PHYS 1901 – Physics 1A (Advanced)
Mechanics module

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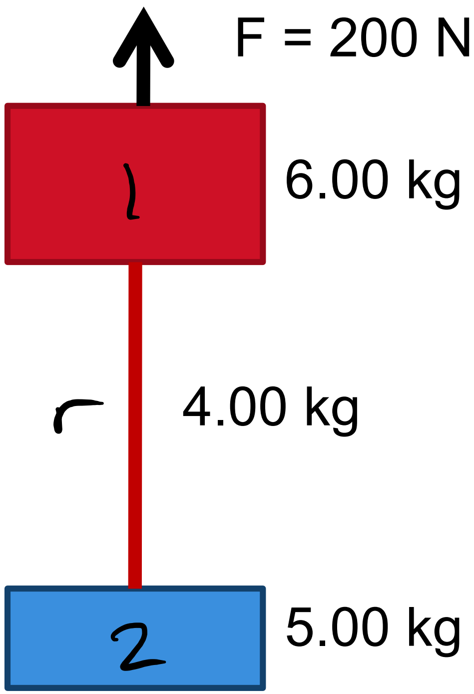
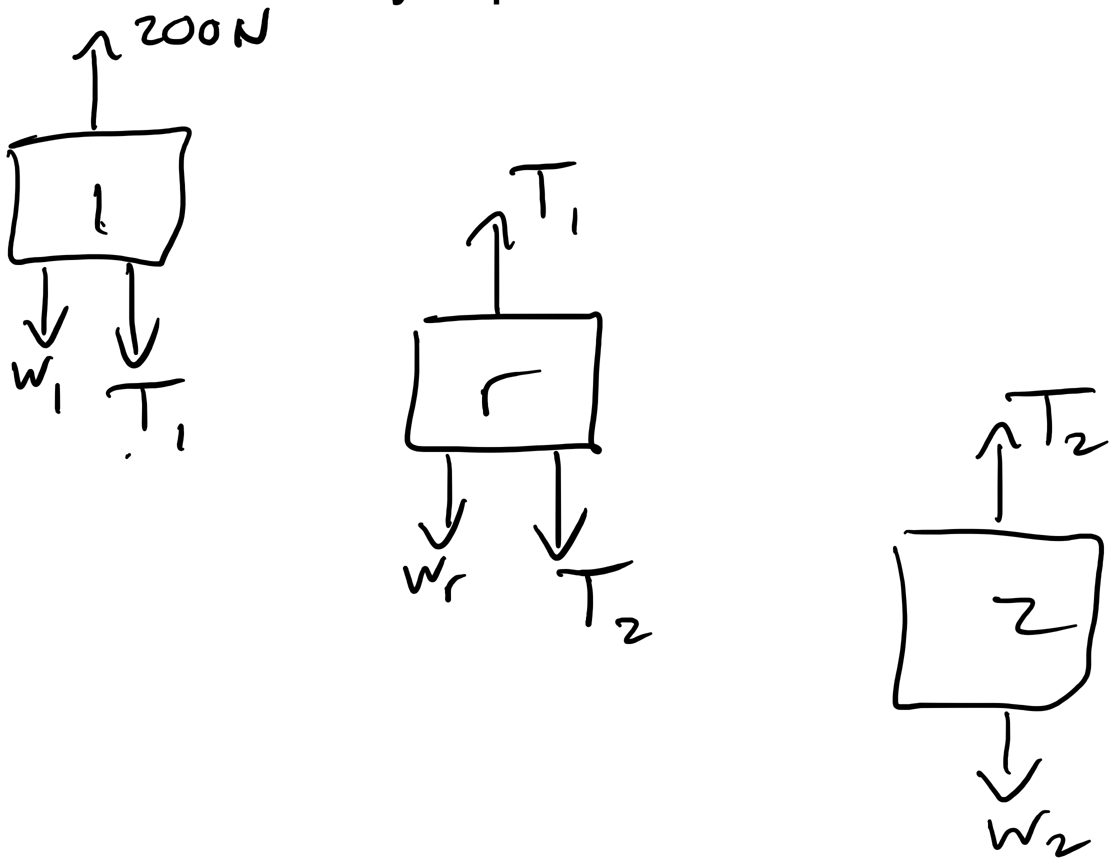
Problem 4.54



a) Draw free-body diagrams for both masses, and for the heavy rope.



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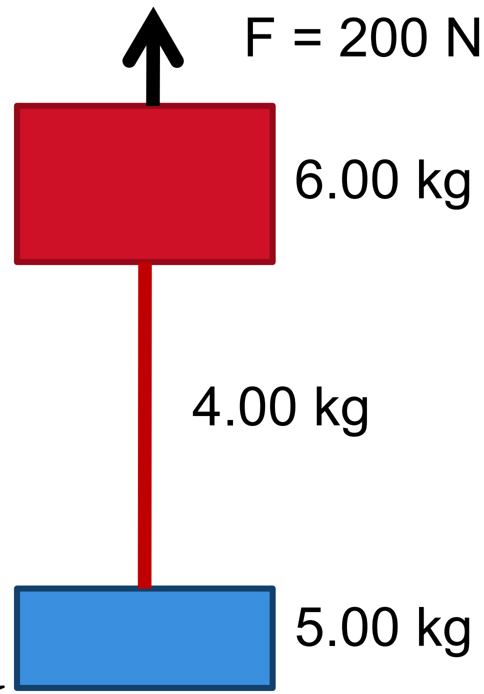
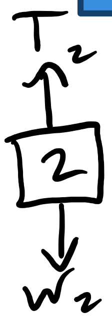
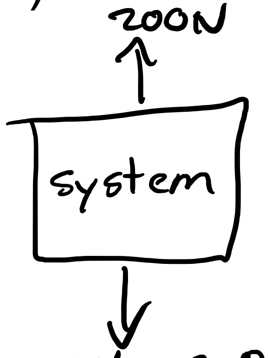




Solve for T_2 same way as b)

b) What's the acceleration of the system?

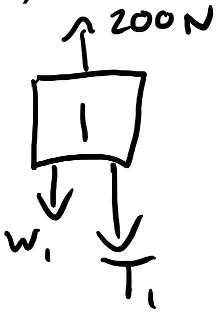


$F_{net} = 52.8\text{ N (up)}$

$F_{net} = ma \Rightarrow a = 3.52\text{ m/s}^2$ (up)

$w_{sys} = m_{system}\, g = (15.00\text{ kg})(9.80\text{ m/s}^2) = \cancel{147.2\text{ N}}$ 147 N

c) What's the tension at the top of the rope?



$F_{net,1} = m_1 a = (6.00\text{ kg})(3.52\text{ m/s}^2)$

$= 200\text{ N} - (6.00\text{ kg})g - T_1$

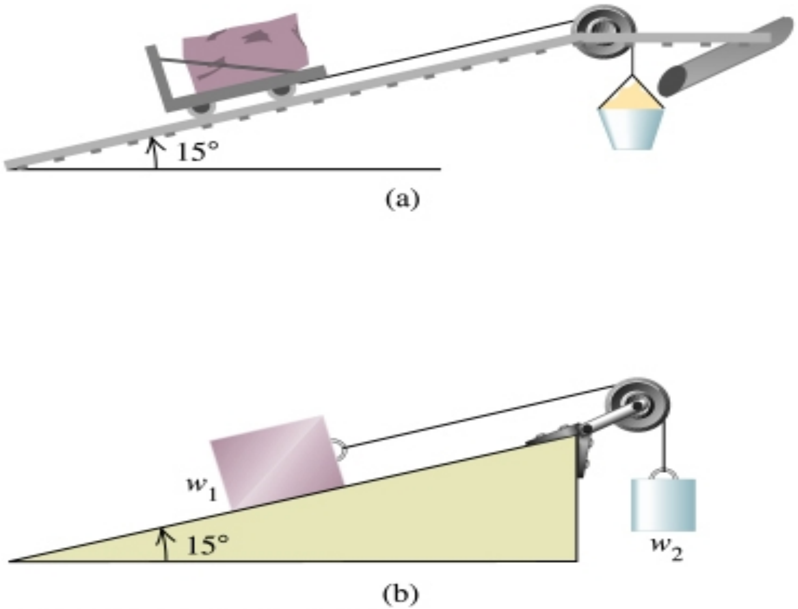
$T_1 = 120\text{ N}$

d) At the mid-point?

$T_{mid} = 93.3\text{ N}$

$T_2 = 66.7\text{ N}$

Example



A trolley of mass m_1 is place on a slope inclined at 15^o. It is attached via a light string and pulley to a hanging sand bucket. What mass of sand m_2 is needed such that the trolley possesses uniform motion?

(Assume no friction)

Applying Newton’s Laws

Chapter

5

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Complications: Friction

Experimentally, the force of friction is found to be proportional to the component of weight perpendicular to the surface (the normal force).

Static Friction: The frictional force resisting a force attempting to move an object.

Kinetic Friction: The frictional force experienced by a moving object.

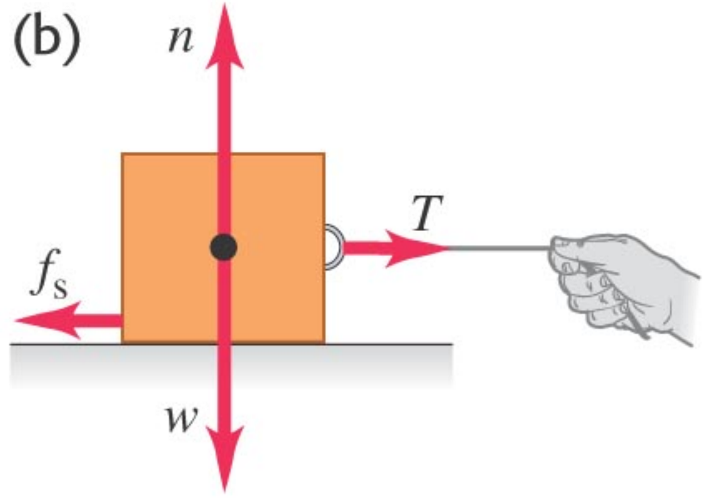
Static Friction

As the object is not moving, there must be no net force,

$$F_f \leq \mu_s N$$

where μ_s is the coefficient of static friction.

The frictional force balances the applied force, up to a maximum value



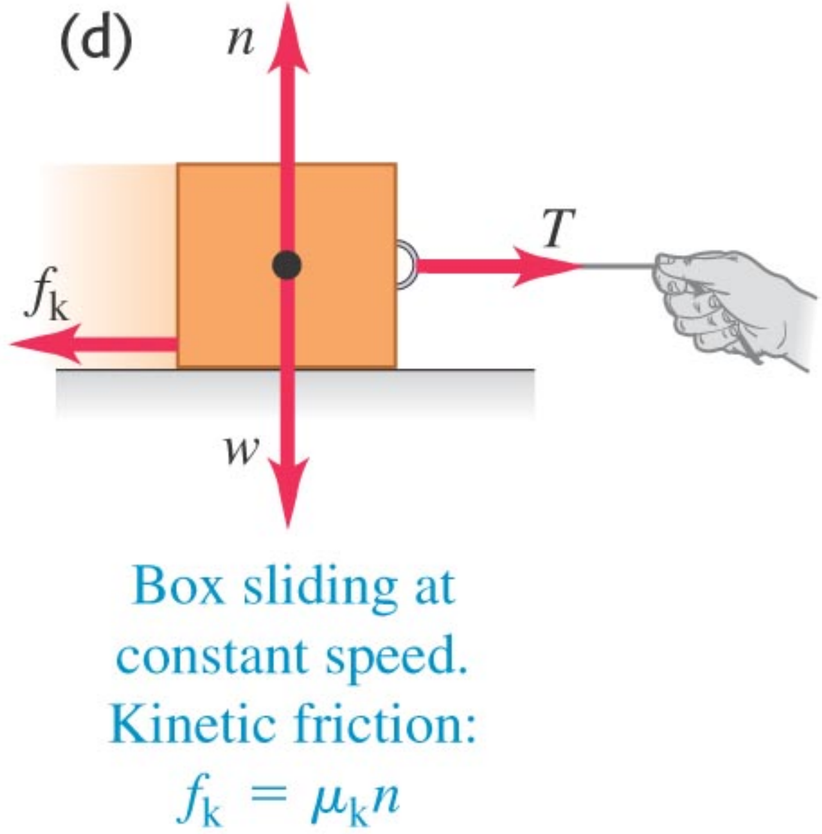
Kinetic Friction

Kinetic friction opposes a moving object.

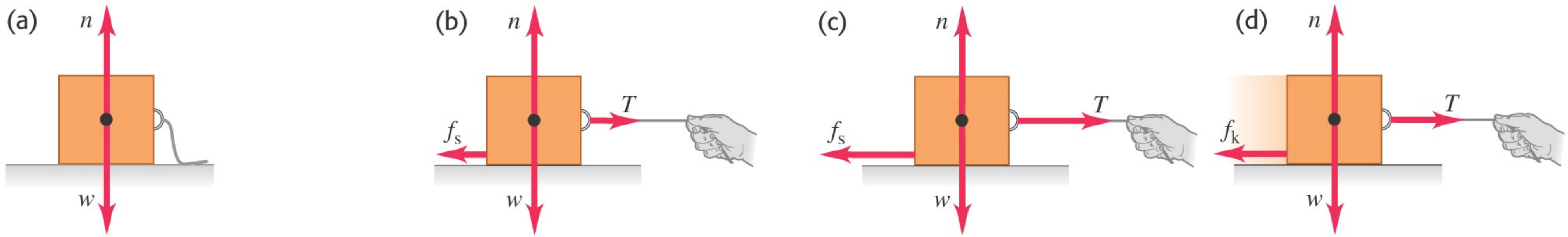
$$F_K = \mu_K N$$

where μ_K is the coefficient of kinetic friction.

Unlike static friction, kinetic friction has a fixed value independent of the applied force.



Friction



(a) No applied force, box at rest. No friction: $f_s = 0$

(b) Weak applied force, box remains at rest. Static friction: $f_s < \mu_s n$

(c) Stronger applied force, box just about to slide. Static friction: $f_s = \mu_s n$

(d) Box sliding at constant speed. Kinetic friction: $f_k = \mu_k n$

Coefficients of Friction

Generally, μ_s is larger than μ_K

(e.g. steel upon steel; μ_s*=0.74* and μ_K*=0.57*)