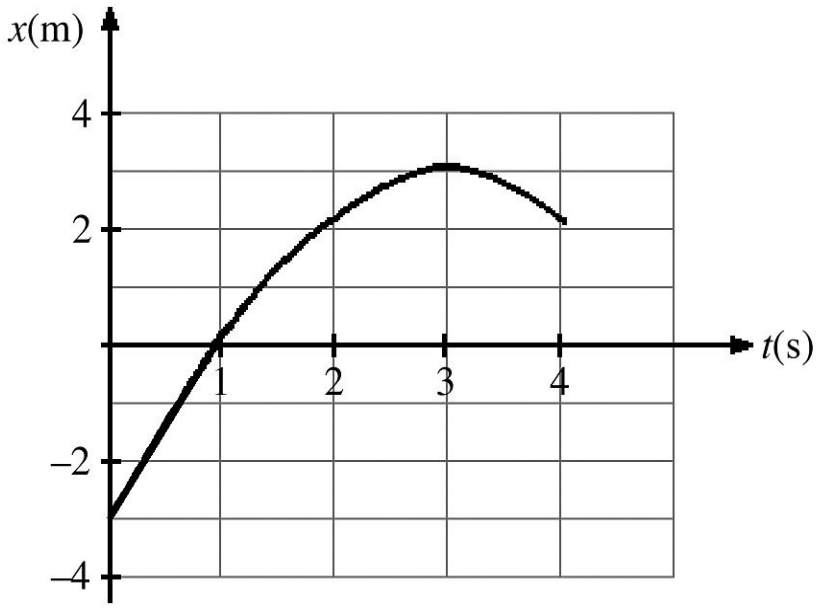
1. Two objects are dropped from a bridge, an interval of 1.0 s apart, and experience no appreciable air resistance. As time progresses, the DIFFERENCE in their speeds

A) increases.
B) remains constant.
C) decreases.
D) increases at first, but then stays constant.
E) decreases at first, but then stays constant.

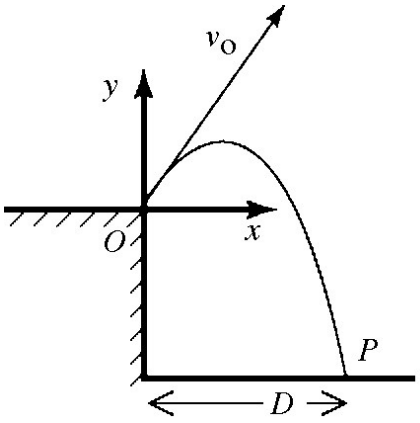
2. The figure represents the position of a particle as it travels along the *x*-axis. Between t = 2 seconds and t = 4 seconds, what is (a) the average speed of the particle and (b) the average velocity of the particle?



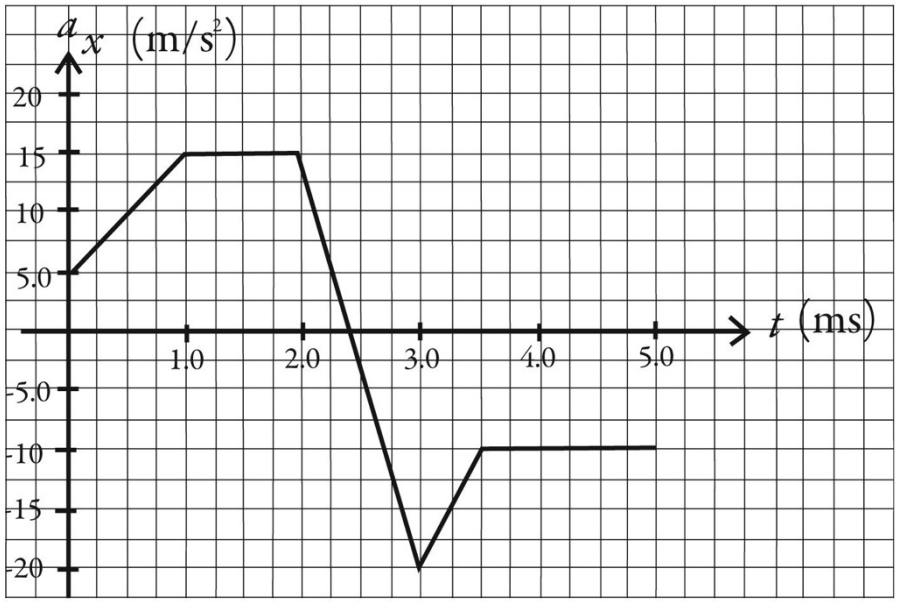
3. An electron moves with a constant horizontal velocity of 3.0×10^6 m/s and no initial vertical velocity as it enters a deflector inside a TV tube. The electron strikes the screen after traveling 17.0 cm horizontally and 40.0 cm vertically upward with no horizontal acceleration. What is the constant vertical acceleration provided by the deflector? (The effects of gravity can be ignored.)

A) 2.5×10^{14} m/s^2
B) 8.3×10^2 m/s^2
C) 1.4×10^4 m/s^2
D) 1.2×10^{14} m/s^2

4. A projectile is fired from point *0* at the edge of a cliff, with initial velocity components of v_{0x} = 60 m/s and v_{0y} = 175 m/s. The projectile rises and then falls into the sea at point *P*. The time of flight of the projectile is 40.0 s, and it experiences no appreciable air resistance in flight. What is the magnitude of the velocity of the projectile 21.0 s after it is fired?



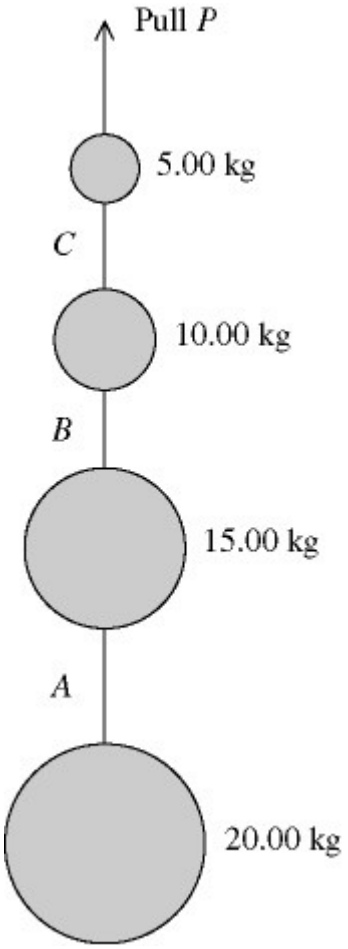
5. The graph in the figure shows the *x* component of the acceleration of a 2.4-kg object as a function of time (in ms).



(a) At what time(s) does the *x* component of the net force on the object reach its maximum magnitude, and what is that maximum magnitude?

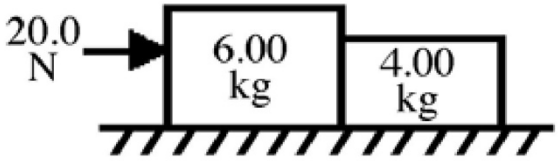
(b) What is the *x* component of the net force on the object at time t=0.0 ms and at t=4.0 ms?

6. A series of weights connected by very light cords are given an upward acceleration of 4.00 m/s^2 (also under the influence of gravity) by a pull *P*, as shown in the figure. *A*, *B*, and *C* are the tensions in the connecting cords. The pull *P* is closest to



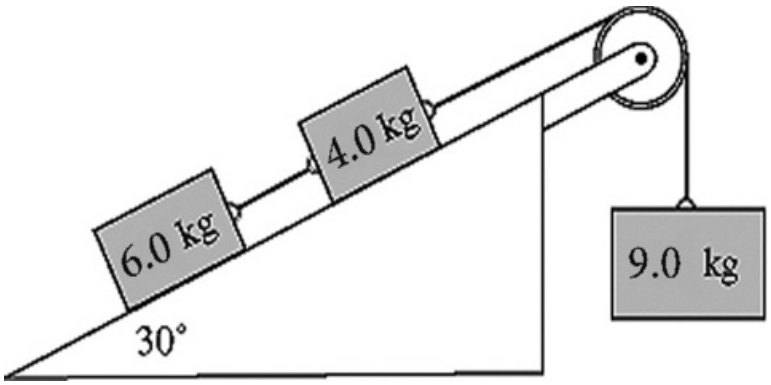
A) 700 N
B) 500 N
C) 300 N
D) 200 N
E) 50 N

7. A 6.00-kg block is in contact with a 4.00-kg block on a horizontal frictionless surface as shown in the figure. The 6.00-kg block is being pushed by a horizontal 20.0 N force as shown. What is the magnitude of the force that the 6.00 kg block exerts on the 4.00 kg block?



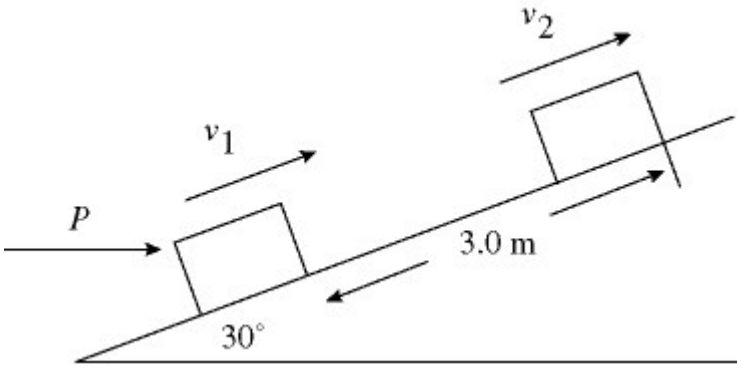
A) 6.00 N
B) 20.0 N
C) 8.00 N
D) 4.00 N
E) 10.0 N

8. A system comprising blocks, a light frictionless pulley, a frictionless incline, and connecting ropes is shown in the figure. The 9.0-kg block accelerates downward when the system is released from rest. The tension in the rope connecting the 6.0 kg block and the 4.0 kg block is closest to which value listed below?



A) 30 N.
B) 33 N.
C) 36 N.
D) 39 N.
E) 42 N.

9. In the figure, a 700-kg crate is on a rough surface inclined at 30°. A constant external force P = 5600 N is applied horizontally to the crate. As the force pushes the crate a distance of 3.00 m up the incline, the speed changes from 1.40 m/s to 2.50 m/s. How much work does gravity do on the crate during this process?



A) -10,300 J
B) -3400 J
C) +10,300 J
D) +3400 J

10. In the figure, two identical ideal massless springs have unstretched lengths of 0.25 m and spring constants of 700 N/m. The springs are attached to a small cube and stretched to a length *L* of 0.30 m as in Figure A. An external force *P* pulls the cube a distance D = 0.020 m to the right and holds it there. (See Figure B.) The external force *P*, that holds the cube in place in Figure B, is closest to which value listed below?

Figure A

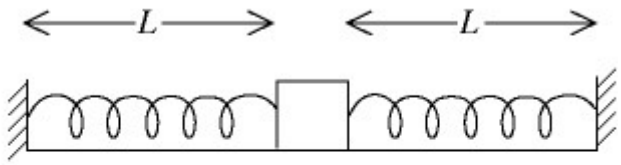
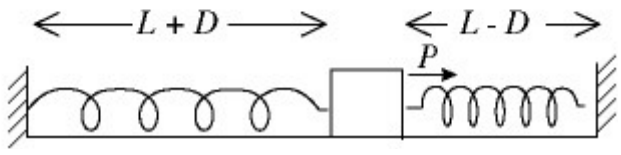
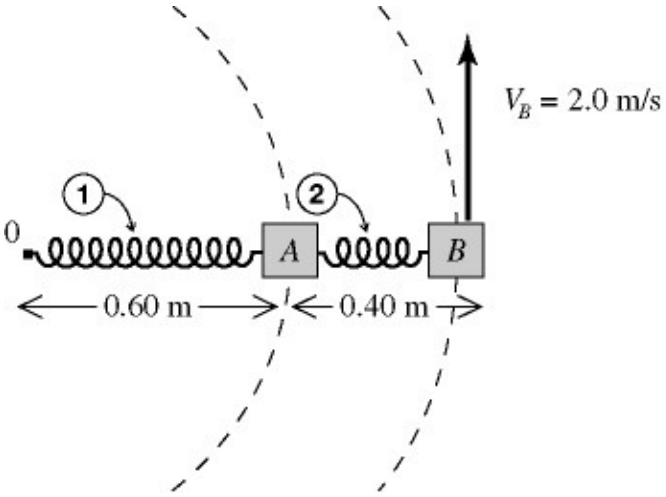


Figure B



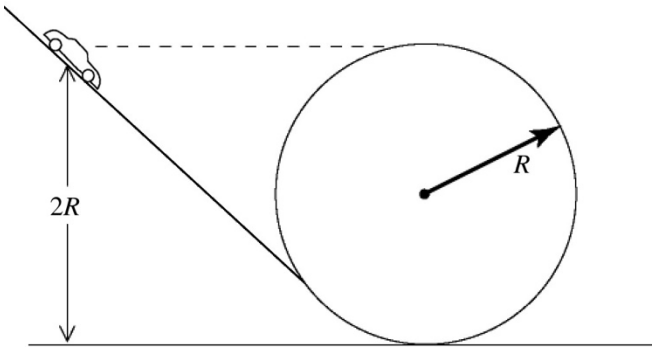
A) 28 N.
B) 25 N.
C) 21 N.
D) 18 N.
E) 14 N.

11. Block *A* (0.40 kg) and block *B* (0.30 kg) are on a frictionless table (see figure). Spring 1 connects block *A* to a frictionless peg at *0* and spring 2 connects block *A* and block *B*. When the blocks are in uniform circular motion about *0*, the springs have lengths of 0.60 m and 0.40 m, respectively. The springs are ideal and massless, and the linear speed of block *B* is 2.0 m/s. If the distance that spring 1 stretches is 0.100 m and the distance that spring 2 stretches is 0.060 m, the spring constant of spring 2 is closest to which value given below?



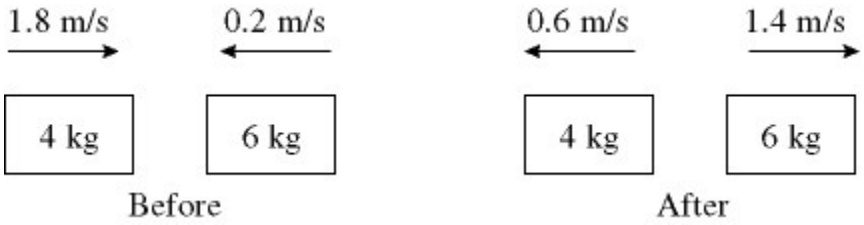
A) 18 N/m.
B) 20 N/m.
C) 22 N/m.
D) 24 N/m.
E) 26 N/m.

12. In the figure, a very small toy race car of mass m is released from rest on the loop-the-loop track. If it is released at a height 2R above the floor, how high is it above the floor when it leaves the track, neglecting friction?



A) 1.67 *R*
B) 2.00 *R*
C) 1.50 *R*
D) 1.33 *R*
E) 1.25 *R*

13. The velocities before and after a collision between two objects are reported as shown in the diagram below. The collision is _____



A) perfectly elastic.
B) partially inelastic.
C) completely inelastic.
D) characterized by an increase in kinetic energy.
E) not possible because momentum is not conserved.

14. A piece of thin uniform wire of mass *m* and length 3*b* is bent into an equilateral triangle. Find the moment of inertia of the wire triangle about an axis perpendicular to the plane of the triangle and passing through one of its vertices.

A) $\frac{2}{3}mb^2$

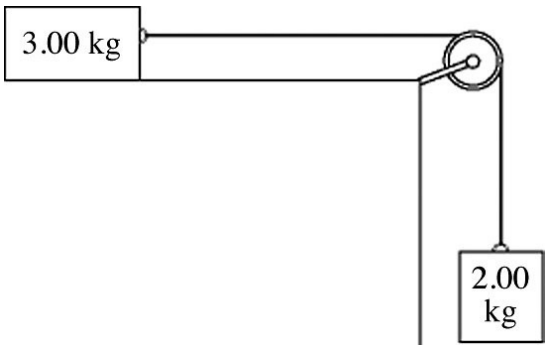
B) $\frac{1}{2}mb^2$

C) $\frac{1}{3}mb^2$

D) $\frac{1}{6}mb^2$

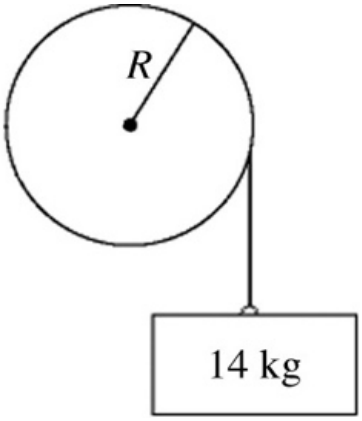
E) $\frac{1}{12}mb^2$

15. In the figure, two blocks, of masses 2.00 kg and 3.00 kg, are connected by a light string that passes over a frictionless pulley of moment of inertia 0.00400 kg • m^2 and radius 5.00 cm. The coefficient of friction for the tabletop is 0.300. The blocks are released from rest. Using energy methods, find the speed of the upper block just as it has moved 0.600 m.

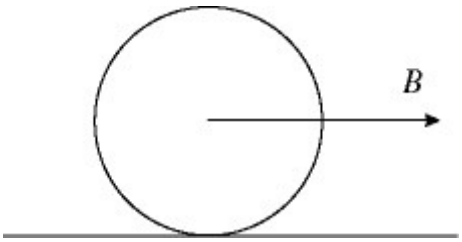


A) 1.22 m/s
B) 5.44 m/s
C) 3.19 m/s
D) 1.95 m/s
E) 1.40 m/s

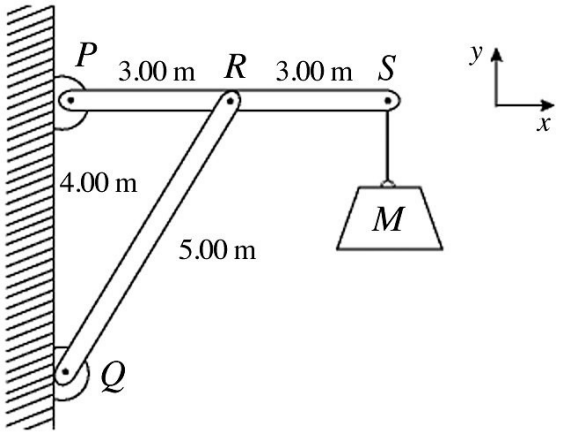
16. In the figure, a very light rope is wrapped around a wheel of radius R = 2.0 meters and does not slip. The wheel is mounted with frictionless bearings on an axle through its center. A block of mass 14 kg is suspended from the end of the rope. When the system is released from rest it is observed that the block descends 10 meters in 2.0 seconds. What is the mass of the wheel?



17. A lawn roller in the form of a uniform solid cylinder is being pulled horizontally by a horizontal force B applied to an axle through the center of the roller, as shown in the figure. The roller has radius 0.65 meters and mass 50 kg and rolls without slipping. What magnitude of the force B is required to give the center of mass of the roller an acceleration of 2.8 m/s^2?



18. A uniform 300-kg beam, 6.00 m long, is freely pivoted at *P*, as shown in the figure. The beam is supported in a horizontal position by a light strut, 5.00 m long, which is freely pivoted at point Q and is loosely pinned to the beam at point R. A load of mass M is suspended from the end of the beam at *S*. A maximum compression of 23,000 N in the strut is permitted, due to safety.



(a) Under maximum load, find the magnitude of the *x* component of the force exerted on the beam by the pivot at point P.

A) 13,800 N
B) 12,800 N
C) 11,200 N
D) 14,400 N
E) 16,000 N

(b) Find the mass of M under these same conditions.

A) 270 kg
B) 470 kg
C) 670 kg
D) 870 kg
E) 1070 kg