

Friction Problems

1. A dockworker loading crates finds that a 20.0 kg crate requires 75.0 N horizontal force to set it in motion, but only requires a 60.0 N force to keep it moving. Find the coefficients of kinetic and static friction.
2. A box rests in the back of a truck, the coefficient of static friction between the box and the truck is 0.300, what is the maximum acceleration the truck can have without the box sliding?
3. A hockey puck is hit on a frozen lake and starts moving with a speed of 12.0 m/s, 5 seconds later it is moving 6.00 m/s. a) What is the average acceleration? b) What is the value of the coefficient of kinetic friction? c) How far does the puck travel in the 5 s?
4. A girl coasts down a hill on a sled, reaching a level surface at the bottom at 7.00 m/s. If the coefficient of kinetic friction between the sled and the ground is 0.050 and together they weigh 600. N, how far will she go before stopping?
5. A scooter a mass of 50 kg and its rider has a mass of 45 kg. The coefficient of static friction between the dry pavement and the tires is .9. The scooter starts from rest and travels for 60 m with a constant acceleration of 15 m/s^2 .
 - a) What is the final velocity of the scooter and its rider?
 - b) What is the force of the engine to get the scooter and rider to accelerate at this rate?
 - c) What is the force of the engine if it meets a head wind that has a force of 450 N?
- d) If the wind switches and becomes a tail wind with the same magnitude as the head wind, what is the force propelling of the scooter and rider?
6. The coefficient of sliding friction between the scooter and the pavement is .8. If the scooter slams on the breaks and skids to a stop in 25 m, what is the force on the scooter and rider with a tail wind? With the head wind?
7. A truck accelerates from rest for 1 minute. His final velocity is 180 km/hr. The truck with its load has a mass of 1200 kg. The coefficient of friction between the tires and the road is .9. It meets a head wind blowing with a force of 300 N. With what force must the engine work to accelerate the truck?
8. Sarah, whose mass is 40.0 kg, is on her way to school after a winter storm moving at 3 m/s when she accidentally slips on a patch of ice. The coefficient of kinetic friction is 0.060.
 - a) What is the force of friction that will bring Sarah to a stop?
 - b) How far will Sarah slide on the ice before she comes to a stop?
9. Molly puts a 1.0 kg mass on a 2.0 kg block of wood. She pulls the combination across another wooden board with a constant speed to determine the coefficient of kinetic friction between the two surfaces.
 - a) If she pulls with a force of 6.0 N, what is the coefficient of kinetic friction?
 - b) If the coefficient of static is .3, with how much force does Molly have to pull to get the two blocks started moving?
10. A 40.0 kg wagon is towed up a 18.5 degree hill with a tow rope that is parallel to the hill and applies a force of 140 N. If the wagon starts at rest at the bottom of a frictionless hill, how fast is it moving after going up the hill 80 m?
11. A workman pushes a 409 kg box up a smooth ramp that is 6.0 m long. The ramp makes an angle of 30.0 degrees to the horizontal. He is able to muster a force of 2080 N while pushing the box.
 - a) What is the net force on the box?
 - b) What is the acceleration of the box?
 - c) How long does it take the box to reach the top of the ramp?
 - d) If the box starts from rest at the bottom of the ramp, how fast is it going at the top of the ramp?

12. A 1250 kg hippo slides from rest down a 50 m long mud-covered hill inclined at an angle of 18 degrees to the horizontal. The coefficient of sliding friction between the hippo and the mud is 0.0900.
- What is the net force on the hippo?
 - What is the acceleration of the hippo?
 - What would be the speed of the hippo at the bottom of the hill?