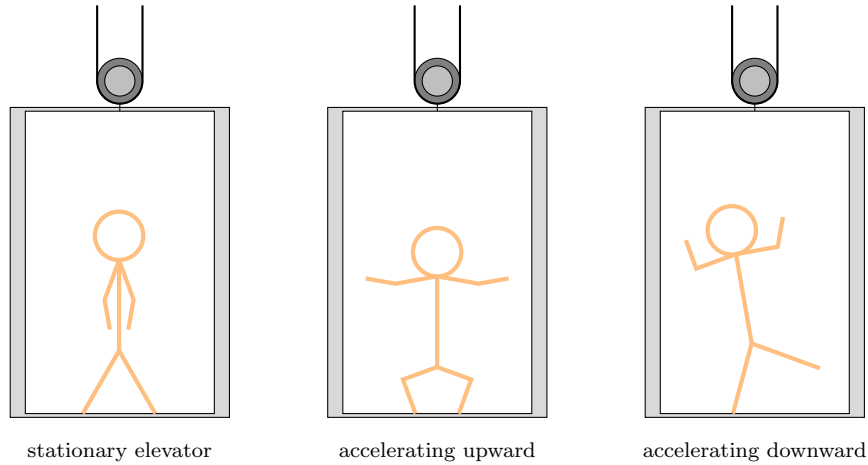


Mind-Bending Force Questions - Part II

1. When do you are riding in an elevator, there are some times that you feel heavier and some times that you feel lighter.

(a) Draw a Free-Body Diagram for each of these situations:



(b) Write an expression for the normal force in each situation above.

(c) Which force corresponds to “how heavy” you feel?

(d) How could you use an elevator to simulate weightlessness?

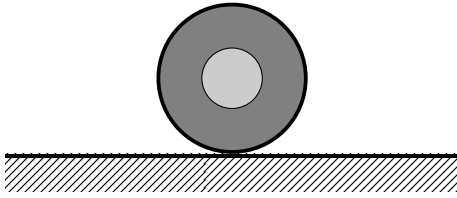
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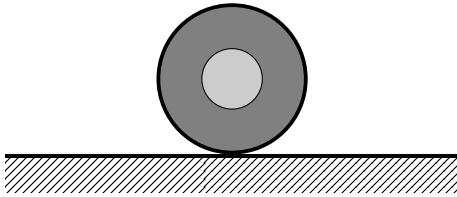
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2. Consider one of the four tires on a car.

- (a) Draw a free-body diagram of the forces acting on the point of the tire that is in contact with the ground while the car is accelerating forward.



- (b) Draw the free-body diagram of the same point if the brakes have been applied and the car is slowing down without the tire skidding.



- (c) Let's consider what happens to a car on an icy road.

If the car has a mass of about 1600 kg, then its weight (that is, force of gravity) is $mg \approx 16,000$ N. That means, each of the four wheels must support a weight of about 4,000 N.

The coefficients of friction between an average tire and hard-packed snow on the road are $\mu_s \approx 0.20$ and $\mu_k \approx 0.15$.

Let's say you have to slam on your brakes on hard-packed snow. Calculate the amount of friction force the tire can provide if it doesn't slip. Also, calculate the amount of friction force the tire can provide when it starts to slip.

- (d) Cars with antilock brakes can sense when the tire starts to slip. The brakes turn on and off rapidly to try to prevent the slipping. Use your calculations above to explain why this is a good feature for a car.