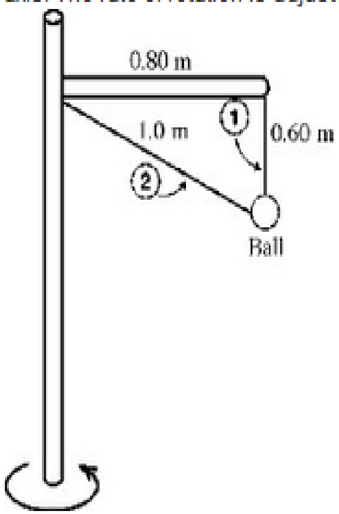
Test 4

Corrected

A ball of mass 5.0 kg is suspended by two wires from a horizontal arm that is attached to a vertical shaft, as shown in the figure. The shaft is in uniform rotation about its axis. The rate of rotation is adjusted until the tensions in the two wires are EQUAL. At that speed, the radial acceleration of the ball is closest to



- 5.9 m/s^2.
- 6.9 m/s^2.
- 7.9 m/s^2.
- 9.9 m/s^2.
- 4.9 m/s^2.

Item 1

From the y-coordinate, we get $T_1 + T_{2,y} - mg = 0$

and from the x-coordinate we get

$T_{2,y} - ma_{rad} = 0$

With $T_1 = T_2$ and $T_{2,y} = 0.6T_2$ and $T_{2,x} = 0.8T_2$, we get

$$T_2 + 0.6T_2 = mg$$

$$0.8T_2 = ma_{rad}$$

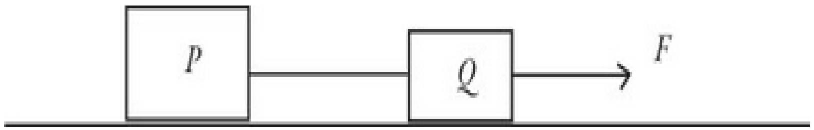
$$\frac{1.6\cancel{T_2}}{0.8\cancel{T_2}} = \frac{\cancel{m}g}{\cancel{m}a_{rad}}$$

$$2.0 = \frac{g}{a_{rad}}$$

$$a_{rad} = \frac{2}{g}$$

a_{rad} = 4.9 m/s^2.

Two bodies P and Q on a smooth horizontal surface are connected by a light cord. The mass of P is greater than that of Q. A horizontal force $\vec{F}$ (of magnitude F) is applied to Q as shown in the figure, accelerating the bodies to the right. The magnitude of the force exerted by the connecting cord on body P will be



- greater than F.
- less than F but not zero.
- zero.
- equal to F.

Item 2

Let the mass of P = M

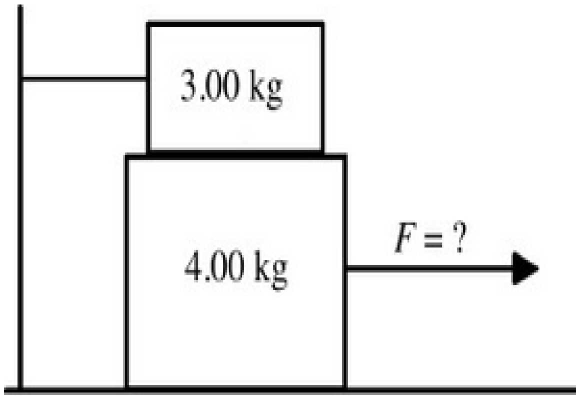
and mass of Q = m

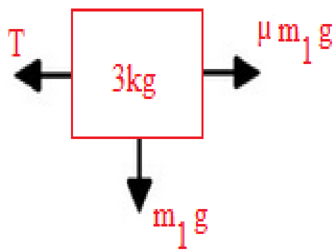
Thus F = (m+M)*a

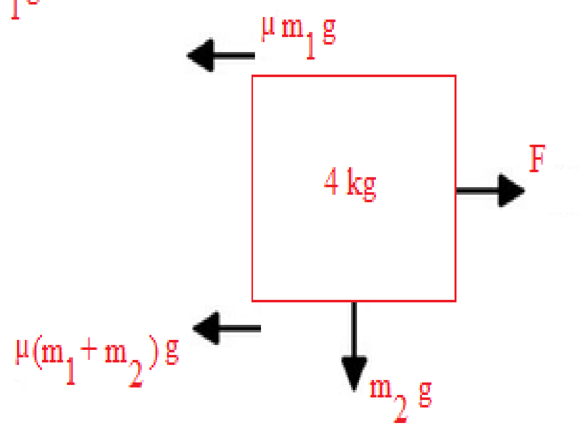
Thus a = F/(m + M)

Thus Force on block F_P = MF/(M+m) < F

A 4.00-kg block rests between the floor and a 3.00-kg block as shown in the figure. The 3.00-kg block is tied to a wall by a horizontal rope. If the coefficient of static friction is 0.800 between each pair of surfaces in contact, what horizontal force F must be applied to the 4.00-kg block to make it move?







Item 3

- 54.9 N
- 78.4 N
- 23.5 N
- 21.1 N
- 16.2 N

$T = \mu m_1 g$

$F = \mu m_1 g + \mu(m_1 + m_2) g$

$F = (0.8 \times 3 \times 9.8) + (0.8 \times [3 + 4] \times 9.8)$

$F = 78.4\ N$

A car travels at a steady 40.0 m/s around a horizontal curve of radius 200 m. What is the minimum coefficient of static friction between the road and the car's tires that will allow the car to travel at this speed without sliding?

Item 4

- 0.952
- 0.816
- 1.23
- 0.736
- 0.662

Given:	Find:
speed of car v =40 m/s Radius r = 200 m	coefficient of friction μ

for the car not to slide,

Frictional Force f should be equal to the centripetal force, we have,

$f = mv^2/r$

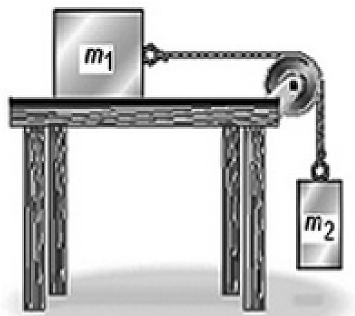
$\mu mg = mv^2/r$

$\mu = v^2/rg$

$= (40^2)/(200 \times 9.8)$

$= \boxed{0.816}$

Two objects having masses $m1$ and $m2$ are connected to each other as shown in the figure and are released from rest. There is no friction on the table surface or in the pulley. The masses of the pulley and the string connecting the objects are completely negligible. What must be true about the tension T in the string just after the objects are released?

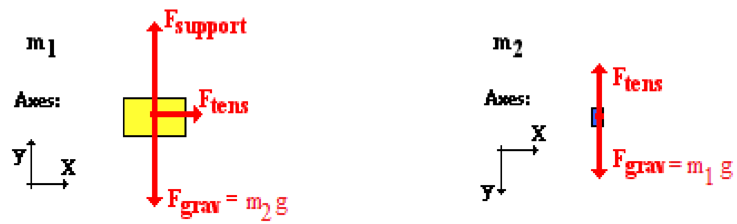


Item 5

- $T = m_2 g$
- $T < m_2 g$
- $T = m_1 g$
- $T > m_1 g$
- $\boxed{T > m_2 g}$

Since there is nothing pushing m_1 to the left, we would reason that it would accelerate to the right due to the pull of the string. The *hanging mass* (m_2) will clearly accelerate downward under the influence of gravity.

Free-Body Diagrams for m_1 and m_2



$$F_{tens} = m_2 a$$

$$(m_1 g) - F_{tens} = m_1 a$$

$$(m_1 g) - (m_2 a) = m_1 a$$

$$(m_1 g) = (m_1 a) + (m_2 a)$$

$$(m_1 g) = a(m_1 + m_2)$$

$$\frac{(m_1 g)}{(m_1 + m_2)} = a$$

$$F_{tens} = m_2 a = m_2 \frac{(m_1 g)}{(m_1 + m_2)}$$

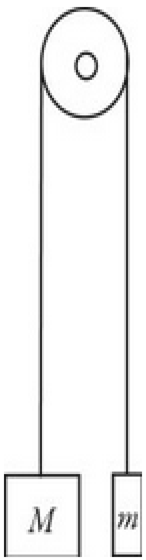
Consider what happens when you jump up in the air. Which of the following is the most accurate statement?

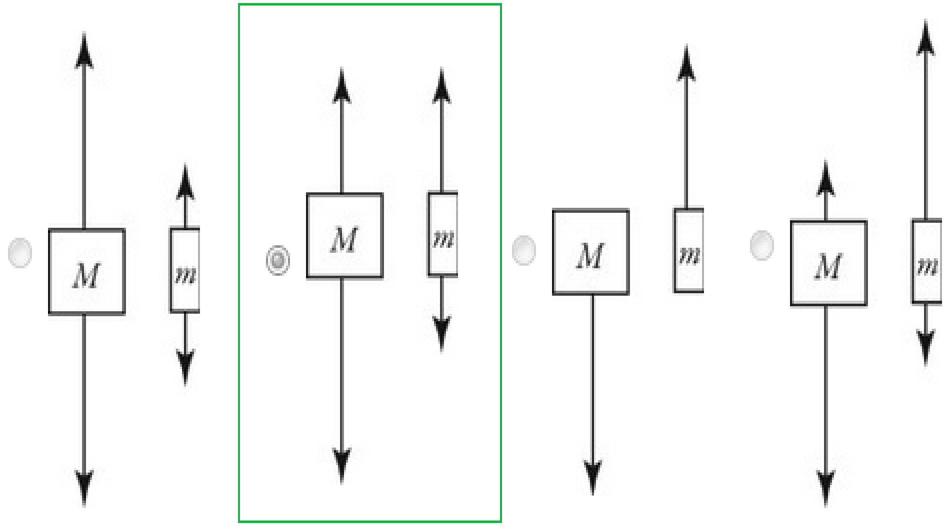
- When you jump up the earth exerts a force F_1 on you and you exert a force F_2 on the earth. You go up because $F_1 > F_2$.
- Since the ground is stationary, it cannot exert the upward force necessary to propel you into the air. Instead, it is the internal forces of your muscles acting on your body itself that propels your body into the air.
- It is the upward force exerted by the ground that pushes you up, but this force cannot exceed your weight.
- When you push down on the earth with a force greater than your weight, the earth will push back with the same magnitude force and thus propel you into the air.
- You are able to spring up because the earth exerts a force upward on you that is greater than the downward force you exert on the earth.

Item 6

This is action - Reaction pair at work here.

Two unequal masses M and m ($M > m$) are connected by a light cord passing over a pulley of negligible mass, as shown in the figure. When released, the system accelerates. Friction is negligible. Which figure below gives the correct free-body force diagrams for the two masses in the moving system?





Atwood machine is tricky.

Item 7

A 600-kg car is going around a banked curve with a radius of 110 m at a speed of 27.5 m/s. What is the appropriate banking angle so that the car stays on its path without the assistance of friction?

- 13.5°
- 33.8°
- 56.2°
- 60.9°
- 35.0°

Item 8

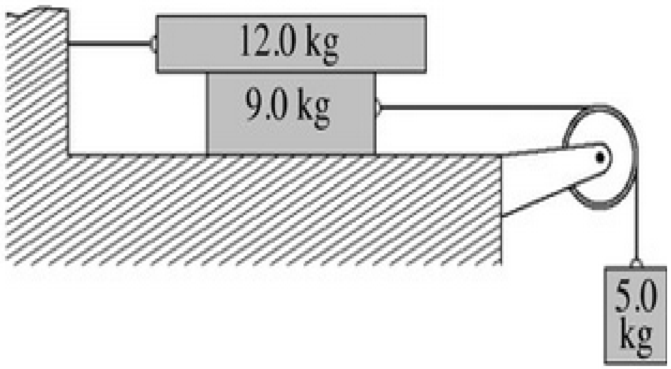
Given:	Find:	Formulae:
$R = 110$ m $v = 27.5$ m/s	θ	$v^2 = R \cdot g \cdot \tan(\theta)$

$$\tan(\theta) = 27.5^2 / (110(9.8))$$

$$\tan(\theta) = 0.701$$

$$\theta = \tan^{-1}(0.701) = 35.03°$$

A system comprised blocks, a light frictionless pulley, and connecting ropes is shown in the figure. The 9.0-kg block is on a perfectly smooth horizontal table. The surfaces of the 12-kg block are rough, with mu_k = 0.30 between the block and the table. If the 5.0-kg block accelerates downward when it is released, find its acceleration.



The normal force on the 9kg block due to 12 kg block = 12 kg * 9.8 m/s^2 = 117.6 N

The friction force acting on the 9 kg block towards the left=117.6 N * 0.3 =35.28N

Balancing forces,

$$(5.0\,\text{kg} * 9.8\,\text{m/s}^2) - 35.28\,\text{N} = (9.0\,\text{kg} + 5.0\,\text{kg}) * a$$

$$\frac{(5.0\,\text{kg} * 9.8\,\text{m/s}^2) - 35.28\,\text{N}}{(9.0\,\text{kg} + 5.0\,\text{kg})} = a = 0.98\,\text{m/s}^2$$

Item 9

- 1.8 m/s^2
- 1.0 m/s^2
- 1.6 m/s^2
- 1.4 m/s^2
- 1.2 m/s^2

On a horizontal frictionless floor, a worker of weight 0.900 kN pushes horizontally with a force of 0.200 kN on a box weighing 1.80 kN. As a result of this push, which statement could be true?

- The worker will accelerate at 1.08 m/s^2 and the box will accelerate at 2.17 m/s^2, but in opposite directions.
- The worker and box will both have an acceleration of 1.08 m/s^2, but in opposite directions.
- The worker and box will both have an acceleration of 2.17 m/s^2, but in opposite directions.
- The box will not move because the push is less than its weight.
- The worker will accelerate at 2.17 m/s^2 and the box will accelerate at 1.08 m/s^2, but in opposite directions.

Item 10

worker of weight 0.900 kN ; so worker's mass = (900 / 9.8) = 91.837 kg

force of 0.200 kN exerted by worker on box, = 200 N

box weighing 1.80 kN ; so mass of box = (1800 / 9.8) = 183.673 kg

$F = m * a$

$200\text{ N} = 91.837\text{ kg} * a$

$$\frac{200\text{ N}}{91.837\text{ kg}} = a = 2.178\text{ m/s}^2$$ Worker accelerated

$200\text{ N} = 183.673\text{ kg} * a$

$$\frac{200\text{ N}}{183.673\text{ kg}} = a = 1.089\text{ m/s}^2$$ Box accelerated