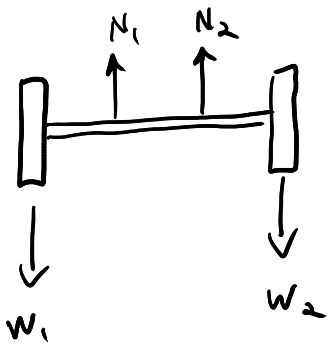

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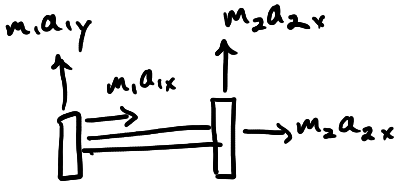
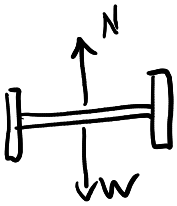


Kinetic Diagram ← important ✌ new ✌ skill



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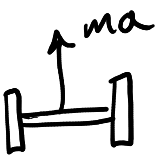
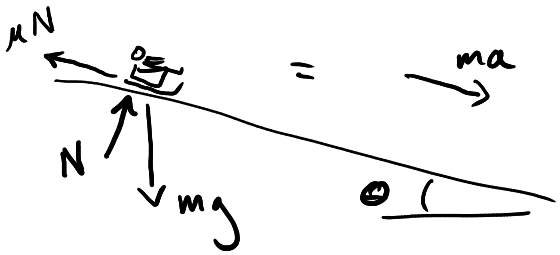


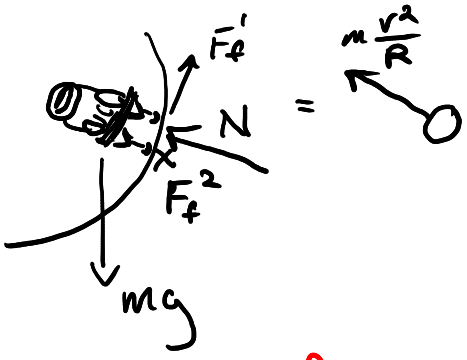
$ma_y = \Sigma F_y$

$ma_y = N - w$

Draw FBD of luge

Figure 2.13 Problem 2.5. Image courtesy of Shutterstock.





$ma = mg\sin\theta - \mu mg\cos\theta$

my pref

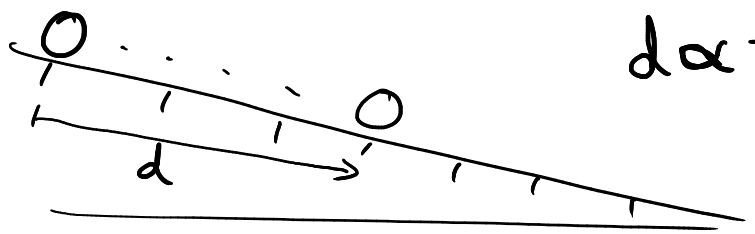
X

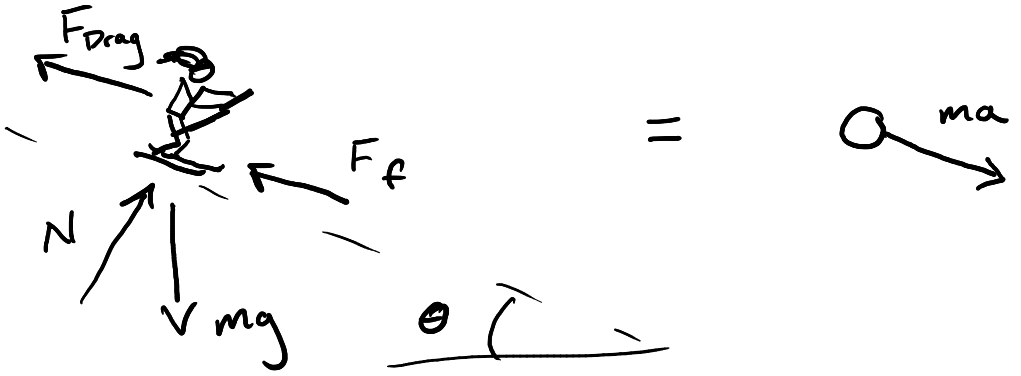
centrifugal "force"

2.11 Despite Galileo's claim, large, heavy skiers have an unfair advantage: they get down a mountain faster than lighter skiers. In fact, in the four-person bobsled, for instance, ballast weights are added to the sled to ensure that every sled, including the drivers, has the same weight (again giving an advantage to larger racers, as the lighter competitors have to push a heavier sled at the start).

Where did Galileo go wrong? That is, using Newton's second law and your knowledge of the forces at work, show why it is that heavier skiers get down the mountain faster.

(You may assume that the skier is acted on by gravity; friction, $\mathbf{F} = \mu\mathbf{N}$; and aerodynamic drag, $\mathbf{F} = \frac{1}{2}C_D A\rho v^2$.)





$$mg\sin\theta - \mu mg\cos\theta - F_{Drag} = ma$$

case 1 $F_{Drag} \sim 0 \Rightarrow \quad a = g(\sin\theta - \mu\cos\theta)$

case 2 $F_{Drag} \neq 0 \Rightarrow \quad ma = mg(\sin\theta - \mu\cos\theta) - \frac{1}{2}C_D A\rho v^2$

$$a = g(\sin\theta - \mu\cos\theta) - \frac{\frac{1}{2}C_D A\rho v^2}{m}$$