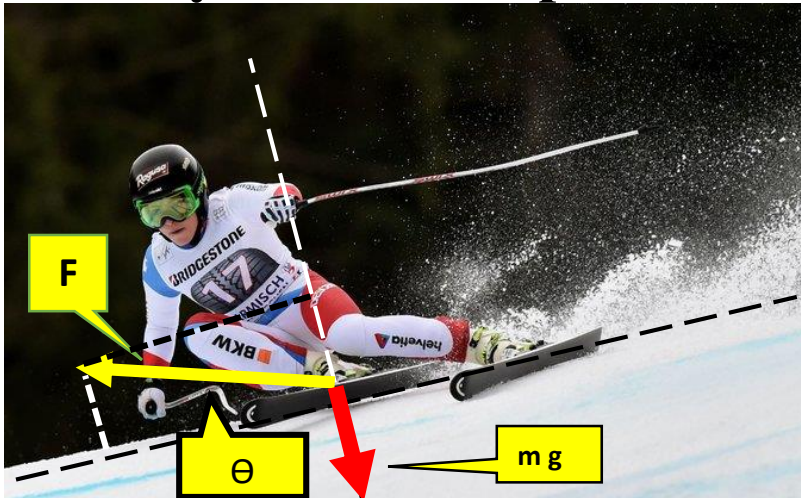


# CENTRIPETAL FORCE

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## Lindsey Vonn's Grip on Overall Lead Loosens a Bit



Lara Gut of Switzerland earned her first super-G win of the season on Sunday. Lindsey Vonn finished third.

Lindsey Vonn is getting some competition for the overall World Cup title, although she is still comfortably ahead. Lara Gut of Switzerland secured her first super-G victory of the season on Sunday, prevailing in Garmisch-Partenkirchen, Germany, to cut into Vonn's lead. Viktoria Rebensburg of Germany edged Vonn for second place as Vonn narrowly missed winning back-to-back races on the Kandahar hill after capturing Saturday's downhill. The race for the overall title tightened a bit because of Gut's victory, her fifth of the season. She is now 87 points behind Vonn, with Rebensburg 240 points back in third.

**INTRODUCTION:** Wikipedia says the official minimum radius of curvature for Super G downhill ski runs is 148 ft. and speeds can reach 80 mph. So, in our application here lets take radius of curvature a little bit larger at 170 ft.(R) and speed as stated 80 mph. Horizontally the skier making a turn to the right has centripetal acceleration and thus a centripetal force exists. In our case here (see graphic)  $F_{\text{CENTRIPETAL}} = F \cos \theta$  . F is force of snow ON her skies. The skier Gut has no acceleration vertically. Thus, the forces vertically must equal 0.  $F \sin \theta - m g = 0$  The purpose of this application is to calculate the angle  $\theta$  at which skier Gut's legs are inclined at.

**QUESTIONS:** (a) Convert 80 mph to ft./s.? , (b) Find angle  $\theta$  her legs are inclined at while making the turn at 80 mph with a radius of curvature of  $R = 170$  feet. (c) Does the answer to  $\theta$  in question (b) seem reasonable compared to angle  $\theta$  seen in picture above?

**HINTS:**  $F_{\text{CENTRIPETAL}} = m v^2/R$  , equals divided by equals are still equal( $F \sin \theta / F \cos \theta = \tan \theta$  ) ,  $g = 32 \text{ ft./s.}^2$

**ANSWERS:** (a) 117.33 ft./s. , (b)  $\sim 21.56^\circ$  (c) Visually comparing the computed angle of  $21.56^\circ$  with the picture of Gut making the 80 mph turn it is possible to see the angle of her legs are certainly at an angle close to  $21^\circ$  . Especially ... look at her left leg and the angle to the horizontal. .... close to  $21^\circ$  .