The magnitude of the normal force on a block sliding down a friction-free inclined plane
a) is equal to mg.
b) is greater than mg, always.
c) may be greater than mg.
d) is less than mg, always.

And when sliding along a horizontal circular path on the inside of a friction-free cone, the magnitude of the normal force
e) is equal to mg.
f) is greater than mg, always.
g) may be greater than mg.
h) is less than mg, always.
i) may be less than mg.

The normal force is perpendicular to the supporting surface.
**Next-Time Question**

The magnitude of the normal force on a block sliding down a friction-free inclined plane:
- a) is equal to mg.
- b) is greater than mg, always.
- c) may be greater than mg.
- d) is less than mg, always.

And when sliding along a horizontal circular path on the inside of a friction-free cone, the magnitude of the normal force:
- e) is equal to mg.
- f) is greater than mg, always.
- g) may be greater than mg.
- h) is less than mg, always.
- i) may be less than mg.

**Answers: d and f**

Vector diagrams help to reveal the answers to these 2 questions. The two forces that act on the block, \( mg \) and the normal force, \( F_N \), must add to a resultant in the direction of the block's acceleration. For the block accelerating down the inclined plane, the resultant is parallel to the plane. The vector diagram shows that \( F_N \) is the side of the red right triangle whose hypotenuse is \( mg \). So the magnitude of \( F_N \) must be less than \( mg \).

For the block circling inside the cone, the resultant is horizontal, directed toward the center of the circle. The vector diagram shows that \( F_N \) is now the hypotenuse of the blue right triangle, with vertical side equal to \( mg \). So \( F_N \) is greater than \( mg \) for any cone angle.

The word "always" is often a red flag. But not here — a distinguishing feature of physics is that its laws are always obeyed.

Can you see that the unlabeled side of the red triangle is equal to \( mg \)? Same for the blue triangle! And notice the parallelogram rule — so useful in vector construction.