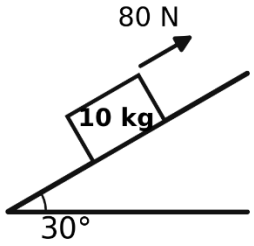
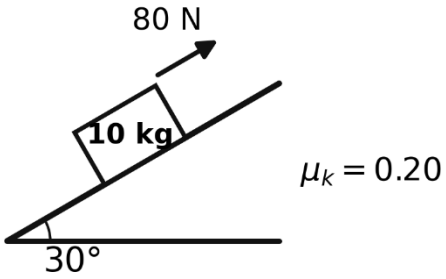
Applied Forces on Inclined Planes

MILD

1. A **10 kg** block is pulled uphill on a frictionless **30°** incline by a constant **80 N** force parallel to the incline.
   a) Determine the component of gravity acting parallel to the incline.
   b) Calculate the magnitude and direction of the block's acceleration.

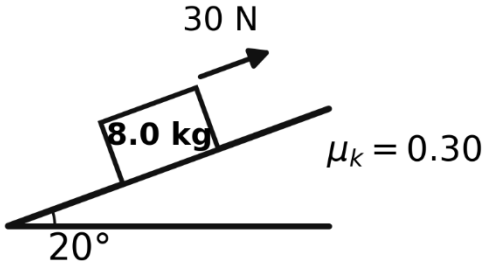


2. The same **10 kg** block is now already sliding uphill on the **30°** incline, with $\mu_k = 0.20$. The same **80 N** force continues pulling parallel to the incline.
   a) Calculate the kinetic friction force.
   b) Determine the magnitude and direction of the acceleration.
   c) Compare the acceleration with Problem 1.

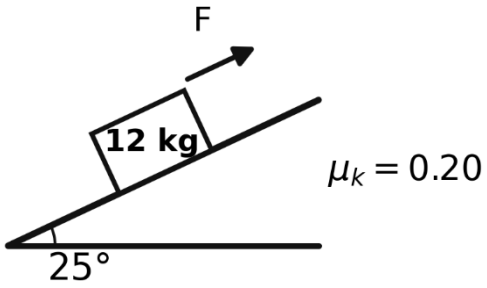


MEDIUM

3. An **8.0 kg** block is already sliding uphill on a **20°** incline. The coefficient of kinetic friction is $\mu_k = 0.30$, and a constant **30 N** force acts uphill, parallel to the incline.
   a) Determine the magnitude and direction of the block's acceleration.
   b) Explain whether the block is speeding up or slowing down.

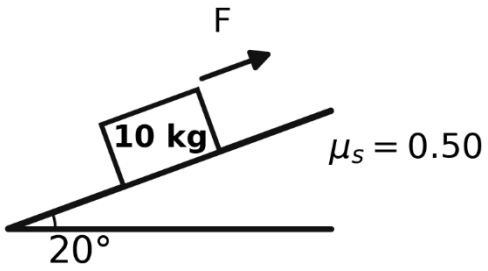


4. A **12 kg** block is sliding uphill on a **25°** incline, where $\mu_k = 0.20$. An unknown constant force **F** acts uphill, parallel to the incline, producing an acceleration of $1.0\ \mathrm{m/s^2}$ uphill.
   a) Write the net-force equation parallel to the incline, using F for the applied force.
   b) Calculate the magnitude of the applied force.

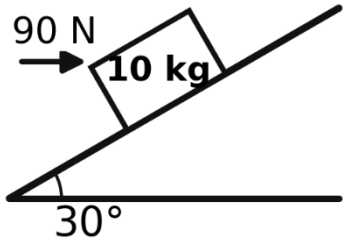


SPICY

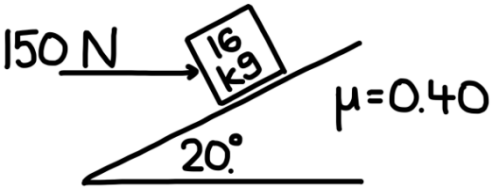
5. A **10 kg block** is initially at rest on a **20° incline**, where $\mu_s = 0.50$. A force parallel to the incline is gradually increased in the uphill direction.
   a) Determine the maximum static friction force available.
   b) Calculate the minimum applied force required to start moving the block uphill.



6. A **10 kg block** is on a **frictionless 30° incline**. A **90 N horizontal force** pushes it right, toward the uphill side of the incline.
   a) Calculate the component of the horizontal force parallel to the incline.
   b) Calculate the normal force acting on the block.
   c) Determine the magnitude and direction of the block's acceleration.



7. A **16 kg block** is **already sliding uphill** on a **20° incline**. A **150 N horizontal force** pushes right, toward the uphill side. The coefficient of kinetic friction is $\mu_k = 0.40$.
   a) Calculate the normal force.
   b) Calculate the kinetic friction force.
   c) Determine the magnitude and direction of the acceleration.



EXTRA-SPICY

8. The same **16 kg block on a 20° incline** is now **initially at rest**. The coefficients of friction are $\mu_s = 0.55$ and $\mu_k = 0.40$. A horizontal force pushes the block right, toward the uphill side.
   a) With a **150 N** applied force, determine the magnitude and direction of the static friction required to hold the block at rest.
   b) Determine whether the **150 N** force starts the block moving.
   c) Calculate the minimum horizontal force required to start moving the block uphill.
   d) The applied force is increased to **200 N**. Determine the acceleration once the block begins sliding uphill.

