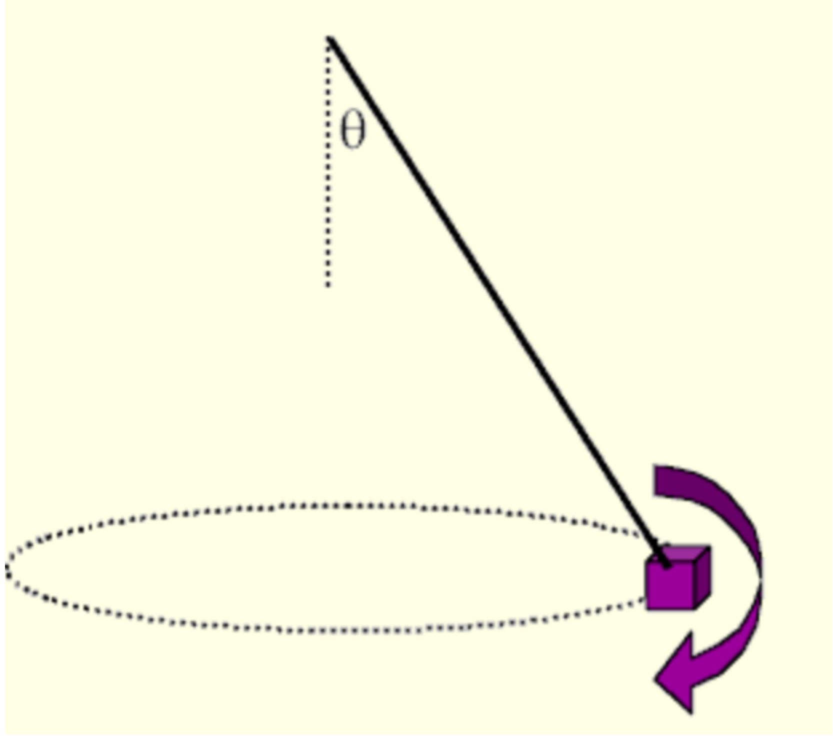
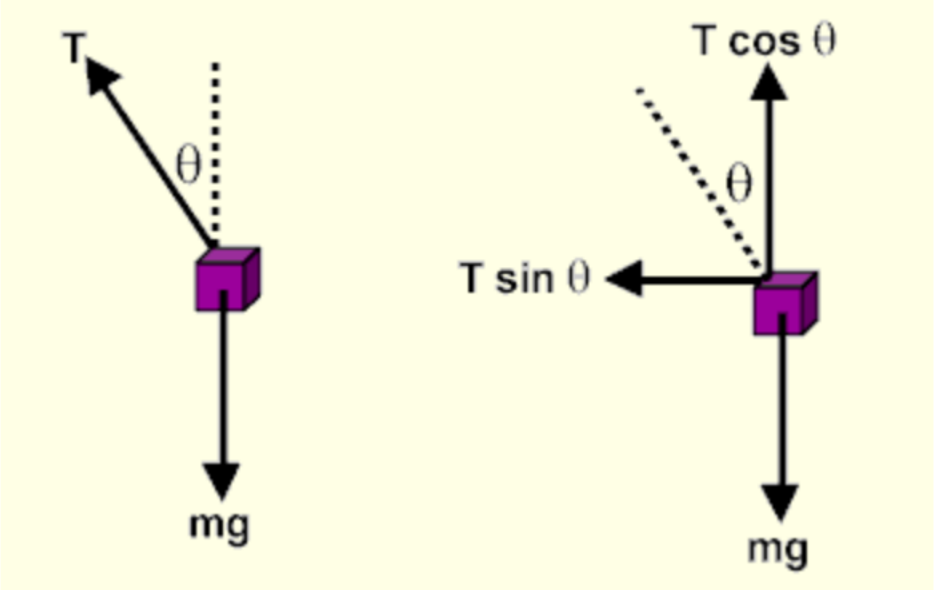
UNIFORM CIRCULAR MOTION WITH TENSION

Images are from the lesson resources at physicslab.org; http://dev.physicslab.org/Lessons.aspx





Since T$cos\theta$ = mg , the centripetal force (the net force) is T$sin\theta$

Object path is in the horizontal plane; Everywhere on the path, the net force is the same.

NON-UNIFORM CIRCULAR MOTION WITH TENSION

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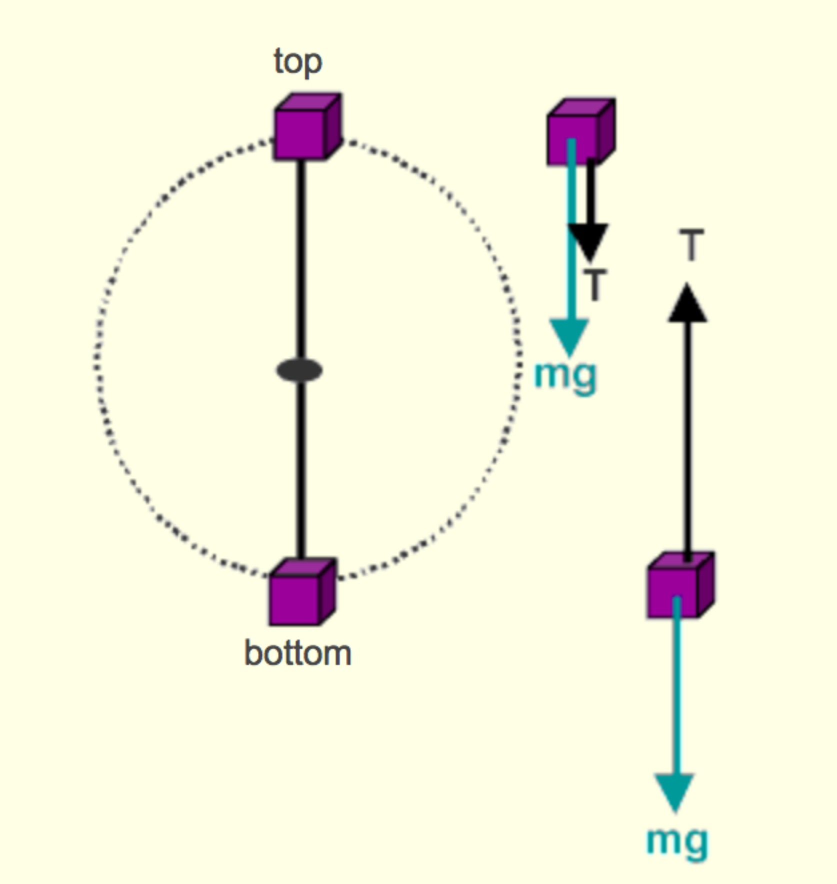
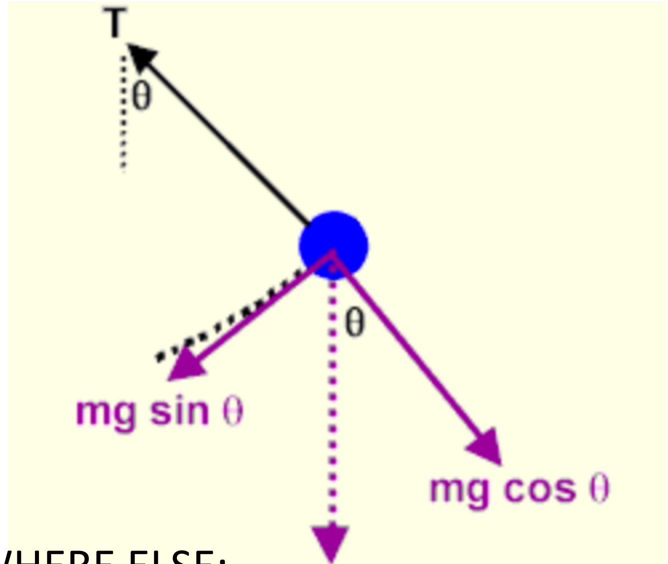


When the tension in the rope approaches zero…

$0 = m(v^2/r) - mg$
$m(v^2/r) = mg$
$v^2/r = g$
$v^2 = rg$
$v = \sqrt{(rg)}$

…the minimum speed needed to get around the top of the circle can be found



EVERYWHERE ELSE:

$\text{net } F_c = T - mg\cos\theta$
$mv^2/r = T - mg\cos\theta$
$T = mv^2/r + mg\cos\theta$

TOP:

net force to the center = T + mg
$F_c = T + mg$
$m(v^2/r) = T + mg$
$T = m(v^2/r) - mg$

BOTTOM:

net force to the center = T - mg
$F_c = T - mg$
$m(v^2/r) = T - mg$
$T = m(v^2/r) + mg$