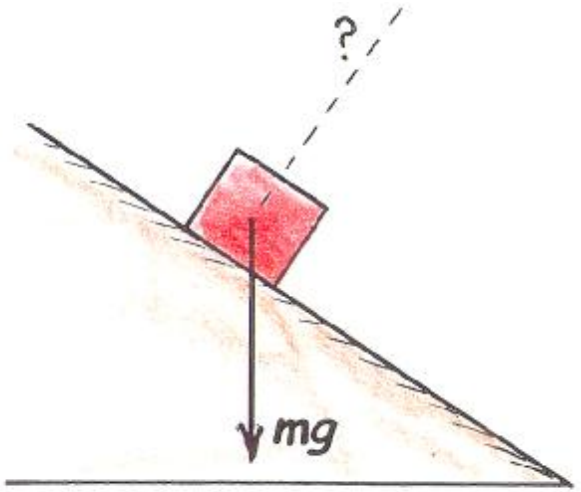
Next-Time Question

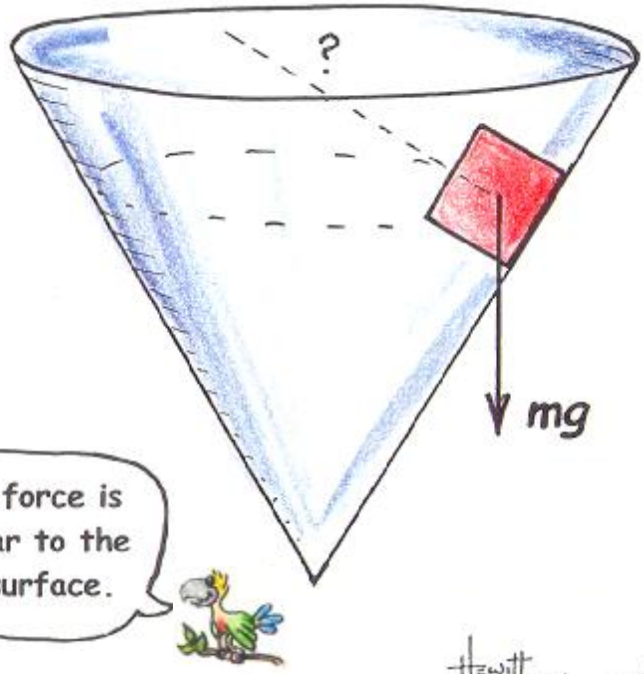
The magnitude of the normal force on a block sliding down a friction-free inclined plane

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*.

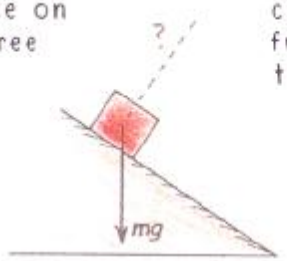


NEXT-TIME QUESTION

CONCEPTUAL Physics

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*.
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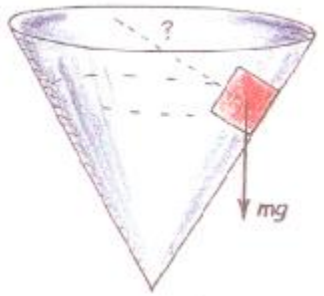
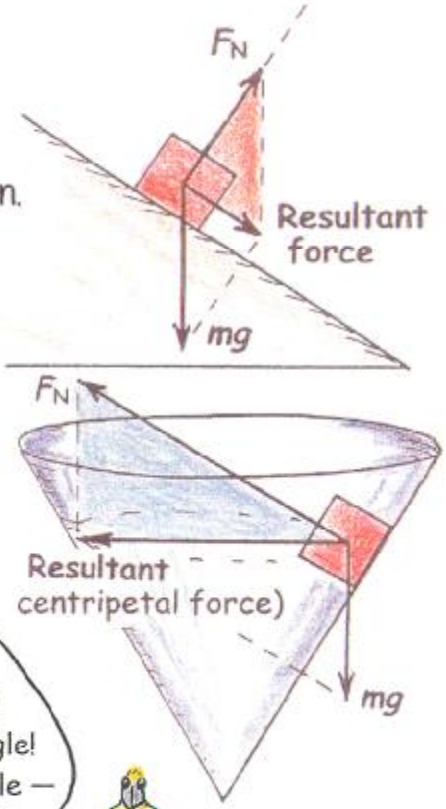


Answers: d and f

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.

Hewitt Drew it!