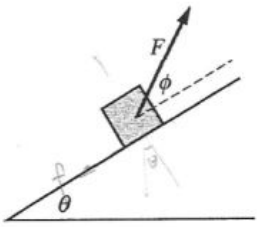
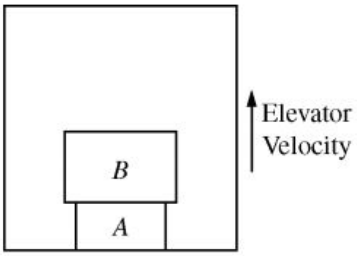


A box of mass m is on a rough inclined plane that is at an angle θ with the horizontal. A force of magnitude F at an angle ϕ with the plane is exerted on the block, as shown above. As the block moves up the plane, there is a frictional force between the box and the plane of magnitude f. What is the magnitude of the net force acting on the box?

(A) $F\sin\phi - mg\cos\theta - f$
(B) $F\cos(\phi+\theta) + mg\sin\theta - f$
(C) $F\cos\phi - mg\sin\theta - f$
(D) $F\cos(\phi+\theta) - mg\sin\theta - f$

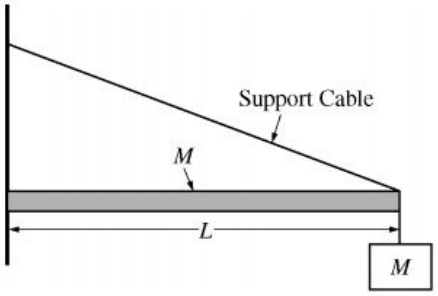
Block A and block B move toward each other on a level frictionless track. Block A has mass m and velocity $+v$. Block B has mass $2m$ and velocity $-v$. The blocks collide, and during the collision the magnitude of the net force exerted on block A is F. What is the magnitude of the net force exerted on block B, and why does it have that value?

(A) $2F$, because the mass of block B is twice that of block A and the blocks have the same acceleration during the collision.
(B) $F/2$, because the mass of block B is twice that of block A and the blocks have the same acceleration during the collision.
(C) F, because the blocks have the same speed immediately before the collision.
(D) F, because the net force is equal to the mutual contact force between the blocks.



Box A of mass m sits on the floor of an elevator, with box B of mass $2m$ on top of it, as shown in the figure above. The elevator is moving upward and slowing down. F_A is the magnitude of the force exerted on box A by box B, F_B is the magnitude of the force exerted on box B by box A, and F_g is the magnitude of the gravitational force exerted on box B. Which of the following ranks the forces in order of increasing magnitude?

(A) $F_B = F_A = F_g$
(B) $(F_B = F_A) < F_g$
(C) $F_B < (F_A = F_g)$
(D) $F_g < F_B < F_A$



The figure above shows a uniform beam of length L and mass M that hangs horizontally and is attached to a vertical wall. A block of mass M is suspended from the far end of the beam by a cable. A support cable runs from the wall to the outer edge of the beam. Both cables are of negligible mass. The wall exerts a force F_W on the left end of the beam. For which of the following actions is the magnitude of the vertical component of F_W smallest?

(A) Keeping the support cable and block as shown in the diagram
(B) Moving the lower end of the support cable to the center of the beam and leaving the block at the outer end of the beam
(C) Keeping the lower end of the support cable at the outer end of the beam and moving the block to the center of the beam
(D) Moving both the support cable and the block to the center of the beam

Side View

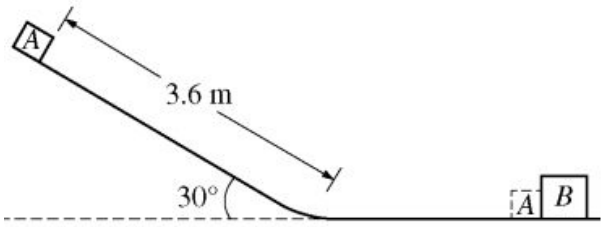
A ball attached to a light string swings in a counterclockwise vertical circle, as shown above. Which of the following arrows represent one of the forces exerted on the ball at the moment it passes through point P ? Select two answers.

(A)

(B)

(C)

(D)



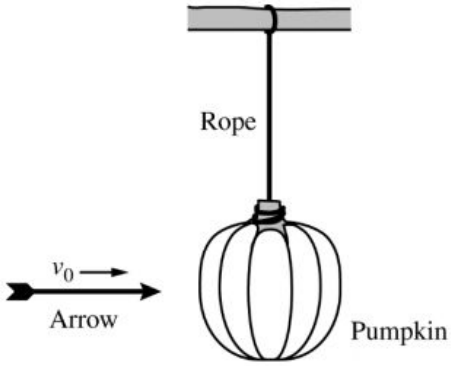
). Block A of mass 2.0 kg is released from rest at the top of a 3.6 m long plane inclined at an angle of 30°, as shown in the figure above. After sliding on the horizontal surface, block A hits and sticks to block B, which is at rest and has mass 3.0 kg. Assume friction is negligible. The speed of the blocks after the collision is most nearly

(A) 2.4 m/s
(B) 3.2 m/s
(C) 3.8 m/s
(D) 6.0 m/s

FR:

An archer tests various arrowheads by shooting arrows at a pumpkin that is suspended from a tree branch by a rope, as shown to the right. When struck head-on by the arrow, the pumpkin swings upward on the rope. The maximum angle θ that the rope makes with the vertical is different for each arrowhead that the archer tests. Each arrow, including its arrowhead, has the same mass m and is shot with the same velocity v_0 toward the right.

The arrowheads are made of different materials, however, and each behaves differently when it strikes the pumpkin, as described below.



- *Embedded arrow*: Strikes the pumpkin and remains embedded, while the pumpkin swings to angle θ_{emb}.
- *Pass arrow*: Passes all the way through the pumpkin and continues traveling away from the archer, while the pumpkin swings to angle θ_{pass}.
- *Bounce arrow*: Bounces off the pumpkin back toward the archer, while the pumpkin swings to angle θ_{bounce}.

(a) Rank the three angles θ_{emb}, θ_{pass}, and θ_{bounce} from greatest to least in the spaces indicated below. Use "1" for the greatest angle, "2" for the next greatest, and so on. If any two or all three angles are the same, use the same number for their ranking.

____ θ_{emb} ____ θ_{pass} ____ θ_{bounce}

(b) In a clear, coherent, paragraph-length response that may also contain figures and/or equations, justify your ranking.