

(1) A ball is tied to the end of a string of negligible mass. The ball is spun in a circle with a radius 4.00 m making 5.00 revolutions every 10.0 seconds. The magnitude of the acceleration of the ball is closest to:

- (a) 78.9 m/s²
- (b) 6.28 m/s²
- (c) 12.6 m/s²
- (d) 19.7 m/s²
- (e) 39.5 m/s²

(2) An amusement park ride that travels in a circle takes 5.0 seconds to accelerate from rest and reach a final angular velocity of 30 revolutions per minute. What is its angular acceleration?

- (a) 0.10 rad/s²
- (b) 0.16 rad/s²
- (c) 0.31 rad/s²
- (d) 0.63 rad/s²
- (e) 6.0 rad/s²

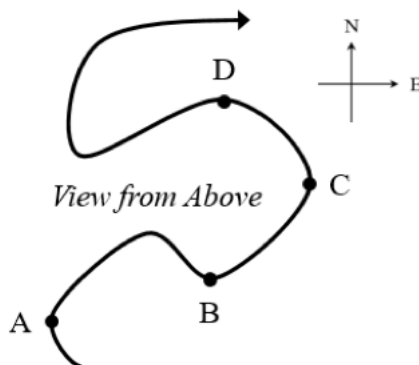
(3) An amusement park ride that travels in a circle accelerates from rest and reaches a final angular velocity of 3.5 rad/s. If it travels half of a full rotation before reaching this speed, what was its angular acceleration?

- (a) 0.97 rad/s²
- (b) 1.1 rad/s²
- (c) 1.9 rad/s²
- (d) 3.9 rad/s²
- (e) 4.2 rad/s²

(4) The following four forces act on a 4.00 kg object: $F_1 = 300$ N towards east, $F_2 = 700$ N towards north, $F_3 = 500$ N towards west, $F_4 = 600$ N towards south. What is the net force on the object?

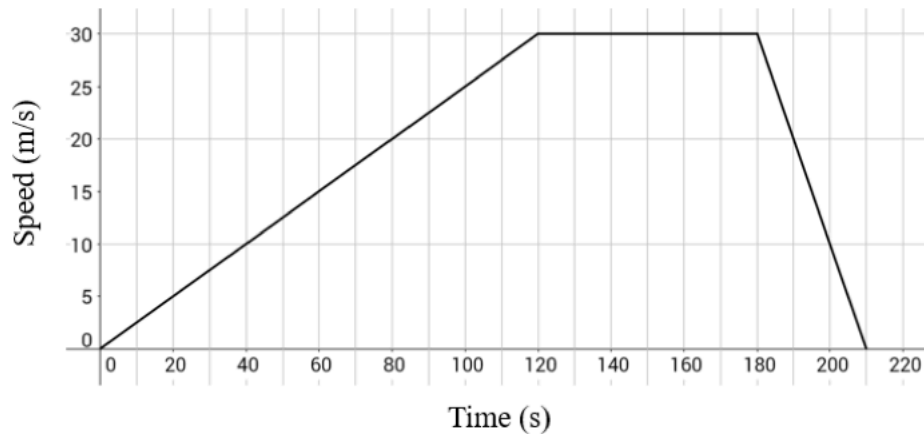
- (a) 224 N in a direction 63.4° north of west
- (b) 300 N in a direction 63.4° north of west
- (c) 300 N in a direction 26.6° north of west
- (d) 224 N in a direction 26.6° north of west
- (e) 2100 N in a direction 26.6° north of west

(5) Shown is a view from above of the path taken by a car traveling around a very curvy, horizontal road. If the car was traveling at a constant speed, at which of the marked points was the direction of the car's acceleration pointing to the north?

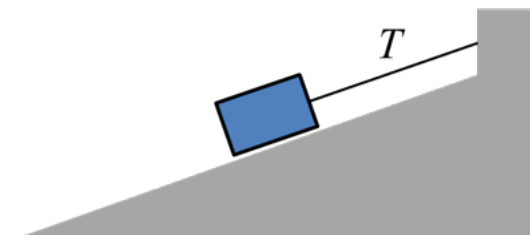


E) None of the marked points.

(6) A car with a mass of 3000 kg is traveling on a horizontal road. The graph below shows its speed as a function of time. During the interval when it was speeding up, what was the magnitude of the accelerating force on the car?



- (a) 0.25 N
 (b) 300 N
 (c) 750 N
 (d) 3000 N
 (e) 9000 N
- (7) For an object in uniform circular motion, its velocity and acceleration vectors are always perpendicular to each other at every point in the path.
 (a) True
 (b) False
 (c) Depends on if we include gravity
 (d) None of the above
- (8) What is the total maximum braking force that a 1400 kg car can apply without starting to slide? The coefficient of static friction between tire and road is $\mu_s = 0.8$ and the coefficient of kinetic friction is $\mu_k = 0.6$.
 (a) 840 N
 (b) 1,100 N
 (c) 0 N
 (d) 13,700 N
 (e) 11,000 N
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- (9) A 60 kg person rides in an elevator while standing on a scale. The scale reads 400 N. The acceleration of the elevator is roughly:
 (a) 3.1 m/s² downward
 (b) 3.1 m/s² upward
 (c) zero
 (d) 6.7 m/s² downward
 (e) 9.8 m/s² downward
- (10) What is the tension T in the rope if the 20.0 kg block is at rest on a frictionless incline at an angle of 60° relative to horizontal?

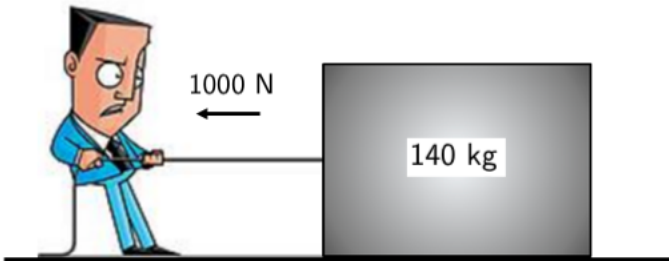


- (a) 35 N
 (b) 75 N
 (c) 195 N
 (d) 170 N
 (e) 196 N

(11) A box is at rest on some ice. The box is given a sudden push and it slides 24 m before coming to rest. If the coefficient of kinetic friction between the box and the ice is 0.20, what was the initial speed of the box?

- (a) 6.8 m/s
- (b) 9.7 m/s
- (c) 21 m/s
- (d) 47 m/s
- (e) 94 m/s

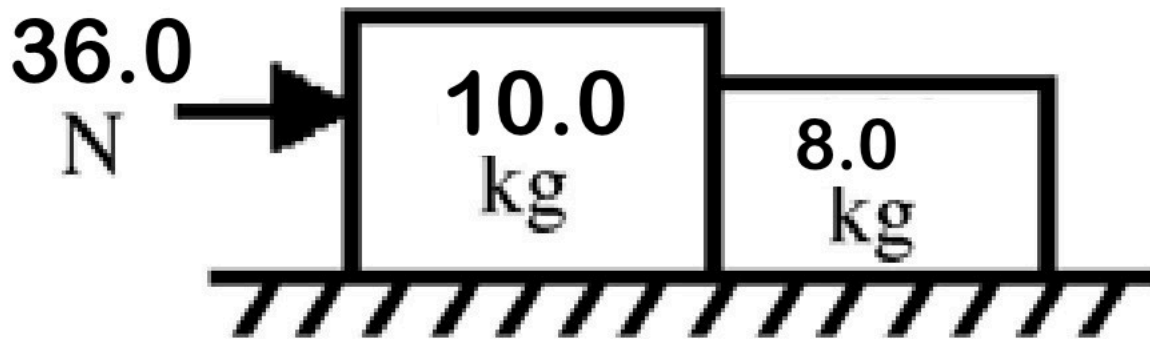
(12) Robert pulls horizontally with a constant force of 1000 N in the negative x direction on a (massless) rope tied to a box with a mass of 140 kg. If the coefficients of static and kinetic friction between the box and the are $\mu_s = 0.9$ and $\mu_k = 0.8$, what will happen?



- (a) The box will not move.
- (b) The box will accelerate at -1.7 m/s^2
- (c) The box will accelerate at 0.70 m/s^2
- (d) The box will accelerate at 1.7 m/s^2
- (e) The box will move at a constant non-zero speed

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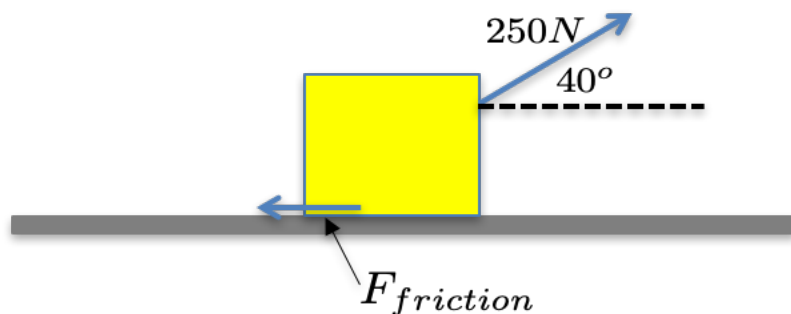
(13) A 10.00 kg block is in contact with an 8.00 kg block on a horizontal frictionless surface as shown in the figure. The 10.00 kg block is pushed by a horizontal 36.0 N force as shown. What is the force that the 8.00 kg block exerts on the 10.00 kg block?



- (a) N
- (b) 36 N to the right
- (c) 36 N to the left
- (d) 16 N to the left
- (e) 16 N to the right

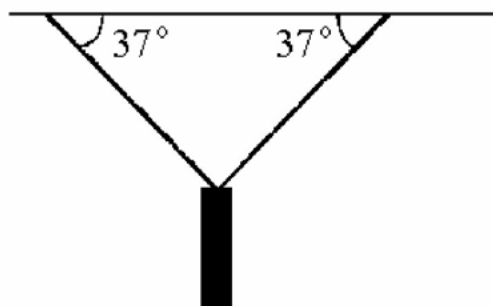
(14) A 30 kg box is pulled across the floor by a force of 250 N applied at an angle of 40° above the horizontal.

The coefficient of kinetic friction $\mu_k = 0.4$. What is the acceleration of the box?



- (a) 4.6 m/s^2
- (b) 2.5 m/s^2
- (c) 1.4 m/s^2
- (d) 4.4 m/s^2
- (e) 8.0 m/s^2

(15) A traffic light weighing 100 N is supported by two ropes as shown in the figure. The tension in each rope is closest to:

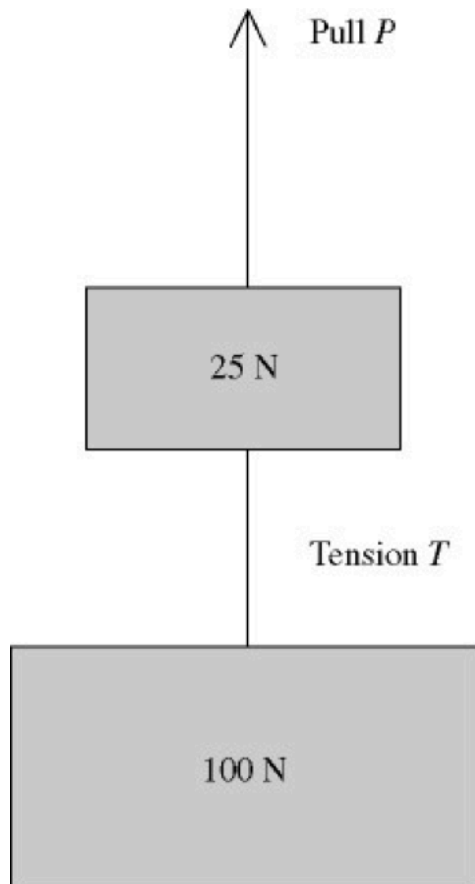


- (a) 810 N
- (b) 610 N
- (c) 50 N
- (d) 63 N
- (e) 83 N

(16) A Ferris wheel has seats for passengers located at a radius of 10.0 meters . The wheel makes one revolution in 8.0 seconds . What is the apparent weight (the normal force exerted on her by the seat) of a person with a mass of 50 kg as she passes through the highest point of her motion?

- (a) 490 N
- (b) 245 N
- (c) 97 N
- (d) 180 N
- (e) 980 N

(17) Two weights are connected by a massless wire and pulled upward with a constant speed of 1.50 m/s by a force P in the vertical direction. The tension in the wire between the two weights is T (see figure). The value of P is closest to:



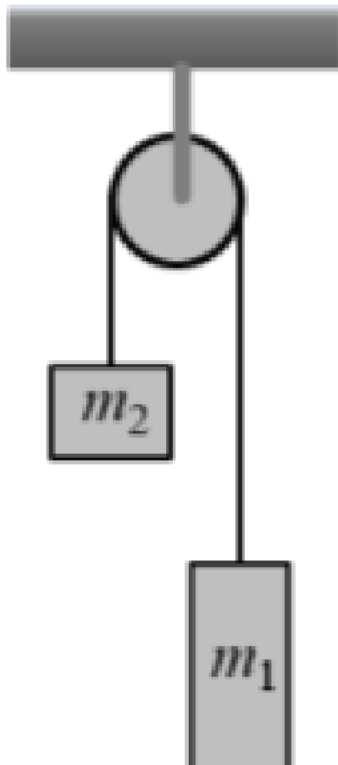
- (a) 19 N
- (b) 125 N
- (c) 98 N
- (d) 38 N
- (e) 150 N

(18) A 10.0 kg object is dropped from rest off a very tall cliff. As it falls, it experiences a drag force with a magnitude proportional to the square of its speed, $F_{\text{drag}} = Cv^2$ where the constant $C = 0.30 \text{ N s}^2/\text{m}^2$. What is the terminal speed of this object? (i.e. what is the maximum speed reached by the object)

- (a) 327 m/s
- (b) 98 m/s
- (c) 9.9 m/s
- (d) 14 m/s
- (e) 18 m/s

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(19) Two blocks are connected by a rope that passes over a pulley as shown. Assume the mass of the rope and friction from the pulley are negligible. What is the acceleration a of mass m_2 (where positive values of a correspond to mass 2 moving up)?



(a) $a = (m_1 - m_2)/(m_1 + m_2)$

(b) $a = (m_2 - m_1)/(m_1 + m_2)$

(c) $a = g$

(d) $a = g(m_1 - m_2)/(m_1 + m_2)$

(e) $a = g(m_2 - m_1)/(m_1 + m_2)$

(20) Two blocks are connected by a rope that passes over a pulley as shown above. Given that $m_1 = 10.0 \text{ kg}$ and $m_2 = 5.0 \text{ kg}$, what is the magnitude of the tension in the connecting rope? (Assume the rope mass and pulley friction are negligible.)

(a) 16 N

(b) 32 N

(c) 65 N

(d) 130 N

(e) 260 N

(21) Two forces act on an object. They are $\vec{F}_1 = 15\text{N} \hat{x}$ and $\vec{F}_2 = 20\text{N} \hat{x} + 10\text{N} \hat{y}$. What is the magnitude and direction of a third force $\vec{F}_3$ that could be applied to stop the object from accelerating?

(a) $F_3 = 16\text{N}$ at 38° counterclockwise from the $\hat{x}$ axis

(b) $F_3 = 16\text{N}$ at 218° counterclockwise from the $\hat{x}$ axis

(c) $F_3 = 18\text{N}$ at 34° counterclockwise from the $\hat{x}$ axis

(d) $F_3 = 16\text{N}$ at 214° counterclockwise from the $\hat{x}$ axis

(e) No such force can be found

(22) A 400 N horizontal force is needed to slide a 70.0 kg box across a surface at a constant velocity. What is the coefficient of kinetic friction between the box and the surface?

(a) 0.75

(b) 0.83

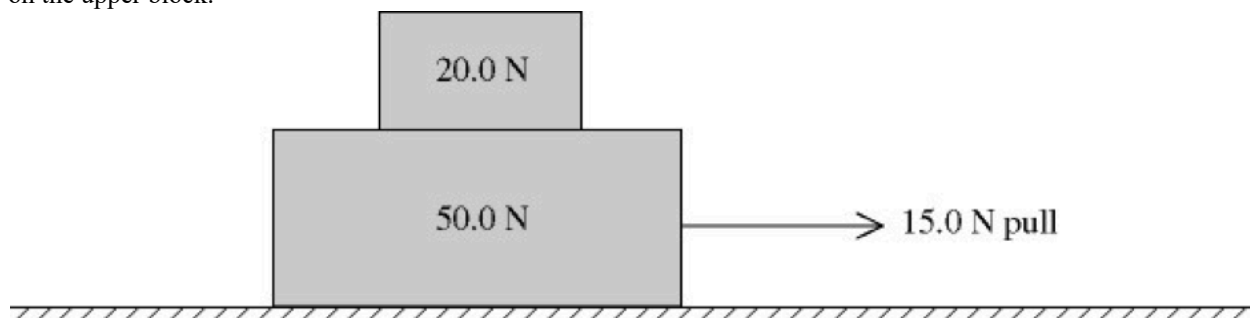
(c) 0.42

(d) 0.57

(e) 0.58

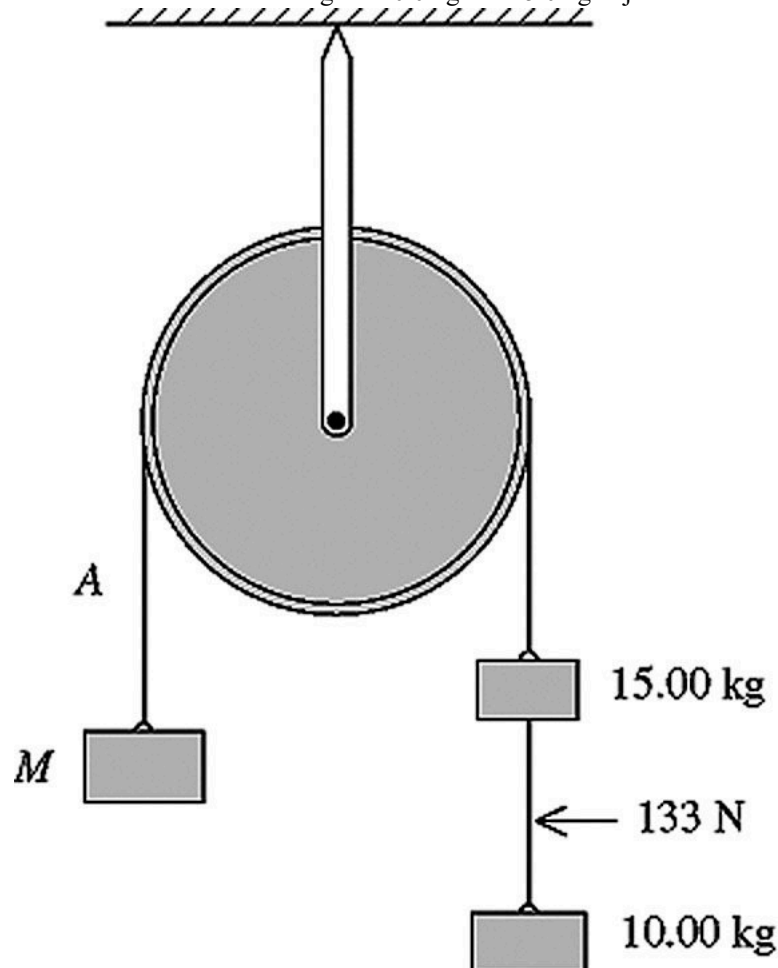
(23) A box with a weight of 20.0 N (mass = 2.04 kg) rests on a 50.0 N box on a frictionless horizontal floor. A horizontal force of 15.0 N pulls on the lower box towards the right (see figure). The boxes move together without slipping because of the static friction force between them. Find the magnitude and direction of the net external force on the system.

on the upper block.



- (a) 0.00 N
- (b) 20.0 N down
- (c) 15.0 N to the right
- (d) 2.10 N to the right
- (e) 4.28 N to the right

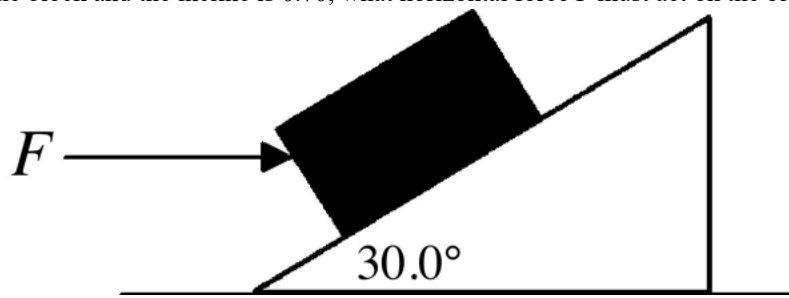
(24) Three objects are connected by massless wires over a massless frictionless pulley as shown in the figure. The tension in the wire connecting the 10.0 kg and 15.0 kg objects is measured to be 133 N. What is the mass M ?



- (a) 8.3 kg
- (b) 34 kg
- (c) 35 kg
- (d) 53 kg
- (e) 95 kg

(25) A 4.0 kg block rests on a 30° incline as shown in the figure. If the coefficient of static friction between

the block and the incline is 0.70, what horizontal force F must act on the block to start it moving up the incline?



- (a) 27 N
- (b) 55 N
- (c) 51 N
- (d) 84 N
- (e) 76 N