p_B$

Provide a physical explanation to justify your answer.