

## Quiz.

1. You can determine the weight of a solid from its density and its volume.
  - a) True.
  - False.
2. How can you change the density of an object?
  - a) compressing or expanding the object
  - b) breaking or cutting the object
  - c) heating or cooling the object
  - d) both a) and c)
  - e) all of the above
3. Which of the following is the densest?
  - a) a slice of bread
  - b) a loaf of bread
  - c) a paper-thin sheet of iron
  - d) an elephant-sized piece of Styrofoam
4. What property of a solid does Hooke's law define?
  - a) density
  - b) elasticity
  - c) strength
5. When an object grows in size while maintaining the same proportions, which increases at the slowest rate?
  - a) cross-sectional area
  - b) surface area
  - c) volume
  - d) weight
6. When an animal grows in size while maintaining the same proportions, which increases at the slowest rate?
  - a) strength
  - b) ability to retain heat
  - c) weight
7. Which structure is at the greatest risk of tension?
  - a) an egg
  - b) a stone arch
  - c) a diving board
8. Which of the following is the most elastic?
  - a) clay
  - b) steel
  - c) aluminum

9. Which animal would need to eat the most in terms of its own weight?
- a) a bird
  - b) a lion
  - c) an elephant
  - d) a giraffe

Answer Key.

1. a)

The density of an object is equal to its mass divided by its volume. If you determine the volume of the object, then you can find the mass, and you can multiply the mass by  $g$  to calculate the object's weight.

2. d)

Expanding or compressing an object changes its volume while keeping the same amount of mass. Heating or cooling an object can accomplish this as well as mechanical manipulation. Cutting or breaking an object (with uniform density) changes the mass and the volume proportionally and would not change the density.

3. c)

A slice of bread should have the same average density as the entire loaf. Styrofoam has the same density no matter what size it is, although an extremely large piece may increase in density due to the compression of its own weight. However, all of these would still be less dense than iron, even if the iron was very thin. Remember, density is a ratio.

4. b)

Hooke's law gives us the relationship between force and change in length of a spring.

5. a)

Areas are two-dimensional, and volumes are three-dimensional. Therefore, when a dimension increases the area will increase by a square of that dimension, and the volume will increase by a cube. Because of this, areas increase at slower rates than volumes, and cross-sectional areas increase at even slower rates. Remember, there are 6 sides to a rectangular cube, and the surface area of a sphere is four times the area of its cross-section-a circle. Weight increases as volume increases since the mass increases with volume at a constant density.

6. a)

This question is related to the previous one. Since cross-sectional area determines strength, surface-area-to-volume dictates the ability to radiate heat, and volume corresponds to weight we see that strength grows the slowest in a growing animal compared to its ability to retain heat and its weight.

7. c)

The catenary shape of an egg and a stone arch are not in danger of tension, and, to a degree, compression actually strengthens their structure. A diving board or cantilever, however, is subject to tension and compression.

8. b)

Clay is the most inelastic of the three, followed by aluminum, and finally steel. The relative inelasticity of aluminum makes it a better choice in car exteriors because the aluminum can absorb more of the energy upon impact than steel during deformation, thereby reducing impact force on the passengers. Since aluminum is also lighter in weight, it is also a good alternative to steel because it can make the car lighter and more fuel efficient.

9. a)

If you've ever heard the phrase "eats like a bird," then you may have been hesitant to select letter a). Birds, especially small birds, actually have to eat much more relative to their body weights than larger animals. While a medium-size bird may eat around twelve percent of its body weight a day, Hummingbirds will eat anywhere from half to eight times their body weight every day!