Physics Challenge for Teachers and Students

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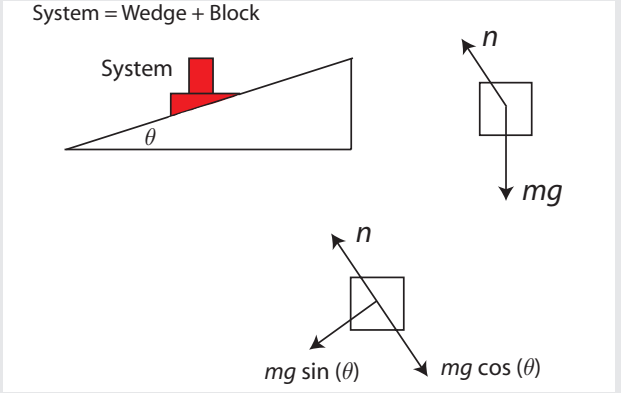
Solution to October 2009 Challenge

A Wedge Issue

A wedge slides down a frictionless inclined plane that makes angle θ with the horizontal. A small block is placed at the horizontal top side of the wedge. During the slide, the block does not move relative to the wedge. Find the minimum possilbe coefficient of static friction μ_s between the block and the wedge.

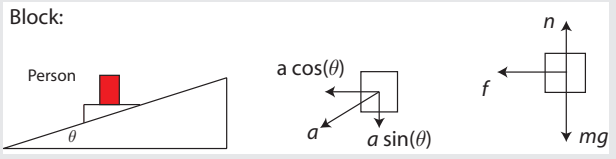
The solutions to the October *Challenge*, **A Wedge Issue**, came not only from the U.S. but also from Asia, Australia, Canada, Europe, and South America. It was great to see quite a few college and high school students among the solvers. We publish the solution by one of those students:

Solution:



Equations:

$$\Sigma F = ma$$
$$n - mg\cos(\theta) = 0$$
$$mg\sin(\theta) = ma$$
$$g\sin(\theta) = a$$



$$\Sigma F = ma$$
$$f_s = \mu_s n$$
$$||\ vertical$$
$$mg - n = ma\sin(\theta)$$
$$mg - n = mg\sin(\theta)\sin(\theta)$$
$$n = mg - mg\sin^2(\theta)$$
$$n = mg[1 - \sin^2(\theta)]$$
$$n = mg\cos^2(\theta)$$
$$||\ horizontal$$
$$f_s = ma\cos(\theta)$$
$$f_s = mg\sin(\theta)\cos(\theta)$$
$$||\ substitution$$
$$\mu_s n = mg\sin(\theta)\cos(\theta)$$
$$\mu_s mg\cos^2(\theta) = mg\sin(\theta)\cos(\theta)$$
$$\mu_s\cos(\theta) = \sin(\theta)$$
$$\mu_s = \tan(\theta)$$

Coefficient of Static Friction: $\mu_s = \tan(\theta)$

(Contributed by Muhammad Saad Shamim, student, The Science Academy of South Texas, Brownsville, TX)

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Many thanks to all contributors and we hope to hear from you in the future!

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