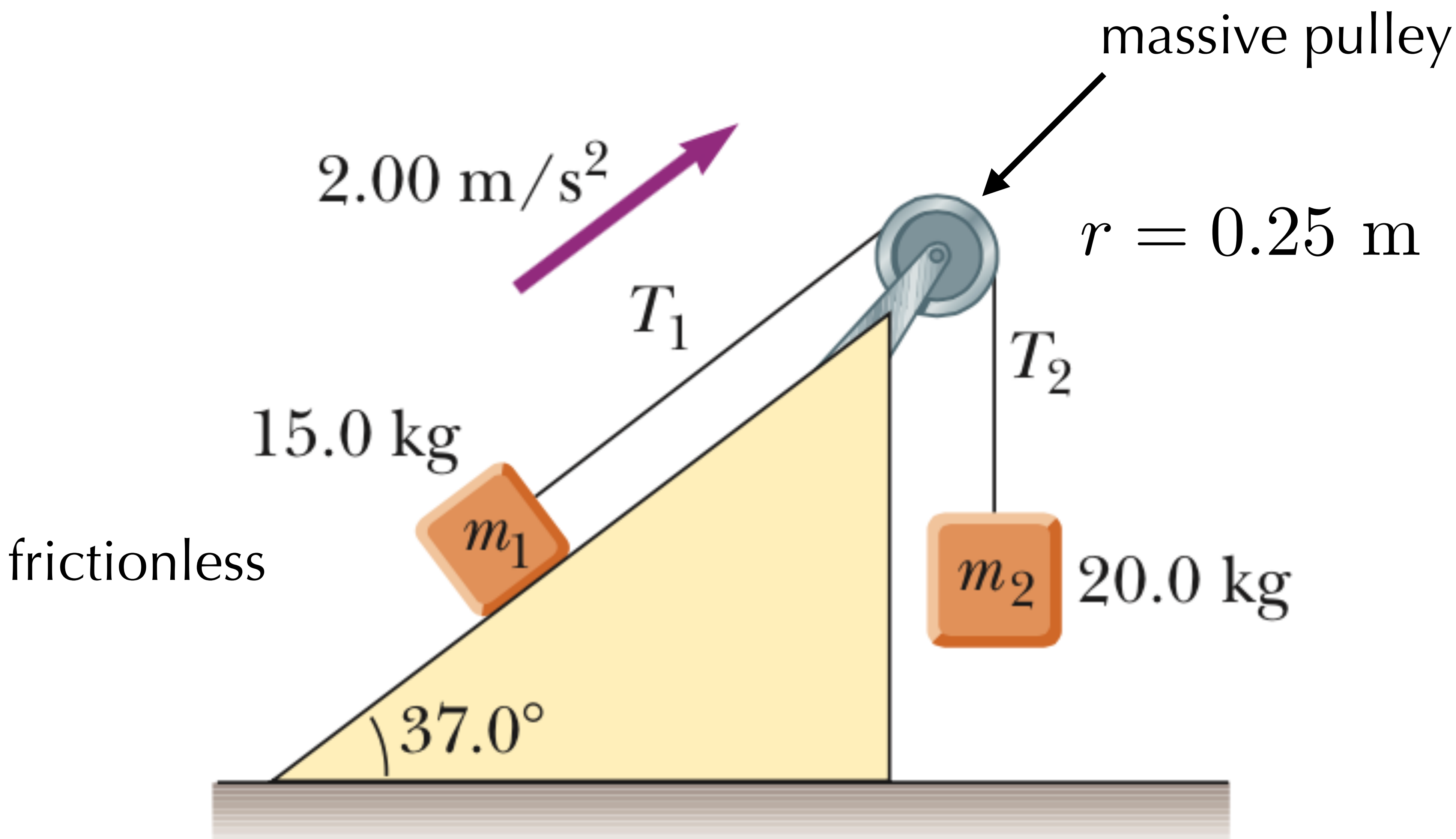
How is this problem different from a chapter 7 problem?

Find T_1, T_2, I(the moment of inertia of the pulley)



How is this problem different from a chapter 7 problem?

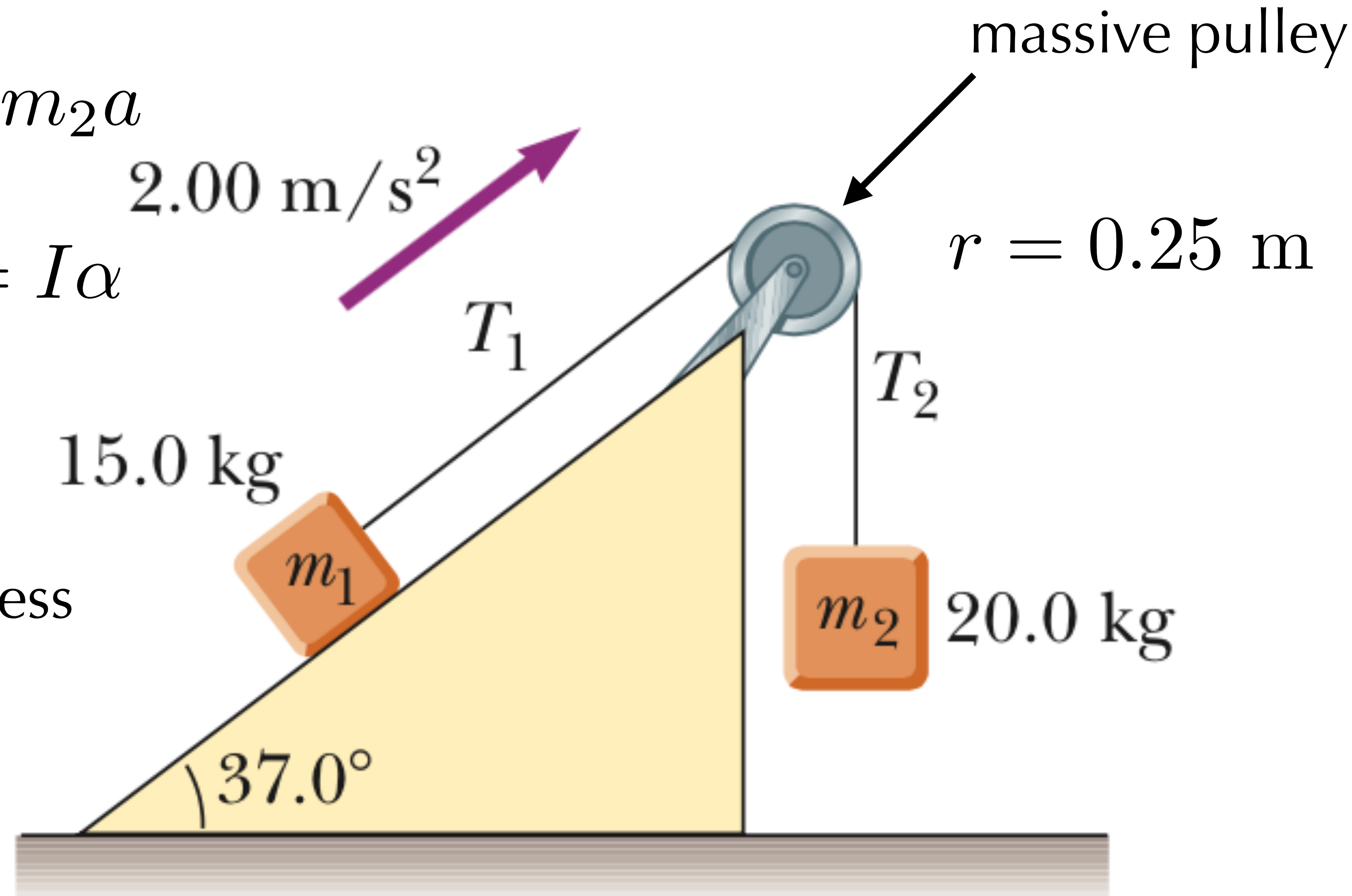
Find T_1, T_2, I(the moment of inertia of the pulley)

$$T_1 - m_1 g \sin\theta = m_1 a$$

$$m_2 g - T_2 = m_2 a$$

$$T_2 R - T_1 R = I\alpha$$

frictionless



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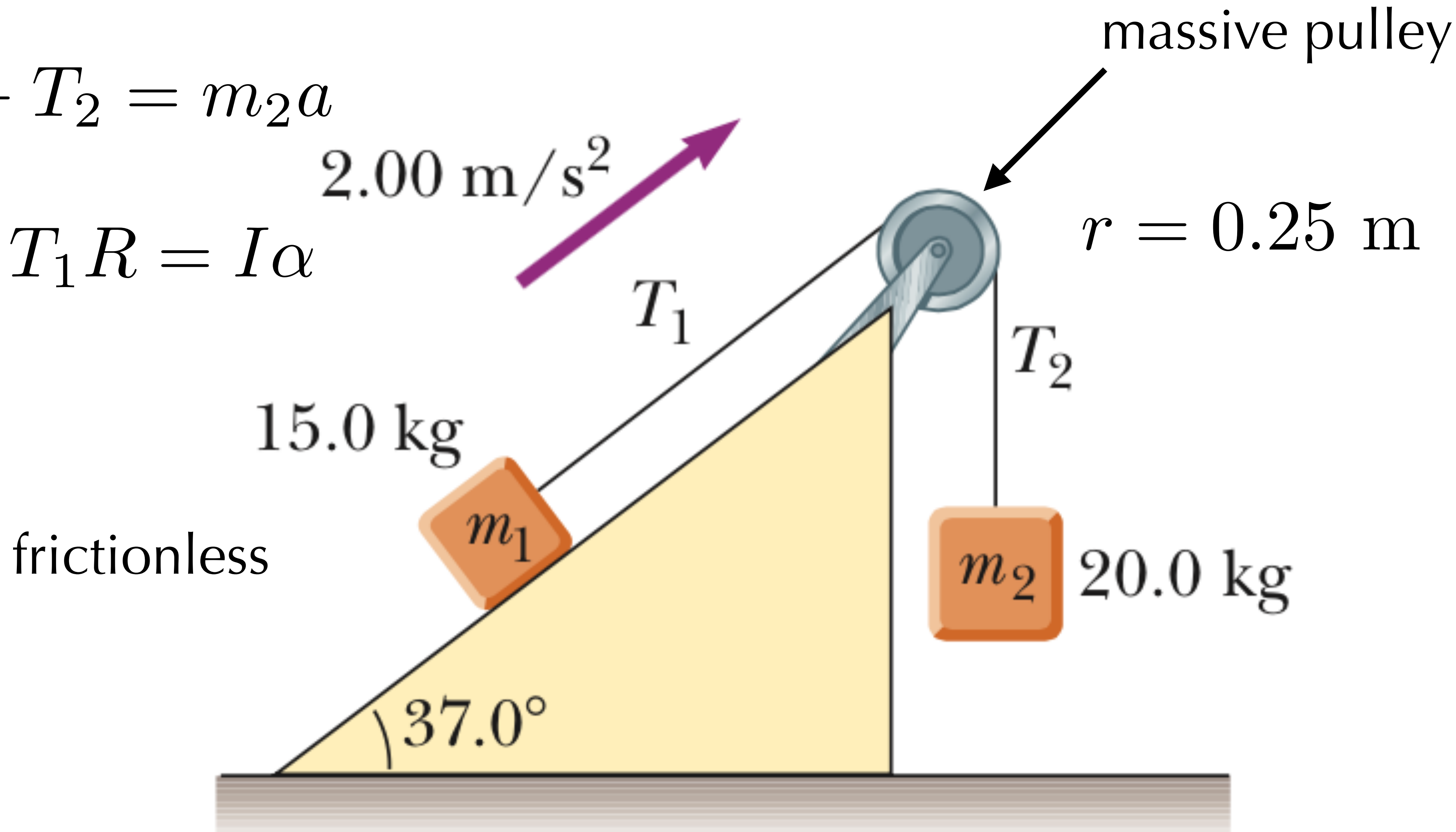


$$I = 1.17 \text{ kg m}^2$$

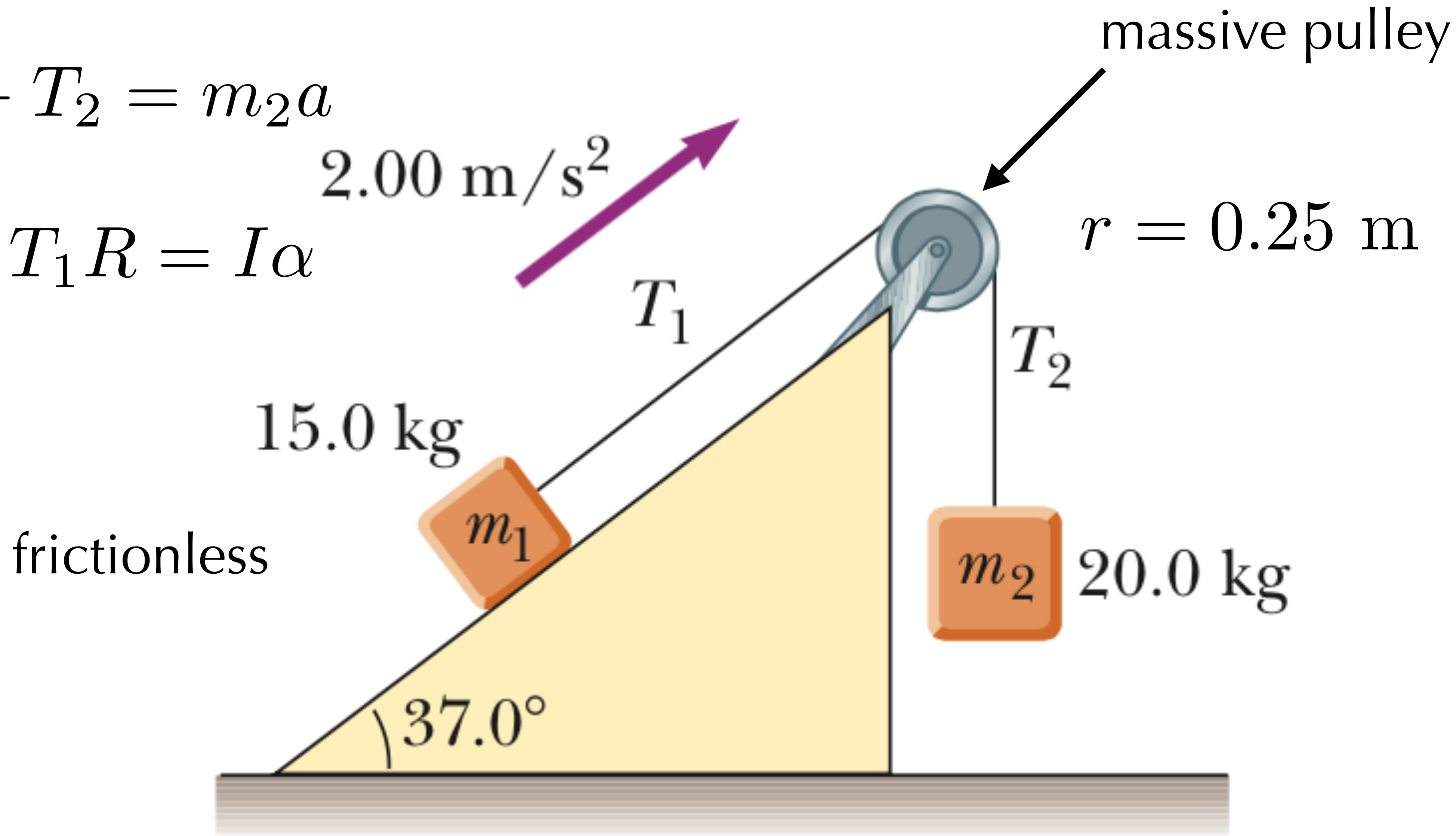
How is this problem different from a chapter 7 problem?

Find T_1, T_2, I(the moment of inertia of the pulley)

$$T_1 - m_1 g \sin\theta = m_1 a$$

$$m_2 g - T_2 = m_2 a$$

$$T_2 R - T_1 R = I\alpha$$



$$T_1 = 118\ \mathrm{N}$$

$$I = 1.17\ \mathrm{kg\ m^2}$$

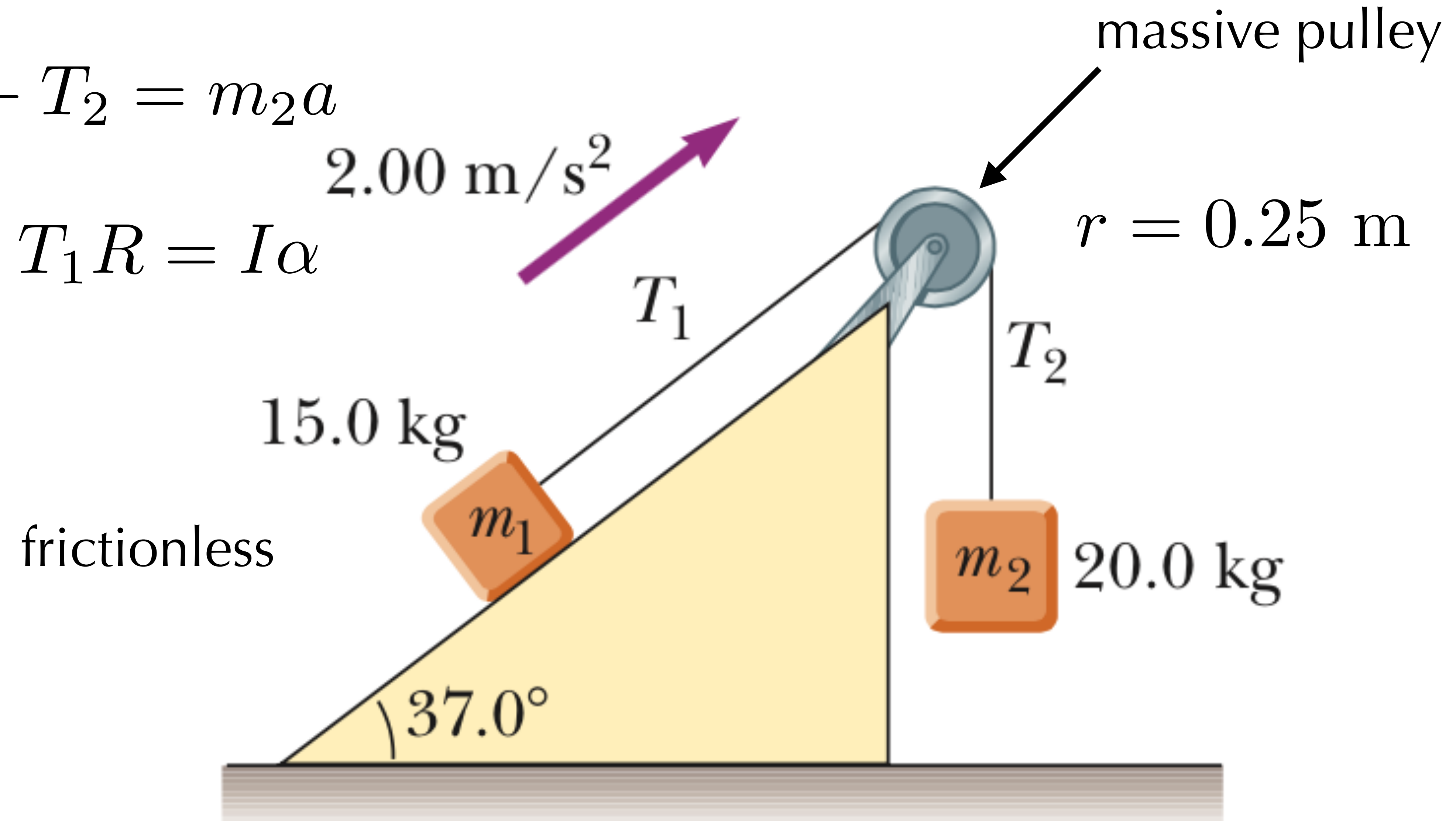
How is this problem different from a chapter 7 problem?

Find T_1, T_2, I(the moment of inertia of the pulley)

$$T_1 - m_1 g \sin\theta = m_1 a$$

$$m_2 g - T_2 = m_2 a$$

$$T_2 R - T_1 R = I\alpha$$

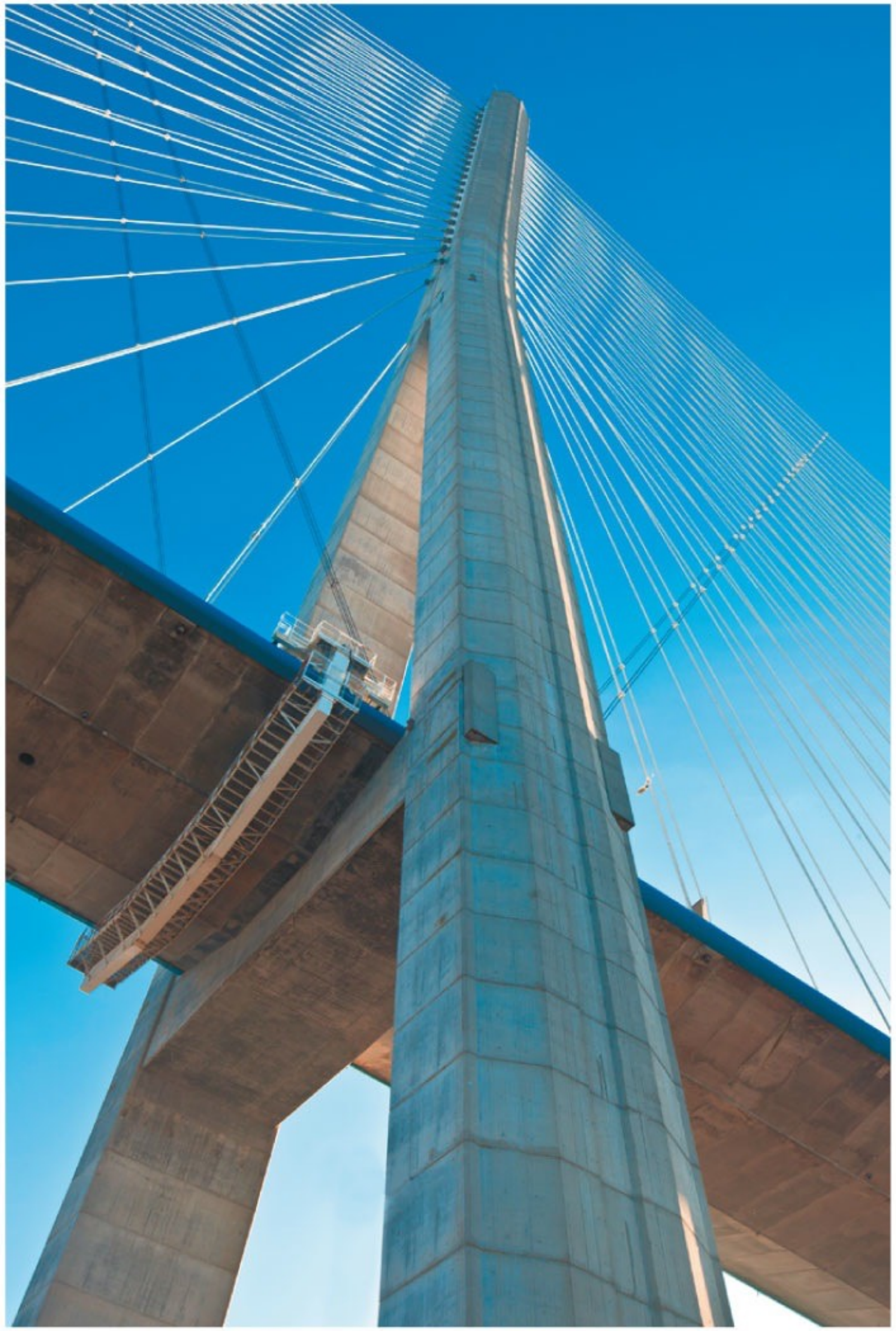


$T_1 = 118$ N $\quad T_2 = 156$ N $\qquad I = 1.17 \text{ kg m}^2$

Static Equilibrium

- A rigid body is in *static equilibrium* if there is **no net force** and **no net torque.**
- An important branch of engineering called *statics* analyzes buildings, dams, bridges, and other structures in total static equilibrium.
- **For a rigid body in total equilibrium, there is no net torque about any point.**

$$\sum F_x = 0 \quad \sum F_y = 0 \quad \sum \tau = 0$$



Question #20

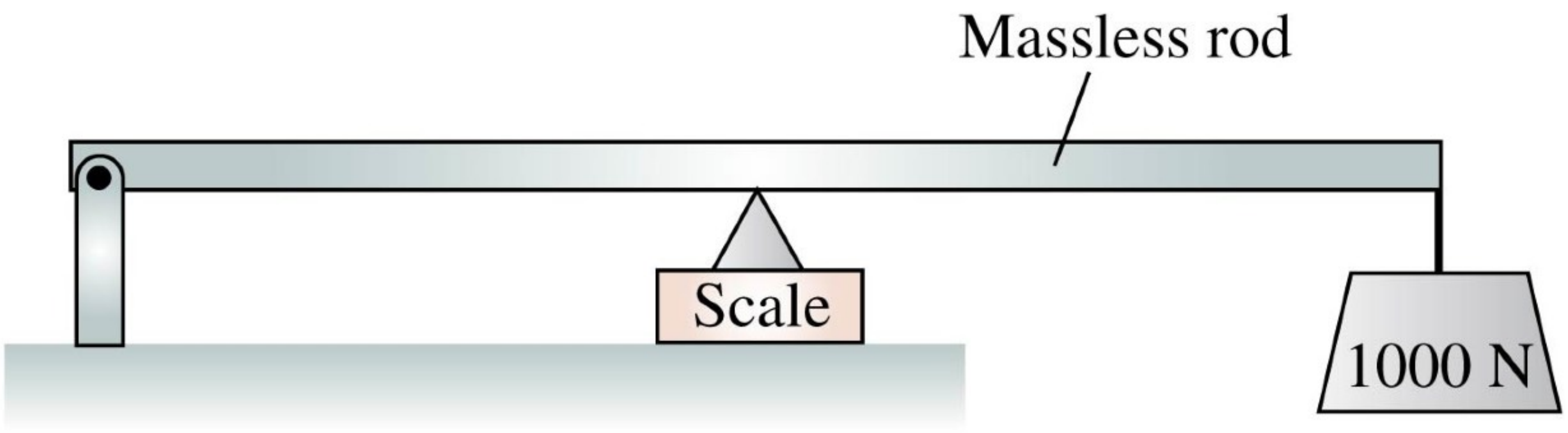
Which object is in static equilibrium?

A B C D

Question #21

What does the scale read?

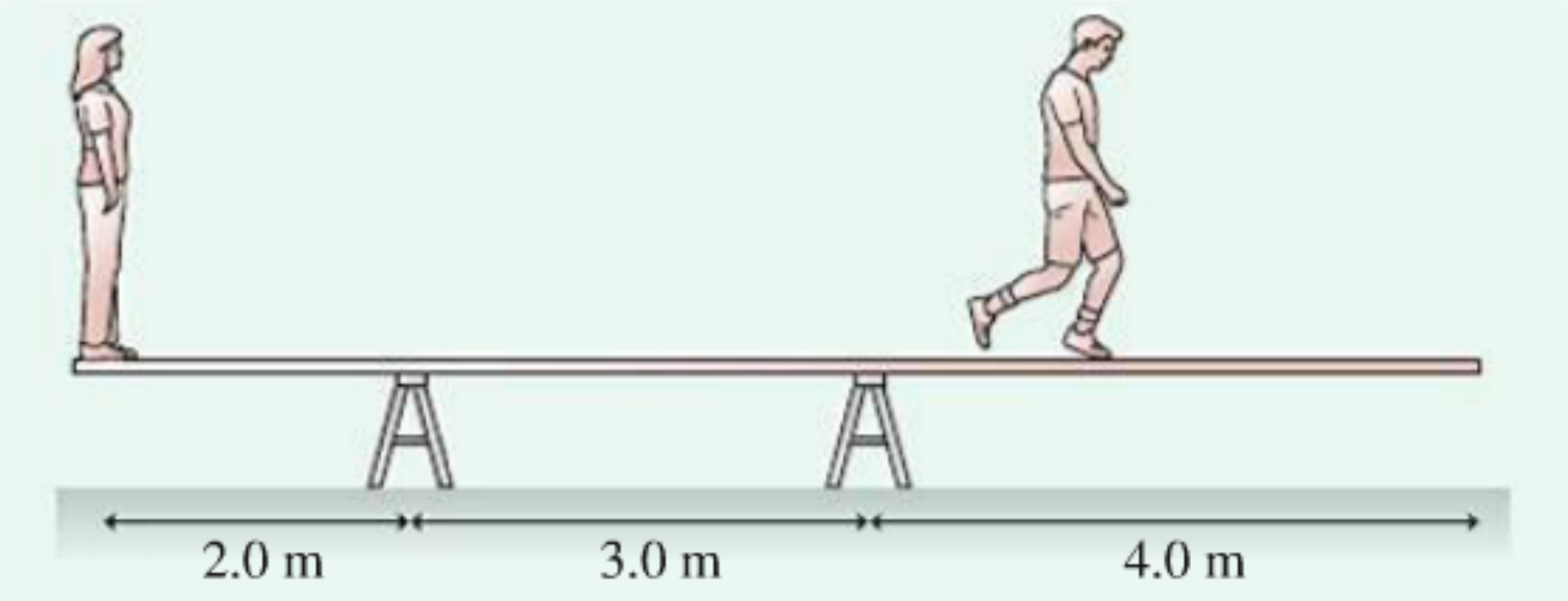
a. 2000 N
b. 1000 N
c. 500 N
d. 4000 N



Answering this requires reasoning not calculating.

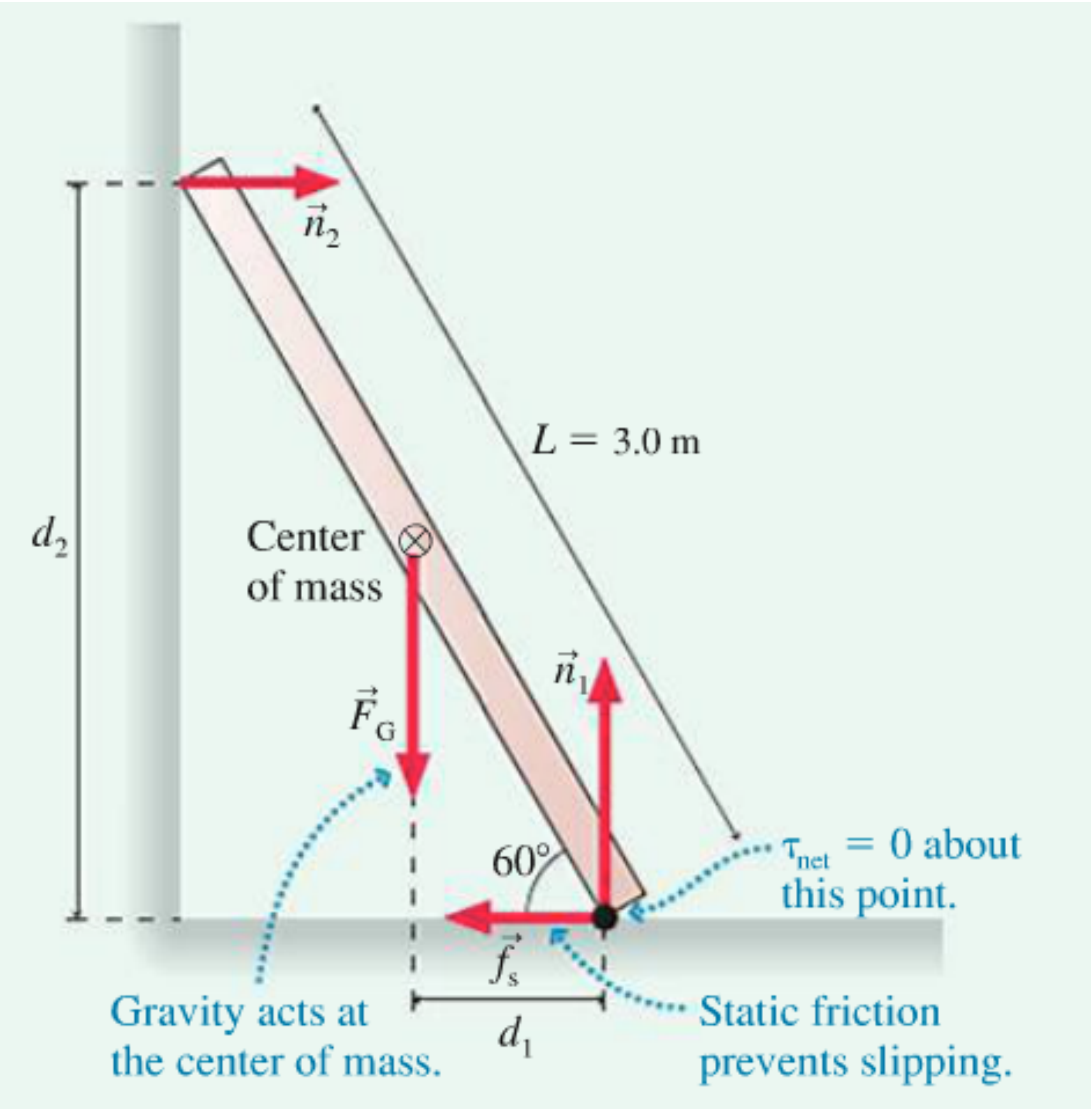
Example Problem

Adrienne (50 kg) and Bo (90 kg) are playing on a 100 kg rigid plank resting on two supports. If Adrienne stands on the left end, can Bo walk all the way to the right end without the plank tipping over? If not, how far can he get past the support on the right?

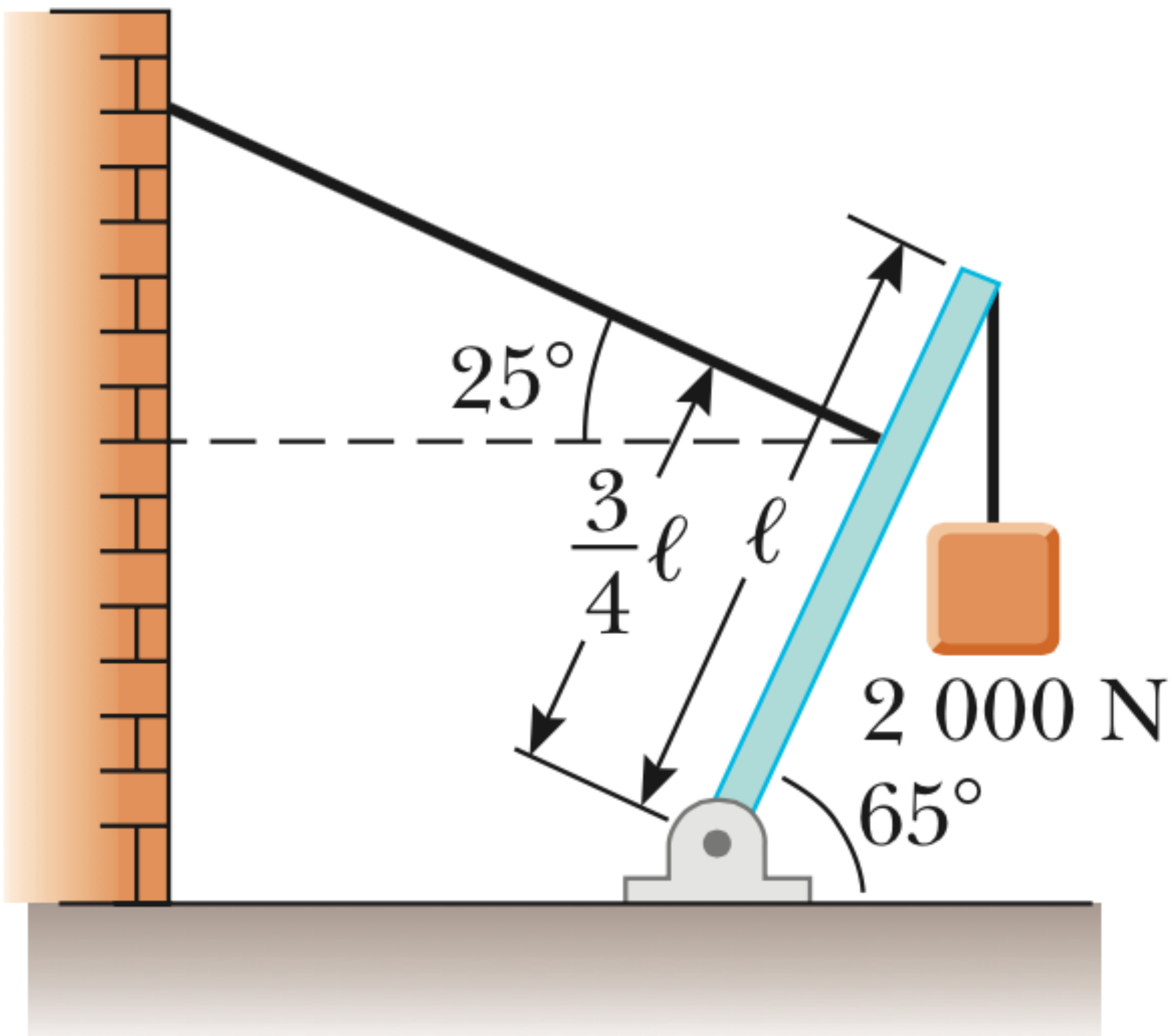


Another one

A 3.0-m-long ladder leans up against a frictionless wall at an angle of 60 degrees. What is the minimum value of the coefficient of static friction with the ground that prevents the ladder from slipping?

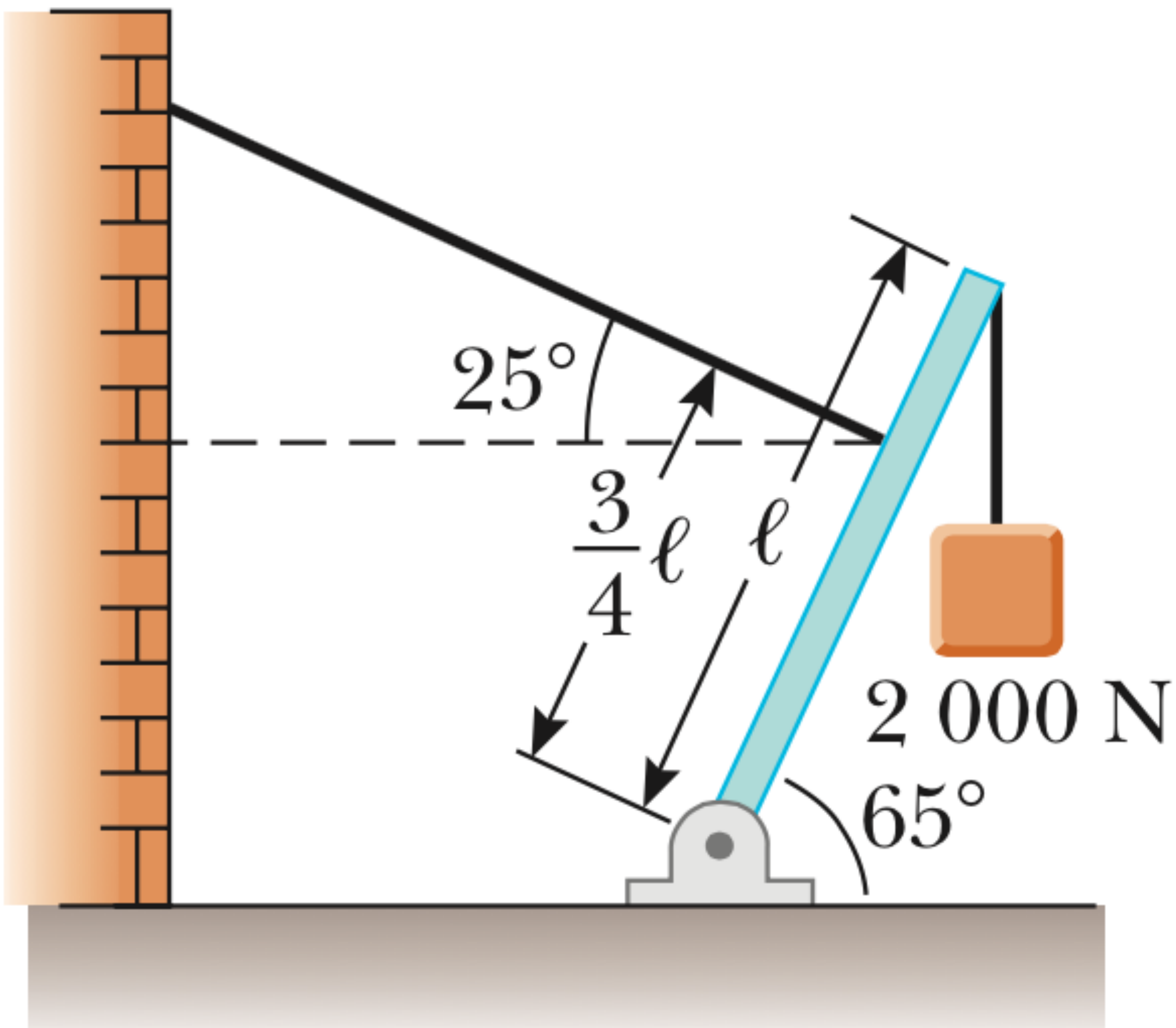


A 1200-N uniform beam is supported by a cable. Find the tension in the cable and the force of the floor on the beam at the hinge point.



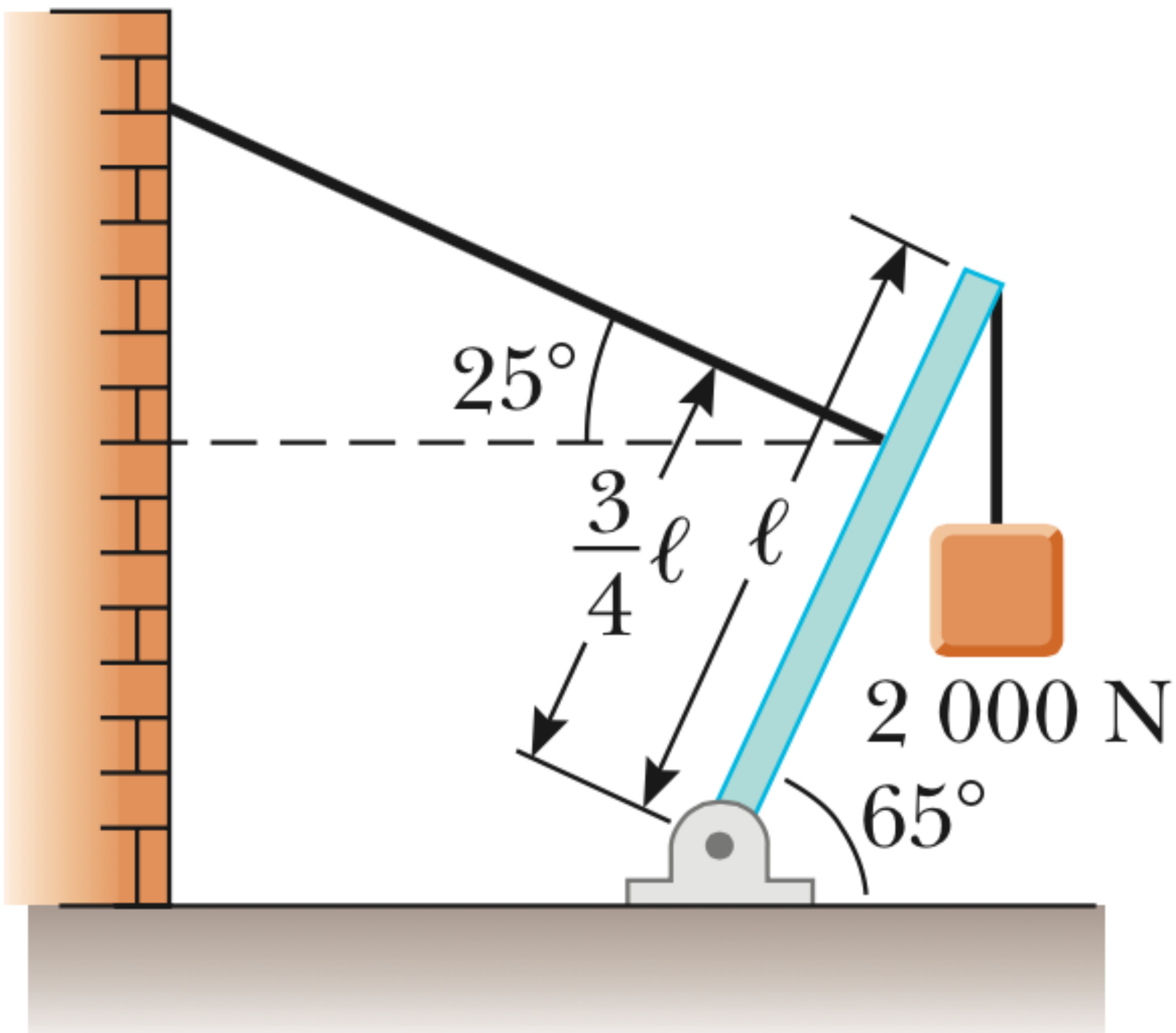
A 1200-N uniform beam is supported by a cable. Find the tension in the cable and the force of the floor on the beam at the hinge point.

$T = 1.46\ \text{kN}$ $N_x = 1.33\ \text{kN}$ $N_y = 2.58\ \text{kN}$

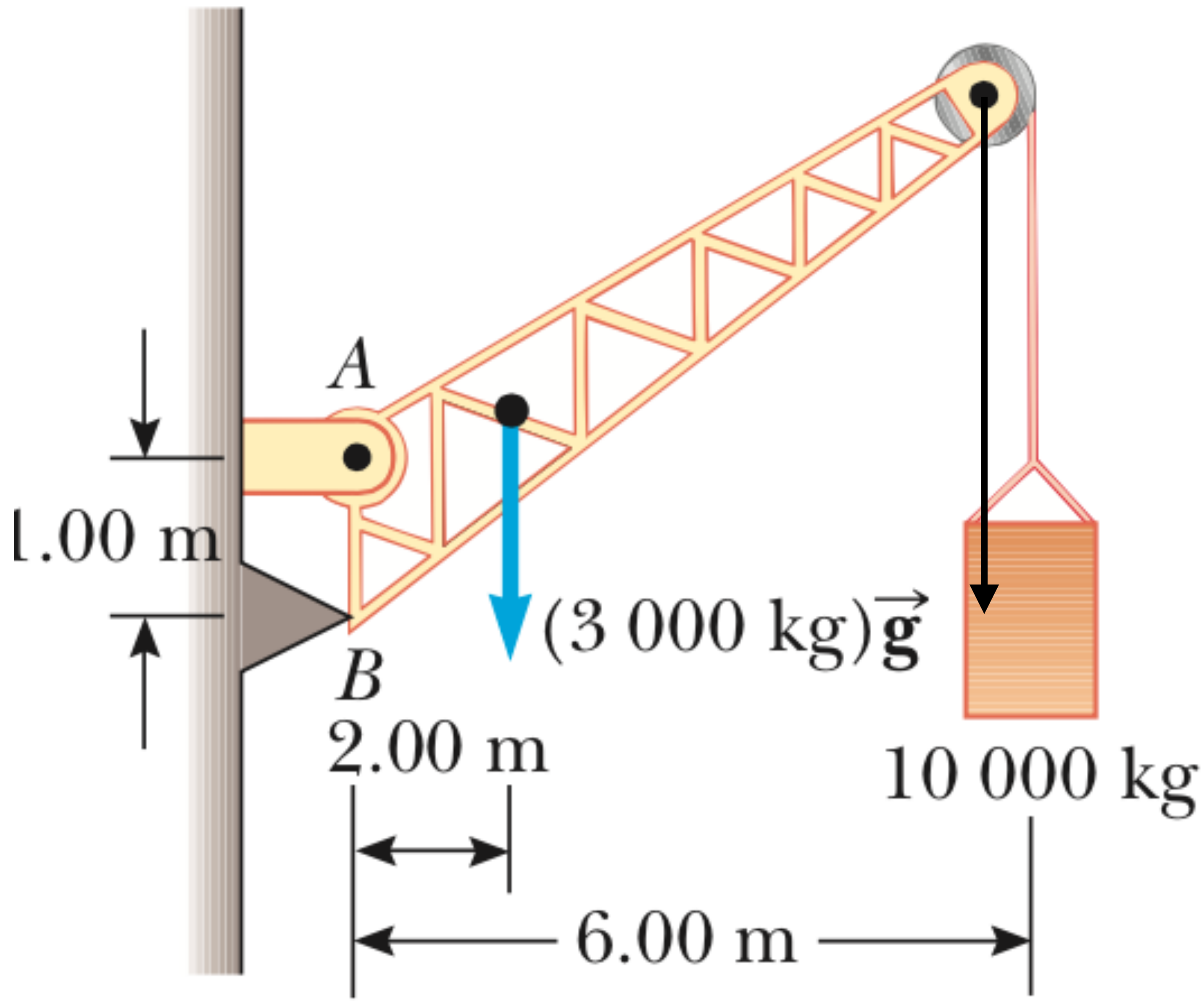


A 1200-N uniform beam is supported by a cable. Find the tension in the cable and the force of the floor on the beam at the hinge point.

$T = 1.46$ kN $\qquad N_x = 1.33$ kN $\qquad N_y = 2.58$ kN

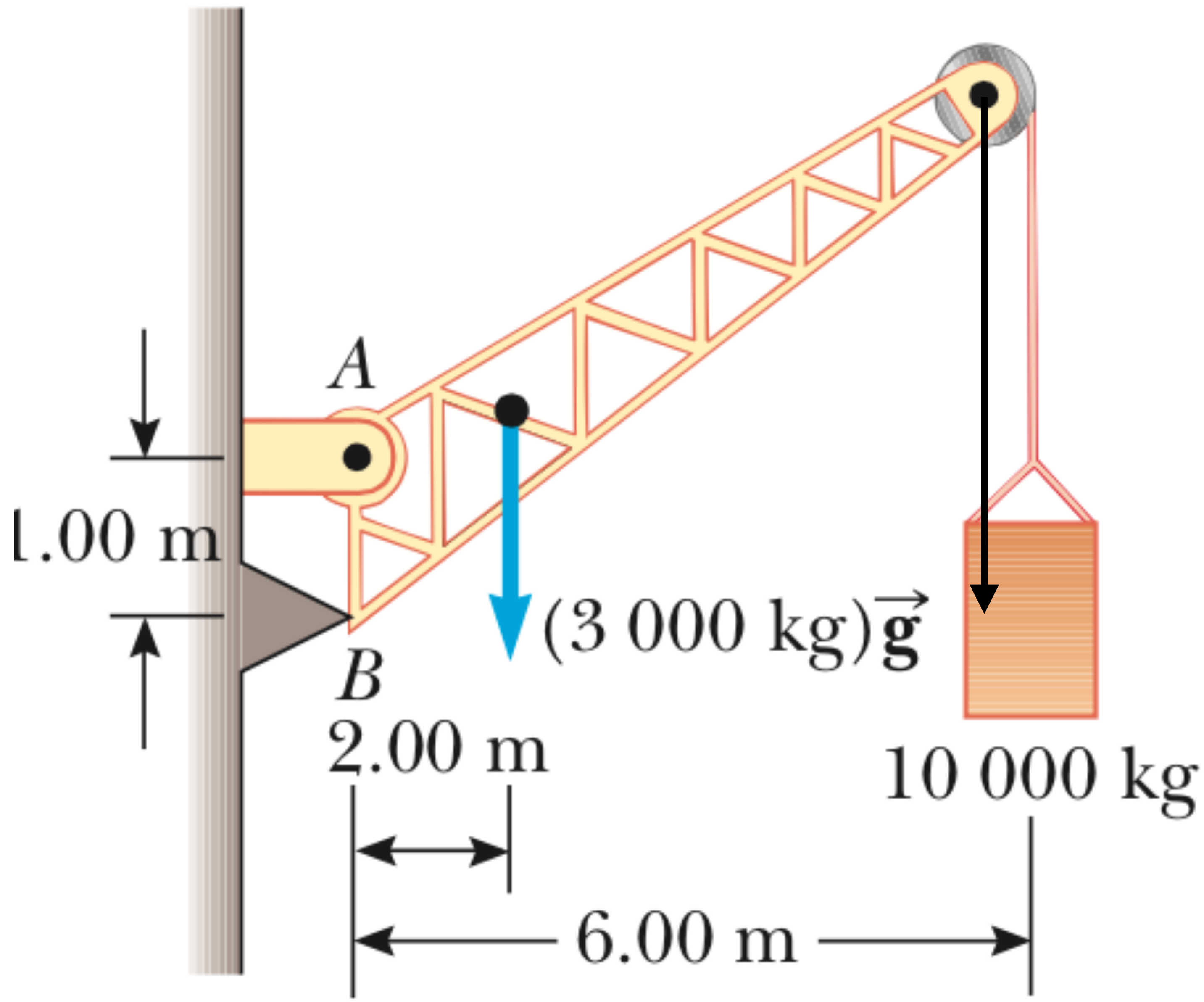


Find the forces exerted on the beam at points A and B



Find the forces exerted on the beam at points A and B

$$B = 6.47 \times 10^5 \text{ N} \quad A_x = -6.47 \times 10^5 \text{ N} \quad A_y = 1.27 \times 10^5 \text{ N}$$



Torque/Rotational Dynamics

12.28 12.65

12.72 $\boxed{12.24}$ ← Simple

12.66

Static Equilibrium

12.29

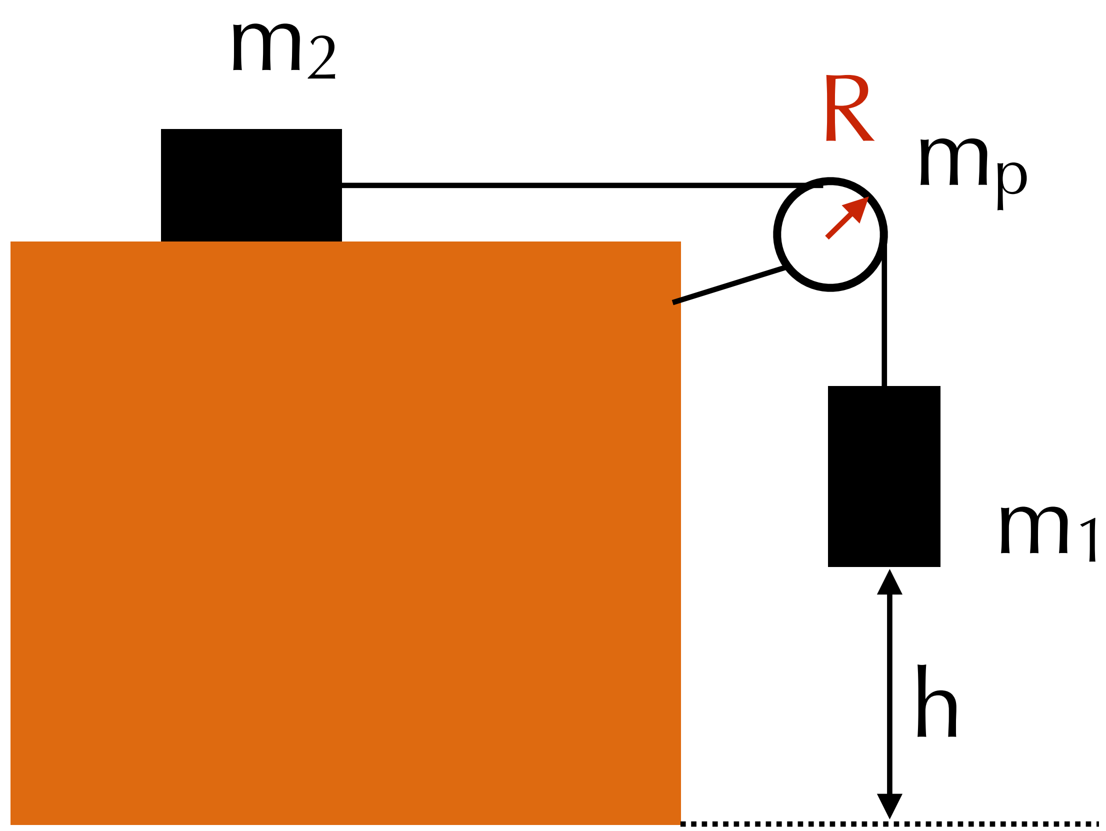
12.30

12.58

12.59

Rotational Kinetic Energy

How fast are the block moving just before m_1 hits the ground?

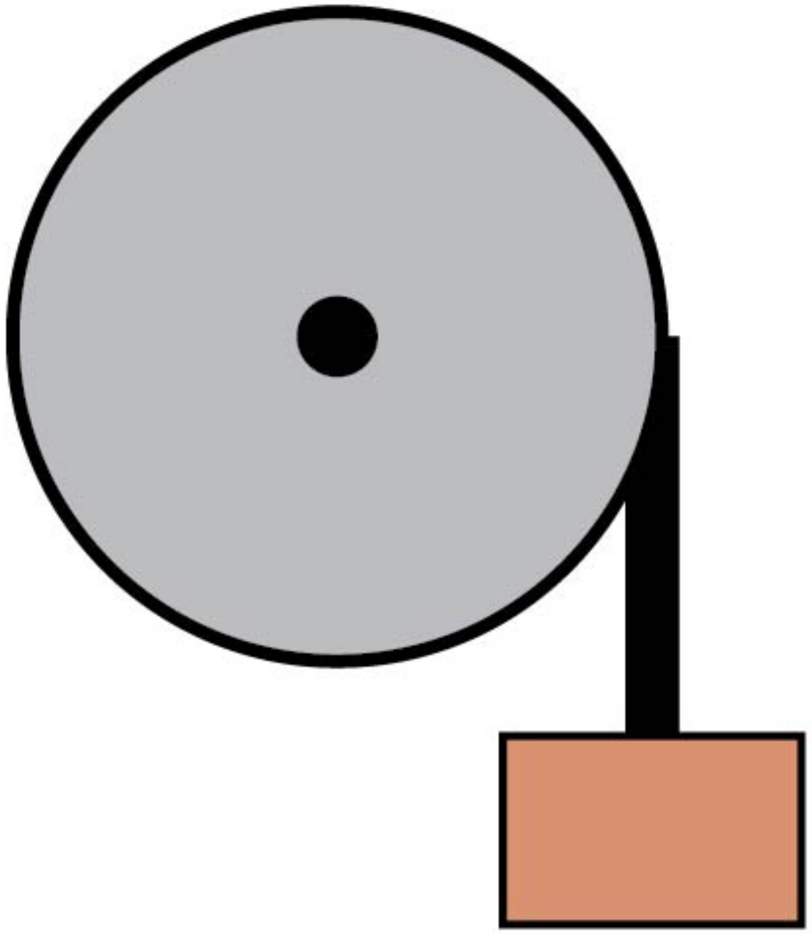


Question # 25

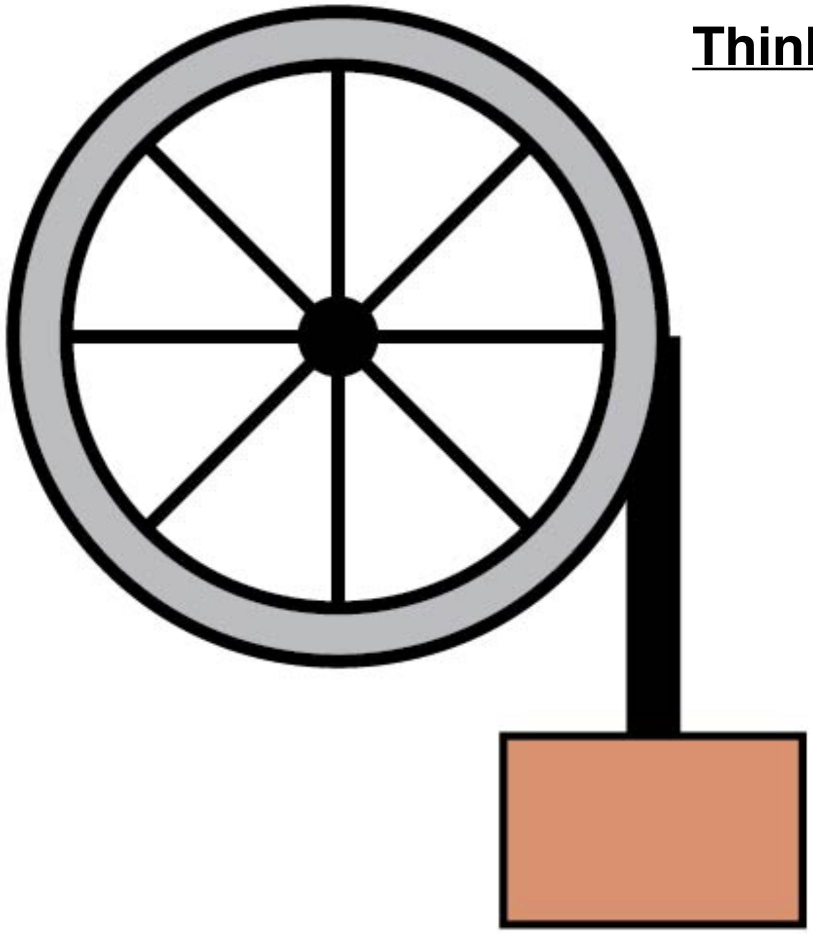
In which case will the block be moving faster just before it hits the floor?

<u>Think energy!!</u>

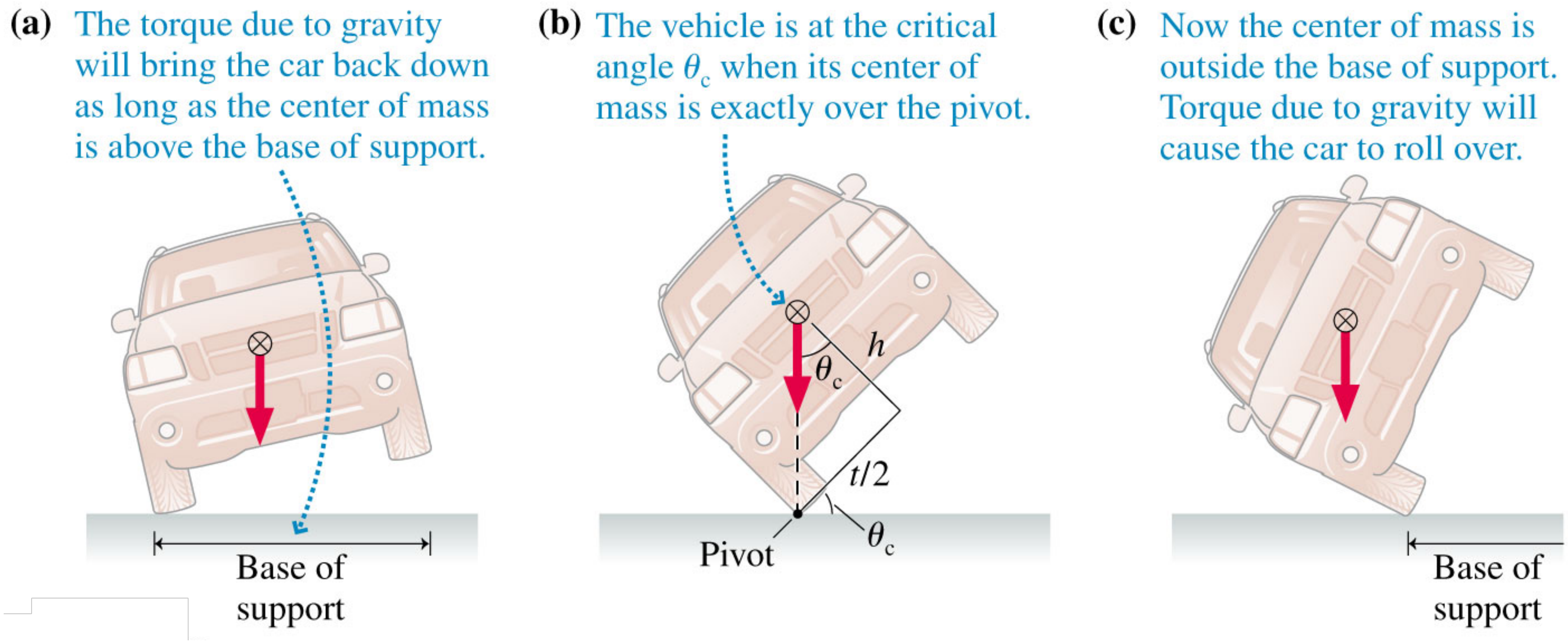
A



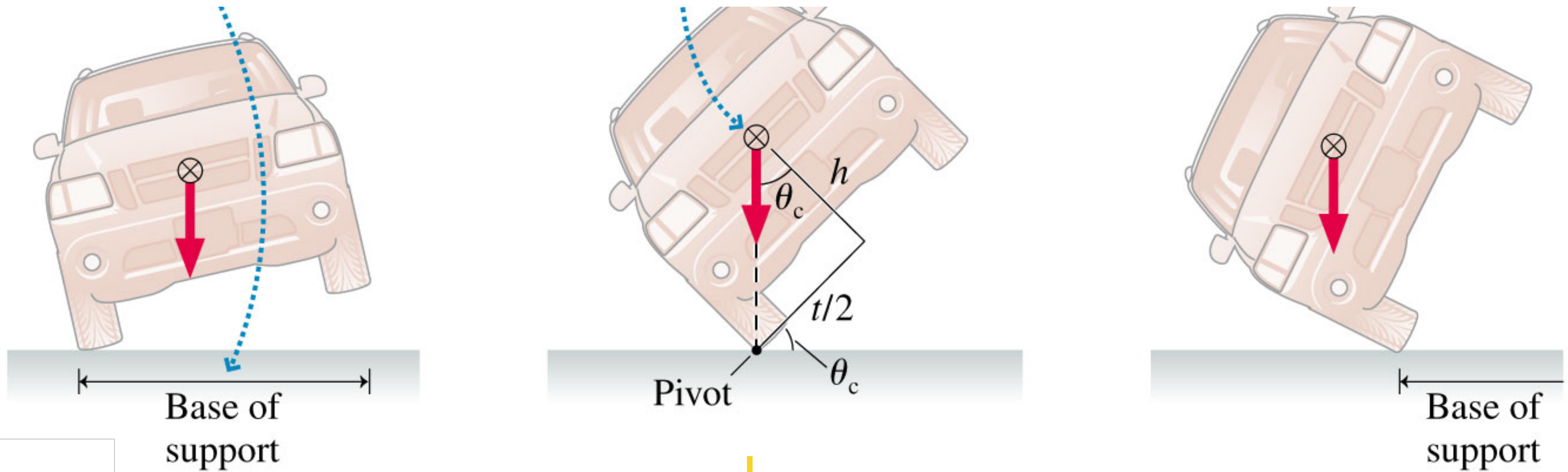
B



Balance and Stability



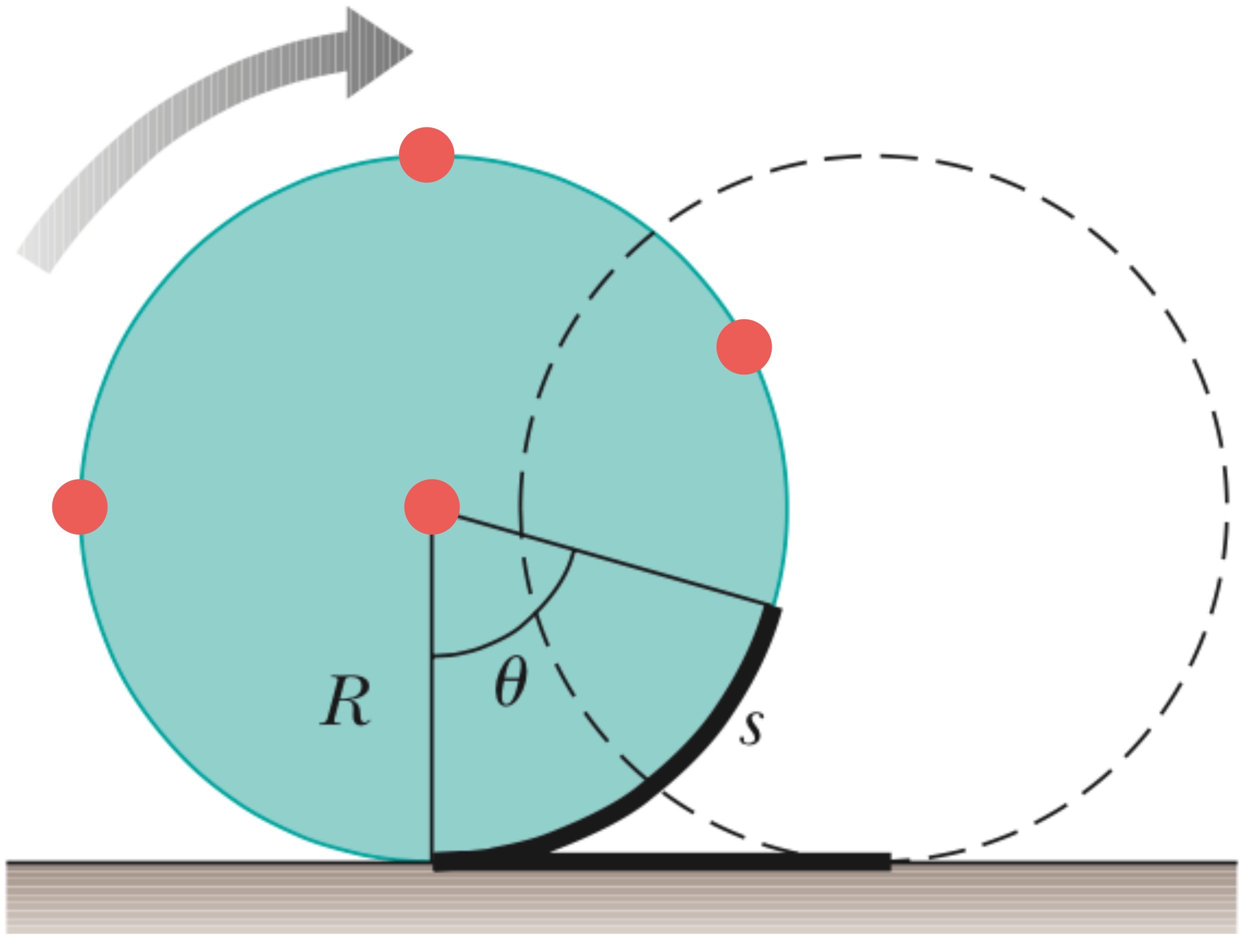
$$\theta_c = \tan^{-1}\left(\frac{t}{2h}\right)$$



Sooners wagon

Rolling Motion

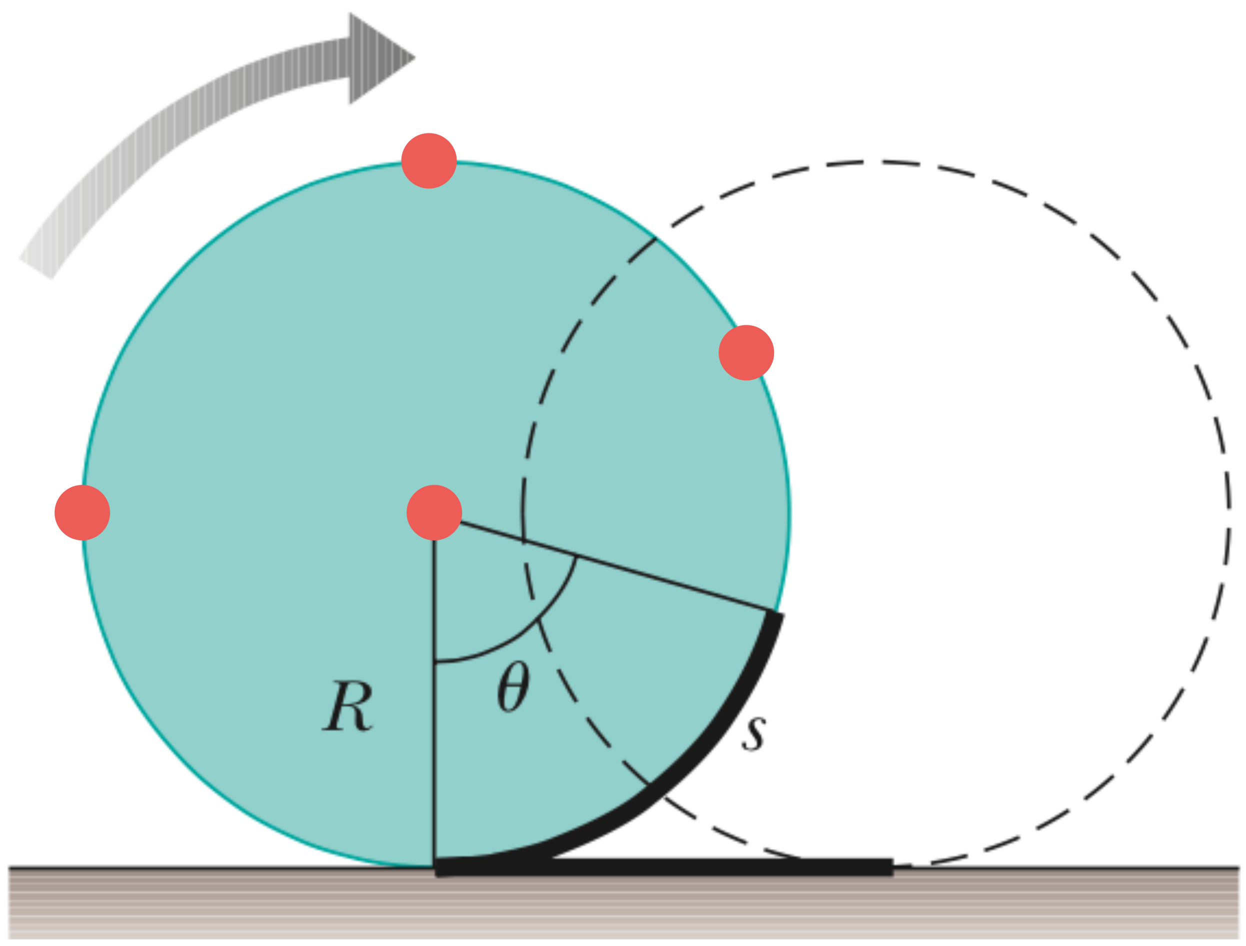
If this disk rolls for one full revolution, how far has the center of mass moved horizontally



Rolling Motion

If this disk rolls for one full revolution, how far has the center of mass moved horizontally

$$v_{\mathrm{cm}} = R\omega$$

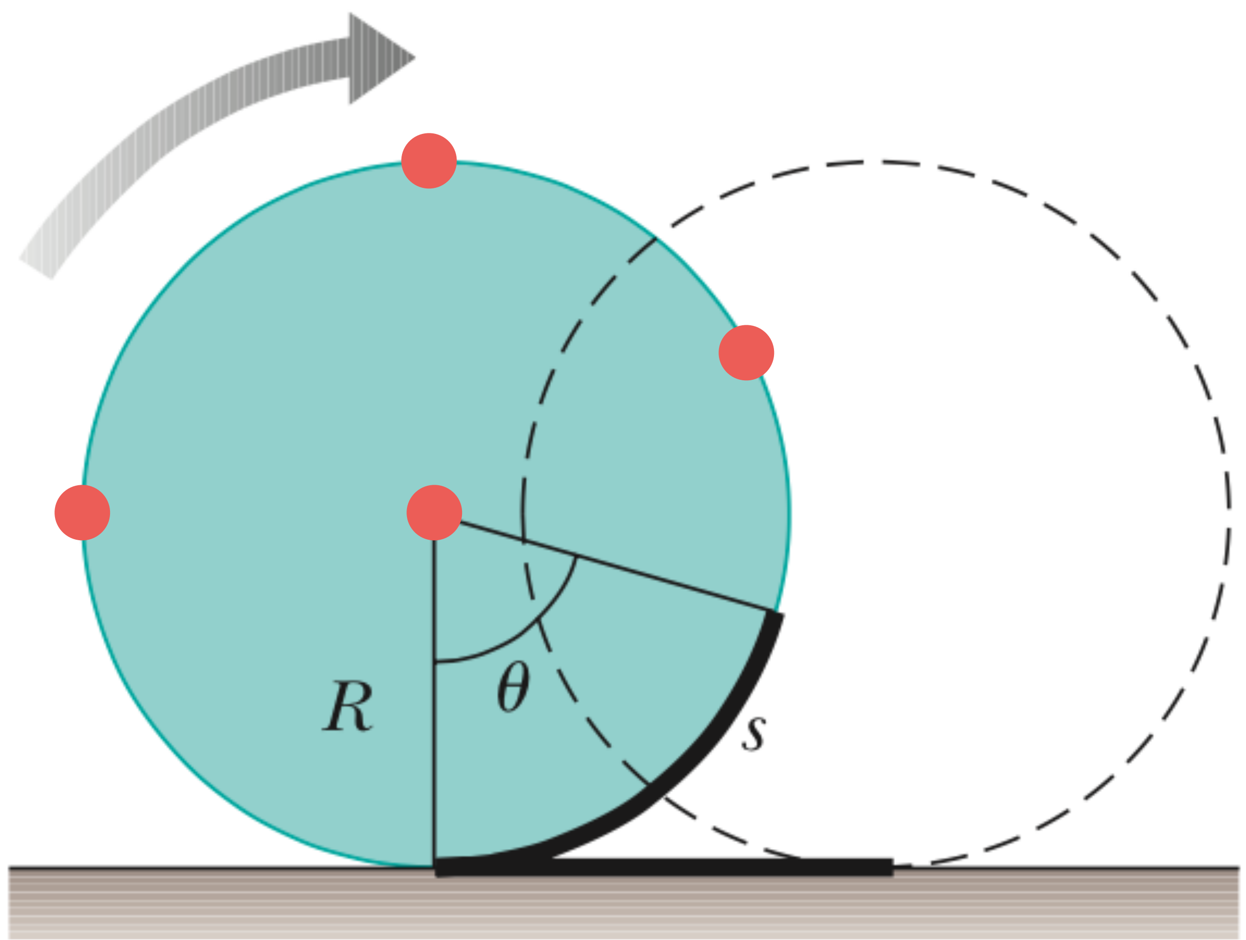


Rolling Motion

If this disk rolls for one full revolution, how far has the center of mass moved horizontally

$$v_{\mathrm{cm}} = R\omega$$

What is the velocity vector?



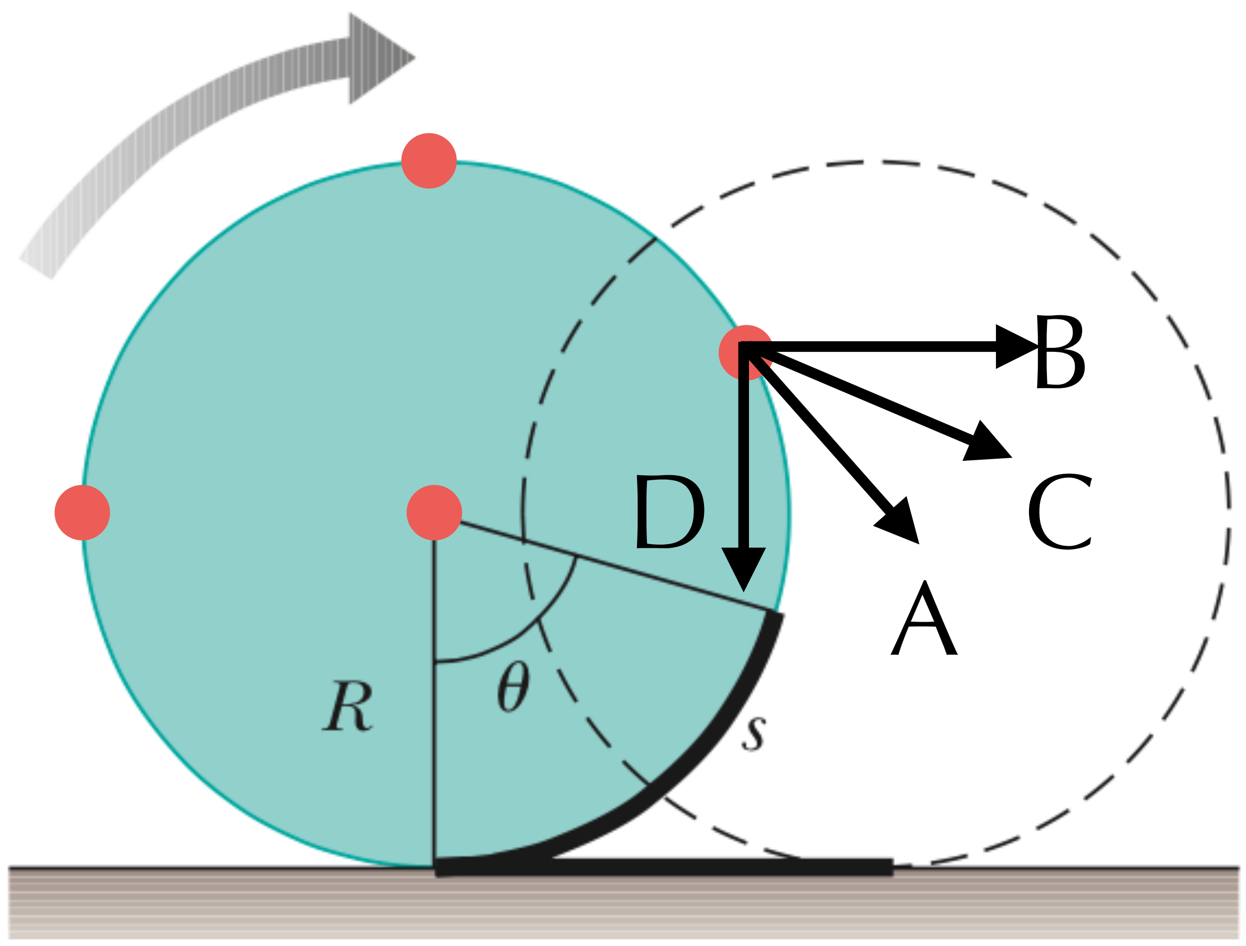
Rolling Motion

If this disk rolls for one full revolution, how far has the center of mass moved horizontally

$$v_{\text{cm}} = R\omega$$

What is the velocity vector?

Question #18

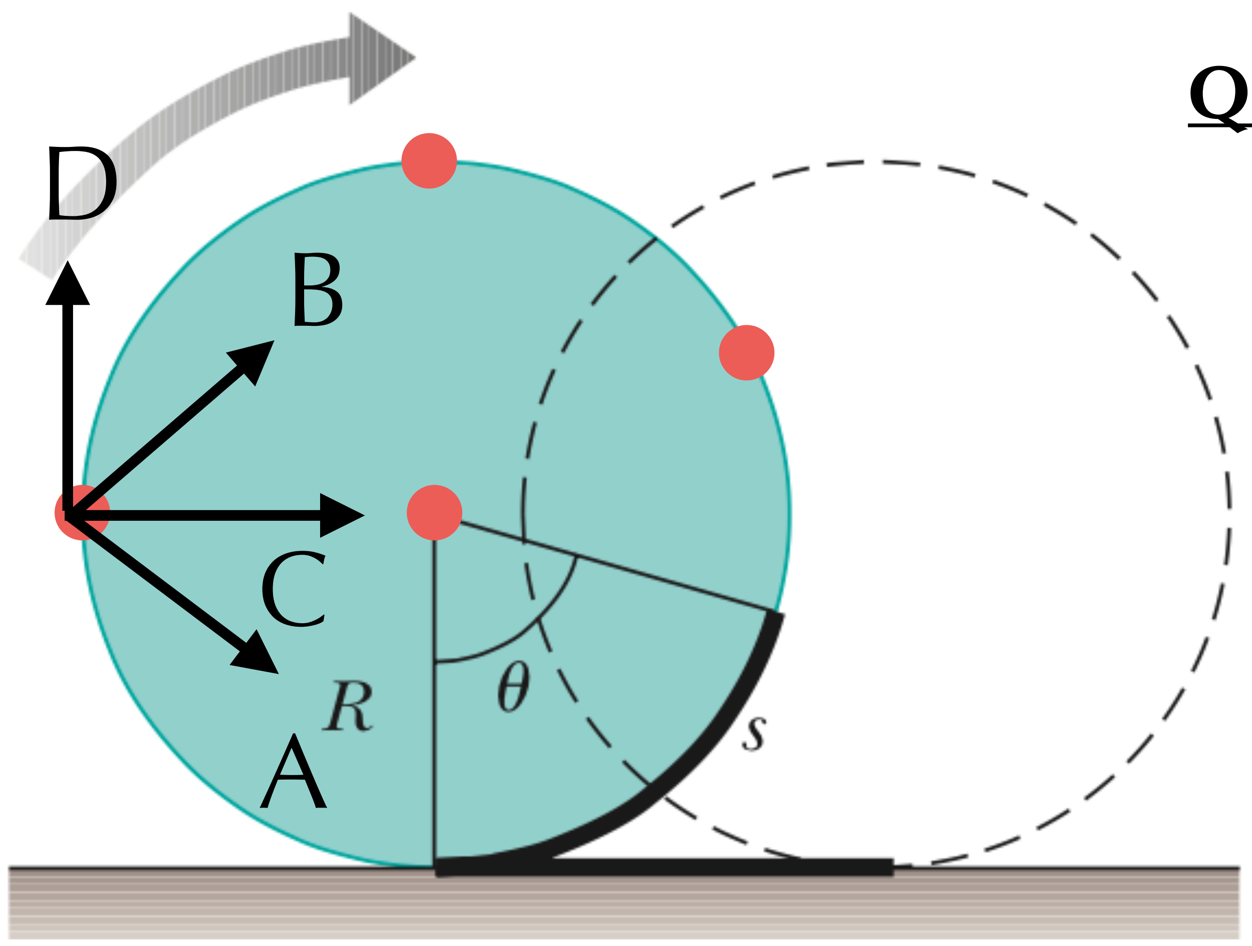


Rolling Motion

If this disk rolls for one full revolution, how far has the center of mass moved horizontally

$$v_{\mathrm{cm}} = R\omega$$

What is the velocity vector?



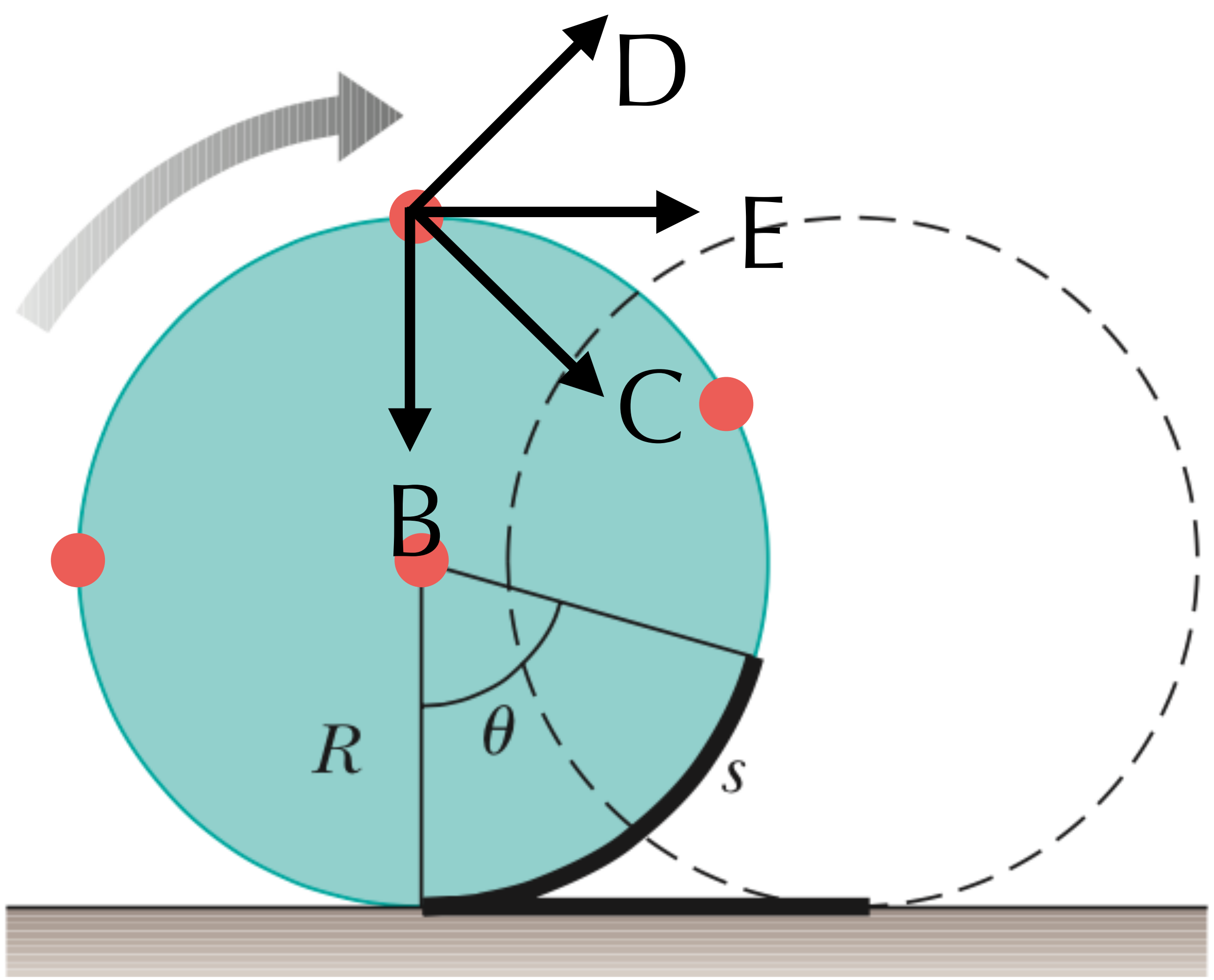
Question #19

Rolling Motion

If this disk rolls for one full revolution, how far has the center of mass moved horizontally

$$v_{\rm cm} = R\omega$$

What is the velocity vector?

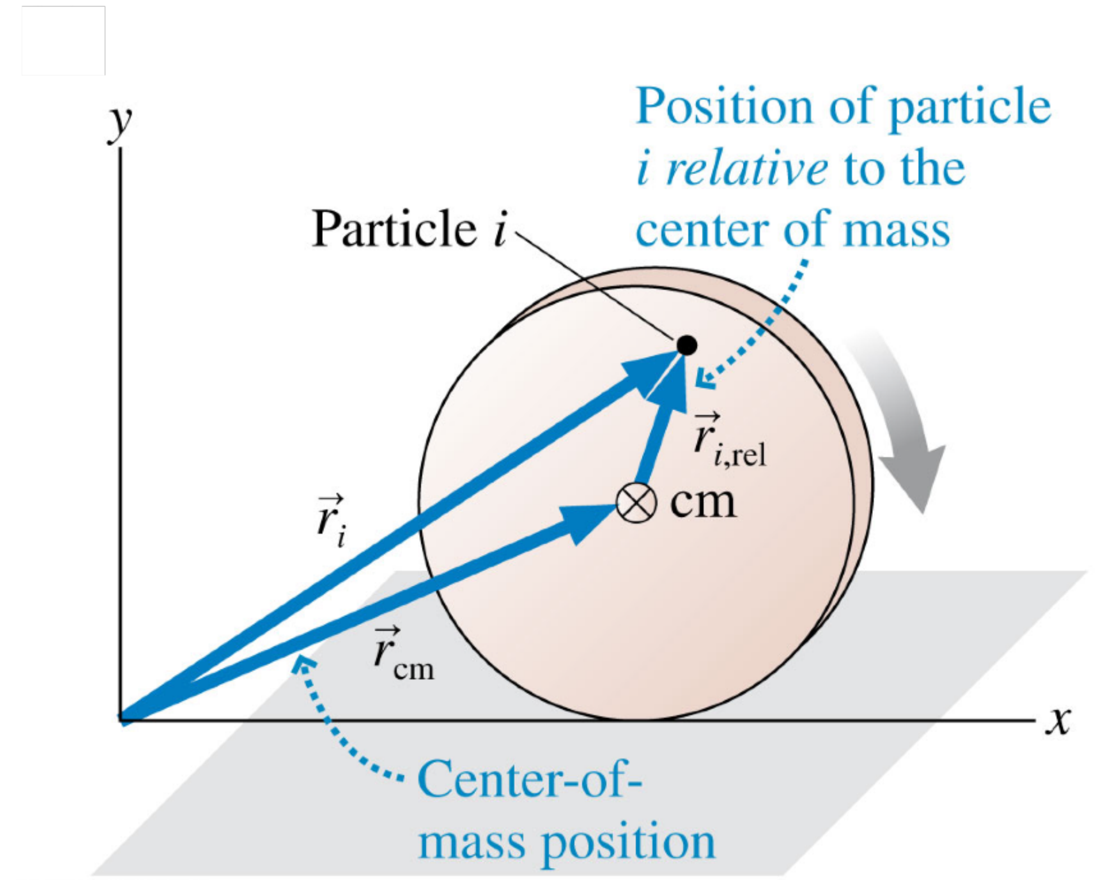


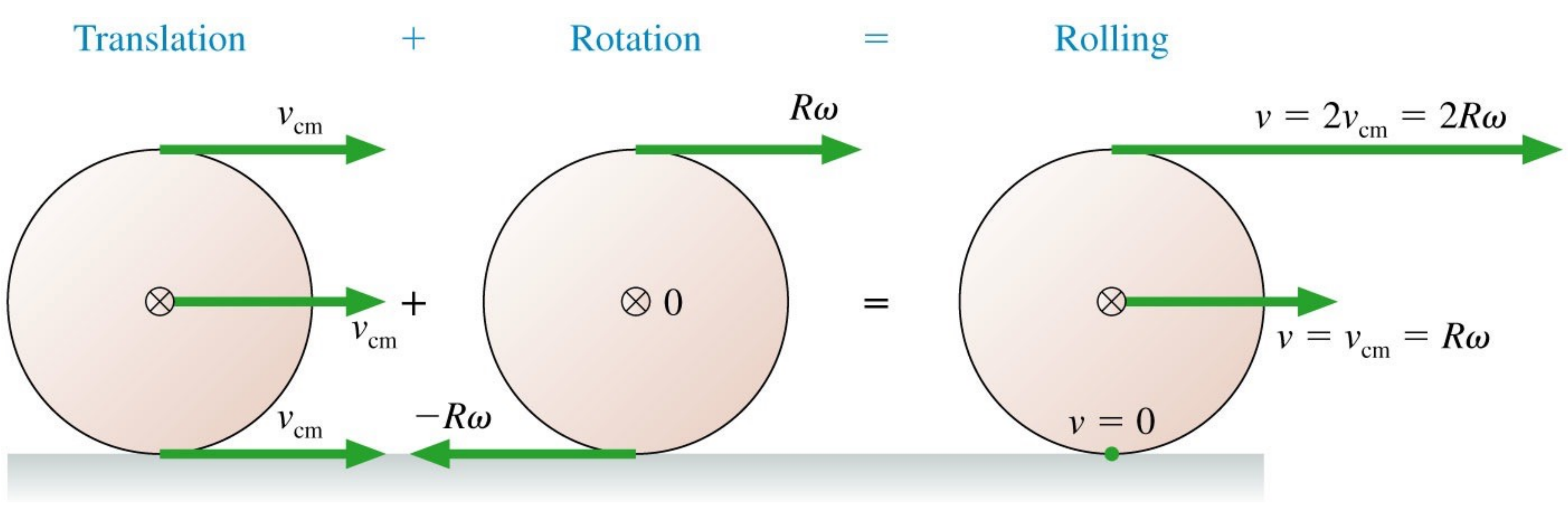
Question #20

Rolling without slipping

Time derivative of position vector

$$\vec{v}_i = \vec{v}_{\text{cm}} + \vec{v}_{i,\,\text{rel}}$$





Kinetic Energy of rolling

$$K_{\mathrm{rolling}} = \frac{1}{2} I_{\mathrm{cm}} \omega^2 + \frac{1}{2} m v_{\mathrm{cm}}^2$$

Disks rolling down incline!!