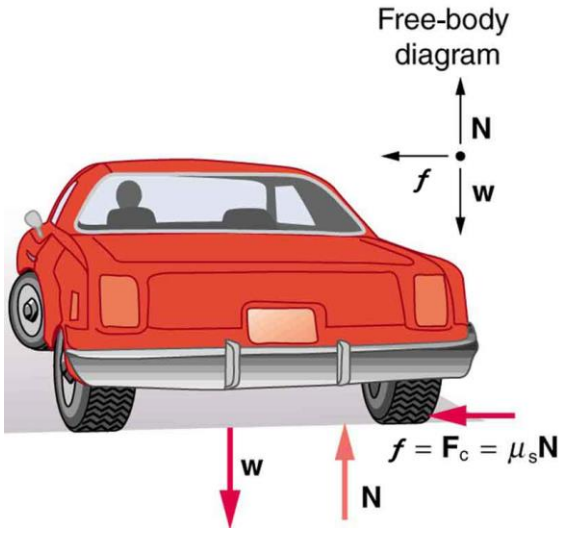
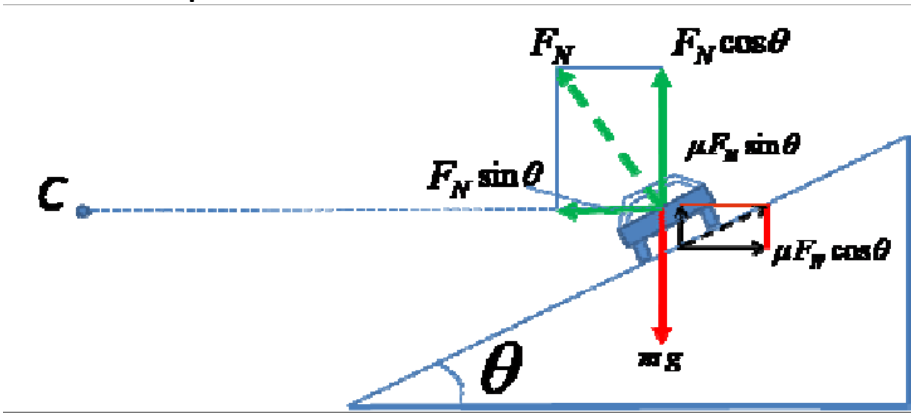
AP Physics
Instructor: Mr. Butler

Uniform Circular Motion
Free-Body Diagram Examples

1. Car going around a flat curve. The friction force provides the centripetal force.



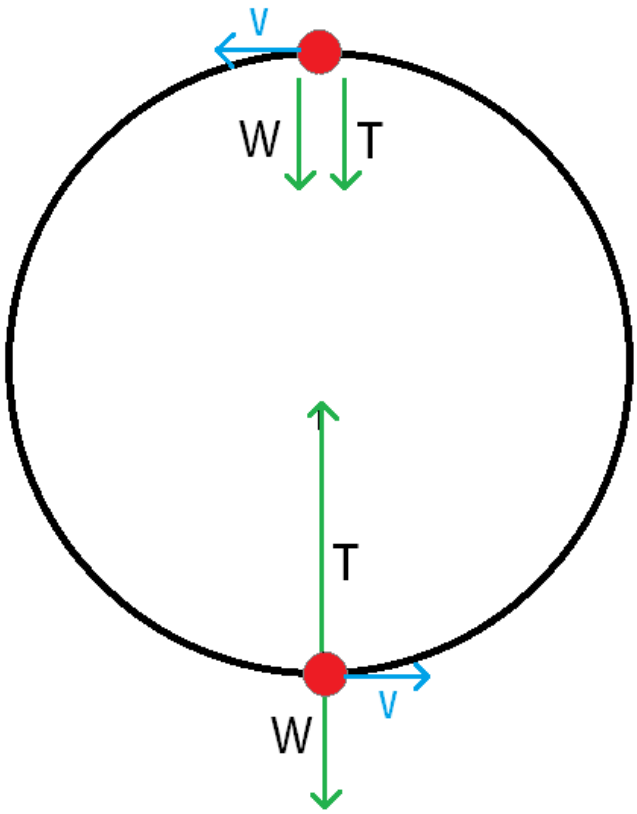
2. Car going around a banked (angled) curve without friction. A component of the normal force provides the centripetal force.



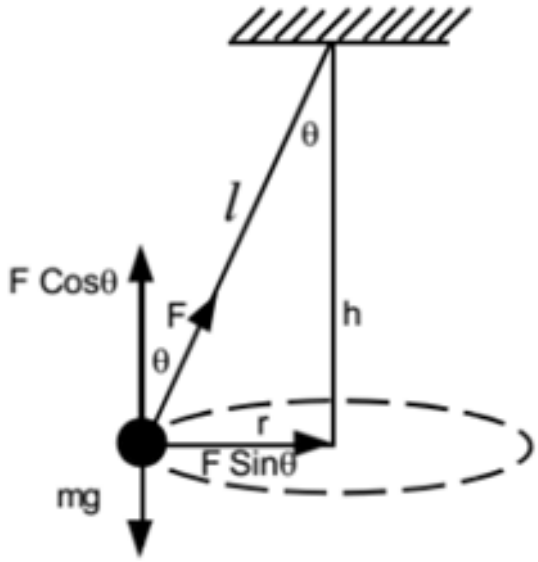
3. Ball being swung around by a string at constant speed in a vertical circle.

a) **At the top, the centripetal force is the sum of the weight and string tension W + T. At the top, the weight helps to maintain the circular motion of the ball by accelerating the ball toward the center. As a result, the string tension will be reduced.**

b) **At the bottom, the centripetal froce is the difference between the weight and string tension T-W. At the bottom, the weight trys to ecay the circular motion by acting to pull the ball away from the circle's center. As a result, the tension must be increased to maintain the ball's change in direction aounf the curved circular path.**



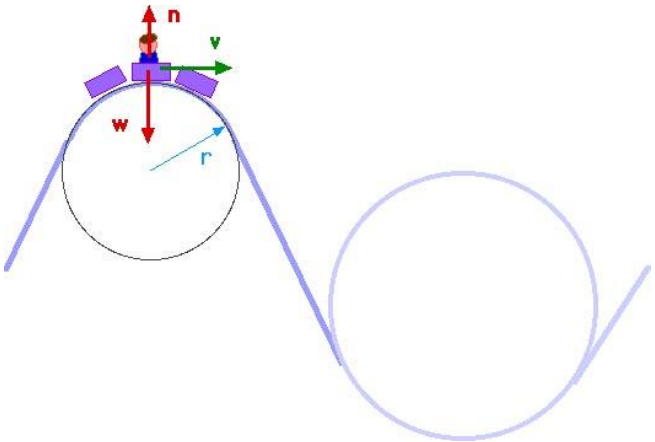
4. Conical circular motion of a tether ball moving in uniform circular motion. In this case, a component of the tension in the rope provides the centripetal force necessary to accelerate the ball around the curved path.



5. Roller coaster car going through different loop-the-loop circular curves. The rider experiences several forces acting on him; some of which help to accelerate him toward the center while others try to pull him away from the center. This result depends on the direction of the forces at different points along the path.

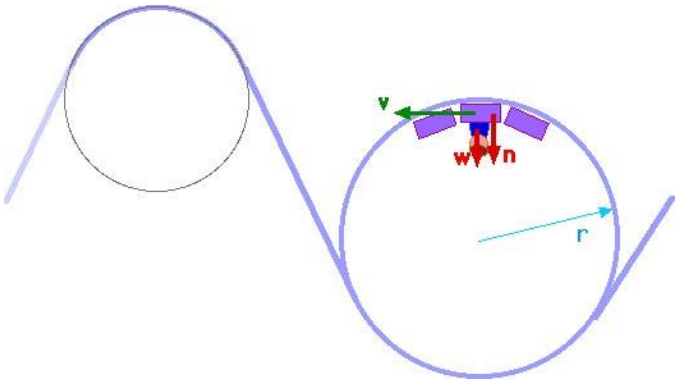
a) At the top and outside of the loop. His weight helps to accelerated him toward the center while the normal force from the seat tries to push him away from the center.

In this case $F_C = W - n$



b) At the top and inside of the loop. Both his weight and the normal force from the seat help to accelerated him toward the center.

In this case $F_C = W + n$



c) At the bottom and inside of the loop. His weight acts to pull him away from the center while the normal force from the seat acts toward the center.

In this case $F_C = n - W$