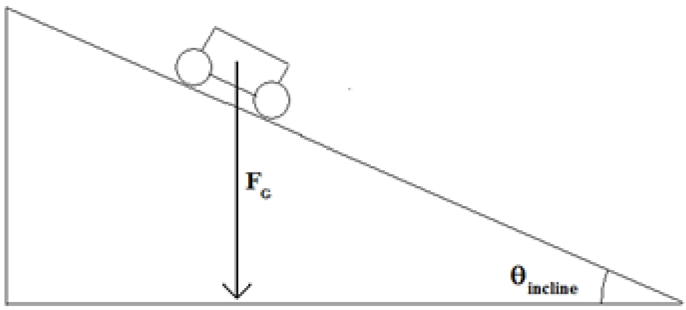
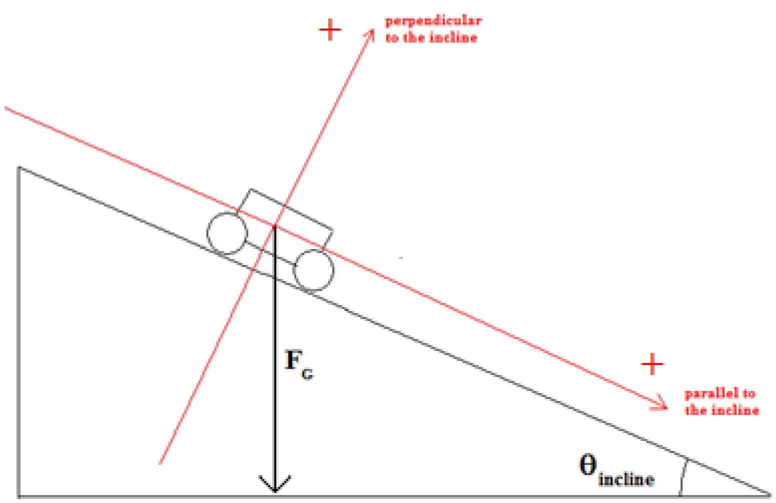
Inclines

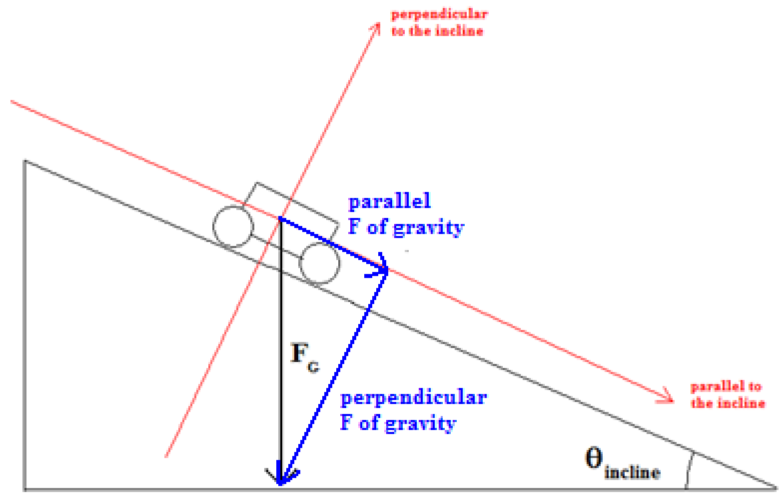


In the diagram above, a cart with a mass of *m* is placed on an inclined plane which has a steepness of $\theta_{incline}$ above the floor. The vector shown is the force of gravity, which would have a magnitude of m·g.

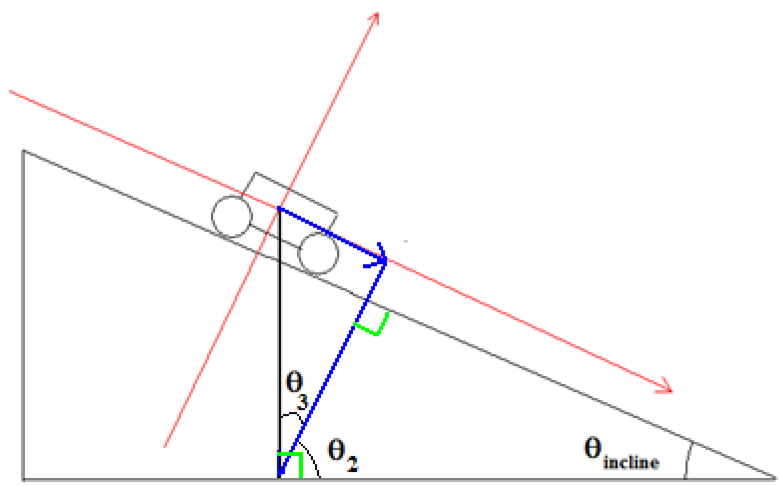
In these situations, it is common to draw the Cartesian coordinates so that one axis is parallel to the plane of the incline itself. Instead of labeling the axes x and y, I'll label them parallel and perpendicular to the incline.



With the axes drawn this way, the force of gravity is actually acting in both dimensions. You can see this if I draw the components of the force of gravity in blue.

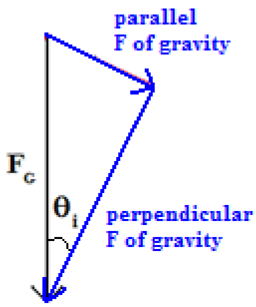


Now I'll redraw that with some of the clutter removed and the various angles labeled.



There are two green right angles labeled. Because of the one on the top, $\theta_{incline} + \theta_2 = 90^o$ and because of the one on the bottom, $\theta_2 + \theta_3 = 90^o$. Therefore, $\theta_3 = \theta_{incline}$.

Now I will extract the vector diagram from the situation just to work with it alone, using θ_i as a shorthand for $\theta_{incline}$.



If F_G = mg, then by the diagram above, the component of gravity perpendicular to the incline equals $-mg \cdot \cos\theta_{incline}$ and the component of gravity parallel to the incline equals $mg \cdot \sin\theta_{incline}$. The negative and positive signs simply follow the red Cartesian axes as originally defined.

Because the cart will roll along the parallel axis, the acceleration along the perpendicular axis must be zero. Therefore, the net force along the perpendicular axis is zero, requiring a normal force of $+mg \cdot \cos\theta_{incline}$ to counteract the component of gravity in the perpendicular dimension.

Answer Webassign Question 1

Answer Webassign Question 2

Answer Webassign Question 3

Answer Webassign Question 4

Answer Webassign Question 5