

# Forces Problems

Fun With Fiziks

July 6, 2022

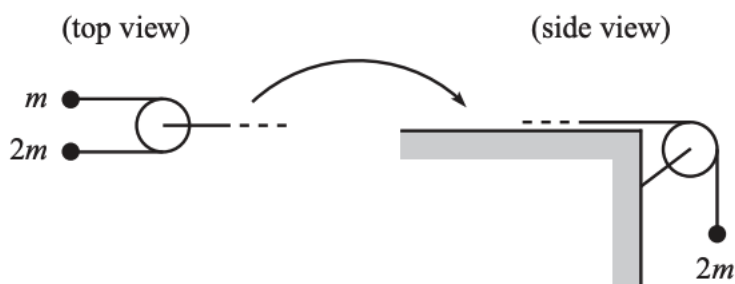
## Practice Problems

### Easy Problems

1. A 10 kg block sits on a 60 degree incline.
  - (a) What is the normal force?
  - (b) What does the coefficient of friction need to be in order to keep the block at rest?
2. There are 2 blocks next to each other. Block A is 1 kg, Block B is 2 kg. You push both of them with 6 N. What is the force of Block B on Block A?
3. There is a pulley with a 1 kg and 2 kg hanging off of each side. What is the acceleration of the blocks?
4. (Morin) If two people pull on a rope with force  $F$ , what is the tension in the rope?
5. A race car is going around a circular track of radius 10 m at 40 m/s. What is the centripetal acceleration that the driver feels?
6. A roller coaster is going around a loop with a radius of 10 m. What is the minimum velocity it needs to have at the top of the loop so that it doesn't fall off?
7. A horizontal spring launcher with a spring constant of 10 N/m is compressed by 1 m. How fast does a 1 kg particle get launched out?
8. A block is traveling at 20 m/s. But, there is friction, with a coefficient of friction of 0.1. How far does the block travel before coming to a stop?

## Hard Problems

9. There is a block on an inclined plane. If the coefficient of static friction between the block and the plane is  $\mu_s$ , what is the maximum angle of the inclined plane such that the block starts slipping.
10. There is a block of mass  $m$  and at a height of  $h$  on an inclined plane of angle  $\theta$ . What is the speed of the block when it reaches the bottom
  - (a) if there is no friction between the block and the plane?
  - (b) if the coefficient of kinetic friction between the block and the plane is  $\mu_k$ ? (Assume that the coefficient of static friction is small enough such that the block starts slipping)?
11. Masses of  $m$  and  $2m$  lie on a frictionless table, connected by a string that passes around a pulley. The pulley is connected to another mass of  $2m$  that hangs down over another pulley, as shown. Find the accelerations of all three masses.



12. A vertical spring stretches a distance of  $x$  when a stationary block is hung on it. What is the displacement of the block when it is attached to
  - (a) two parallel vertical springs?
  - (b) two springs in series?
13. (Kalda,  $\star$ ) A cylinder inclined by an angle of  $\theta$  with radius  $R$  spins around its axis with an angular speed  $\omega$ . On its inner surface there lies a small block; the coefficient of static friction between the block and the inner surface of the cylinder is  $\mu_s$ . Find the values of  $\omega$  for which the block does not slip (stays still with respect to the cylinder).
14. (Kalda,  $\star$ ) There is a block at rest on an inclined plane of angle  $\theta$  with a coefficient of static friction of  $\mu_s$ . What is the minimum force required to move the block along the plane? (Hint: Use the Cauchy-Schwarz Inequality  $(x_1y_1 + x_2y_2)^2 \leq (x_1^2 + y_1^2)(x_2^2 + y_2^2)$ ).