Physics 02-02 Weight and Gravity

Name: _____

Weight

- Force of _____ ($F = ma$)
- Objects near earth _____ downward at 9.80 m/s²

$$W = mg$$

- Unit: N
- Depends on local _____

Mass

- Measure of _____
- Unit: kg
- _____

Newton's Law of Universal Gravitation

Every _____ in the universe exerts a _____ on every other

$$F_G = \frac{Gm_1m_2}{r^2}$$

where:

$G = 6.673 \times 10^{-11} \frac{Nm^2}{kg^2}$

$m_1 and\ m_2$ = _____ *of the objects*

r = _____ between the _____ of the objects

What is the gravitational attraction between a 75-kg boy (165 lbs) and the 50-kg girl (110 lbs) seated 1 m away in the next desk?

Finding Acceleration Due to Gravity

Since weight is the _____ of _____

$$W = mg = \frac{Gmm_E}{r_E^2}$$

$$g = \frac{Gm_E}{r_E^2}$$

Force Problem Solving Strategy

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

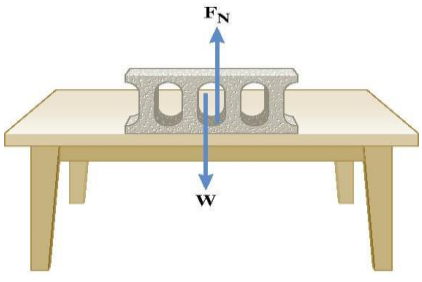
Free-body diagram

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 _____

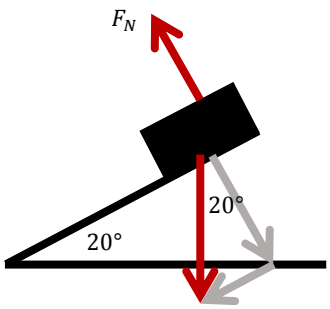


When a problem asks for apparent weight, find the _____

A lady is weighing some bananas in a grocery store when the floor collapses. If the bananas mass is 2 kg and the floor is accelerating at -2.25 m/s², what is the apparent weight (normal force) of the bananas?

Physics 02-02 Weight and Gravity *Name:* _____

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



Homework

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. A bowling ball (mass = 7.2 kg, radius = 0.11 m) and a billiard ball (mass = 0.38 kg, radius = 0.028 m) may each be treated as uniform spheres. What is the magnitude of the maximum gravitational force that each can exert on the other? (Cutnell 4.18) **9.6×10^{-9} N**
5. On earth, two parts of a space probe weight 11000 N and 3400 N. These parts are separated by a center-to-center distance of 12 m and may be treated as uniform spherical objects. Find the magnitude of the gravitational force that each part exerts on the other out in space, far from any other objects. (Cutnell 4.19) **1.8×10^{-7} N**
6. 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 kg, W=1130 N; m=115 kg, W=0 N**
7. What is the acceleration due to gravity on the surface of the Moon? (OpenStax 6.35a) **1.62 m/s²**
8. What is the acceleration due to gravity on the surface of Mars? The mass of Mars is 6.418×10^{23} kg and its radius is 3.38×10^{6} m. (OpenStax 6.35b) **3.75 m/s²**
9. (a) Calculate the acceleration due to gravity on the surface of the Sun. (b) By what factor would your weight increase if you could stand on the Sun? (Never mind that you cannot.) (OpenStax 6.36) **274 m/s², 28 times**
10. What is the acceleration due to gravity as an altitude of 2.0×10^{6} m above the earth's surface? (RW) **5.68 m/s²**
11. 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/s²**
12. 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**
13. 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**
14. A 50-kg woman is riding on an elevator. What is her apparent weight when it is accelerating upward at 1.5 m/s²? (RW) **565 N**
15. What is the apparent weight of a 80-kg man riding tower drop ride that is accelerating at 8.9 m/s² downward? (RW) **72 N**
16. A 5-kg block rests on a frictionless plane inclined at 10°. What is the acceleration of the block as it slides down the incline? (RW) **1.70 m/s²**
17. A 0.05-kg cookie is on a non-stick (frictionless) cookie sheet inclined at 30°. 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 to you have to catch the cookie before it falls off the edge (Note: This is a review question.)? (RW) **4.9 m/s², 0.55 s**