

**Weight**

- Force of \_\_\_\_\_ ( $F = ma$ )
- Objects near earth \_\_\_\_\_ downward at  $9.80 \text{ m/s}^2$

$$W = mg$$

- Unit: N
- Depends on local \_\_\_\_\_

**Mass**

- Measure of \_\_\_\_\_
- Unit: kg
- \_\_\_\_\_

**Force Problem Solving Strategy**

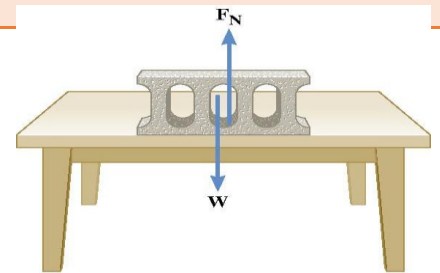
1. Identify the \_\_\_\_\_ involved and \_\_\_\_\_ a \_\_\_\_\_
2. List your \_\_\_\_\_ and \_\_\_\_\_ a \_\_\_\_\_ diagram
3. Apply \_\_\_\_\_
4. Check your \_\_\_\_\_ for \_\_\_\_\_

**Free-body diagram**

Draw only \_\_\_\_\_ acting \_\_\_\_\_ the object  
 Represent the forces with vector \_\_\_\_\_

**Normal Force**

- \_\_\_\_\_ component force between two objects when they \_\_\_\_\_
- Weight pushes \_\_\_\_\_, so the table pushes \_\_\_\_\_
- Newton's \_\_\_\_\_ Law
- Normal force doesn't always = weight
- Draw a \_\_\_\_\_ diagram to find \_\_\_\_\_



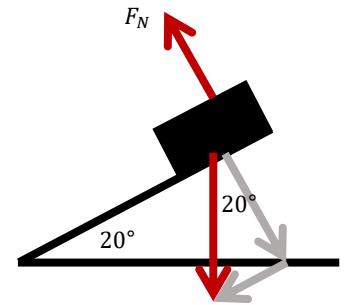
When a problem asks for apparent weight, find the \_\_\_\_\_

A 30-kg box of books is sitting on the floor. A 20-kg child is sitting on the box. What is the normal force between the child and the box?

What is the normal force between the box and the floor?

A lady is weighing some bananas in a grocery store when the floor collapses. If the banana's mass is 2 kg and the floor is accelerating at  $-2.25 \text{ m/s}^2$ , what is the apparent weight (normal force) of the bananas?

A box is sitting on a ramp angled at  $20^\circ$ . If the box weighs 50 N, what is the normal force on the box?



### Practice Work

1. A rock is thrown straight up. What is the net external force acting on the rock when it is at the top of its trajectory?
2. When a body is moved from sea level to the top of a mountain, what changes—the body's mass, its weight, or both?
3. Object A weighs twice as much as object B at the same spot on the earth. Would the same be true at a given spot on Mars? Explain.
4. What direction is the normal force? (RW)
5. A space traveler whose mass is 115 kg leaves earth. What are his weight and mass (a) on earth and (b) in interplanetary space where there are no nearby planetary objects? (Cutnell 4.21)  **$m=115\text{ kg}$ ,  $W=1130\text{ N}$ ;  $m=115\text{ kg}$ ,  $W=0\text{ N}$**
6. A dumbbell weighs 200 N. What is its mass? (RW) **20.4 kg**
7. A rock of mass 45 kg accidentally breaks loose from the edge of a cliff and falls straight down. The magnitude of the air resistance that opposes its downward motion is 250 N. What is the magnitude of the acceleration of the rock? (Cutnell 4.20) **4.2 m/s<sup>2</sup>**
8. A 35-kg crate rests on a horizontal floor, and a 65-kg person is standing on the crate. Determine the magnitude of the normal force that (a) the floor exerts on the crate and (b) the crate exerts on the person. (Cutnell 4.34) **980 N, 640 N**
9. A 10-kg goat stands on a kid's back while playing. (a) What is the normal force on the goat? (b) The goat pushes down with 5 N in order to jump. What is the normal force while the goat is jumping? (RW) **98 N, 103 N**
10. A rocket blasts off from rest and attains a speed of 45 m/s in 15 s. An astronaut has a mass of 57 kg. What is the astronaut's apparent weight during takeoff? (Cutnell 4.35) **730 N**
11. A 50-kg woman is riding on an elevator. What is her apparent weight when it is accelerating upward at 1.5 m/s<sup>2</sup>? (RW) **565 N**
12. What is the apparent weight of an 80-kg man riding tower drop ride that is accelerating at 8.9 m/s<sup>2</sup> downward? (RW) **72 N**
13. What is the apparent weight of a 60-kg woman that is accelerating upwards at 7 m/s<sup>2</sup> while being launched on a slingshot ride? (RW) **1000 N**
14. A 5-kg block rests on a frictionless plane inclined at  $10^\circ$ . What is the acceleration of the block as it slides down the incline? (RW) **1.70 m/s<sup>2</sup>**
15. A 0.05-kg cookie is on a non-stick (frictionless) cookie sheet inclined at  $30^\circ$ . What is the acceleration of the cookie as it slides down the cookie sheet? If the cookie sheet is 0.75 m long, how much time do you have to catch the cookie before it falls off the edge (Note: This is a review question.)? (RW) **4.9 m/s<sup>2</sup>, 0.55 s**