

CHAPTER 6: Mass and Weight

1. Connect the physical property of matter with its proper definition.

Mass	Generated by the force with which earth's gravity pulls on an object's mass.
Weight	Anything that has mass and volume.
Volume	The amount of space occupied by a specific amount of mass.
Matter	The amount of space an object's matter/mass occupies.
Density	The amount of matter an object contains.

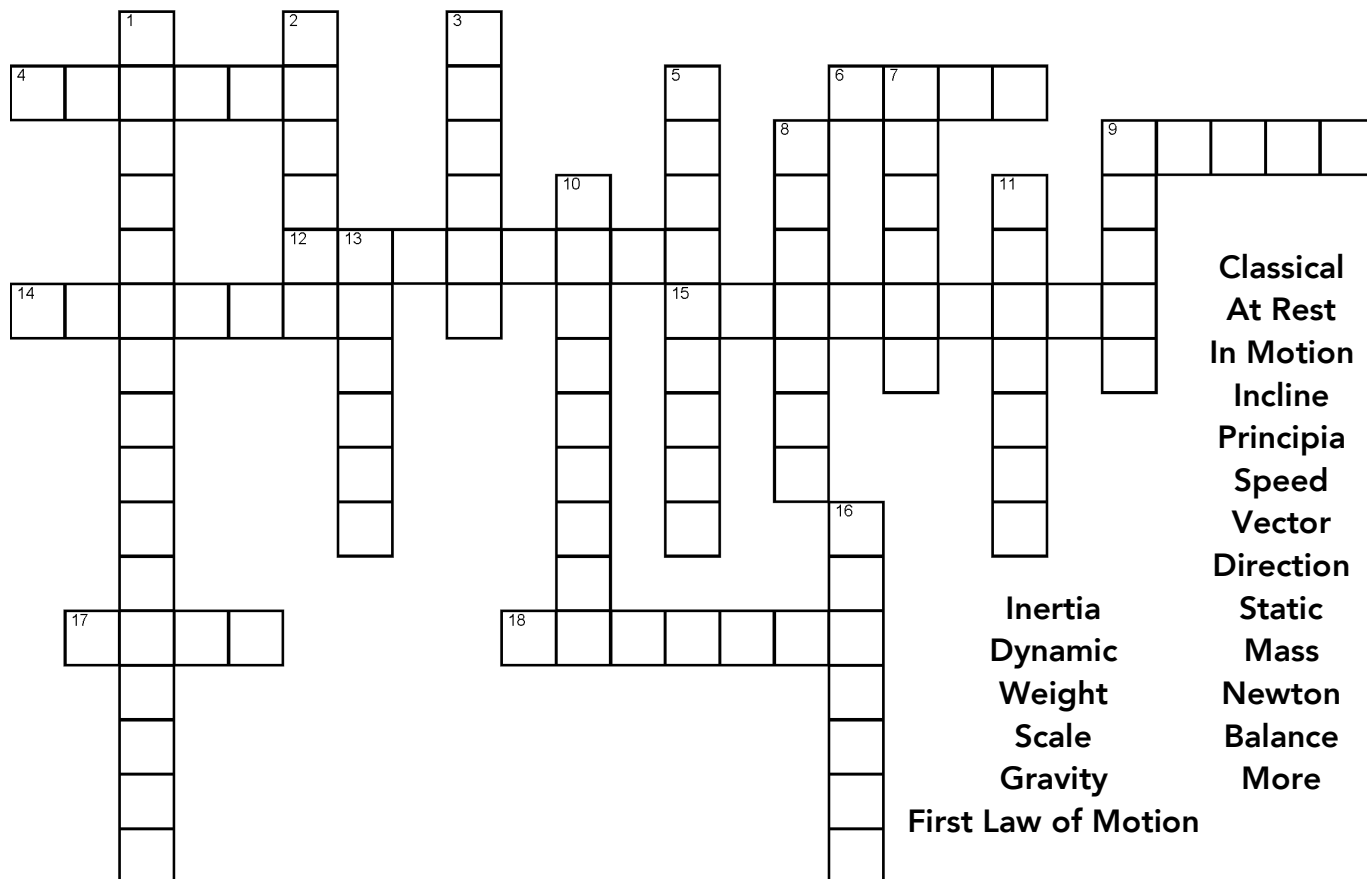
2. The _____ matter an object has, the more mass it has, and the _____ mass it has, the more it weighs. **Word list:** more, less (a word can be used more than once).
3. **True or False?** The more mass an object has, the more matter gravity has to pull down on, which is why weight increases as mass increases.
4. What is the SI unit of weight?
- a. newton
 - b. cm^3
 - c. kilogram
 - d. pound
5. What is the SI unit for mass ("amount of matter an object contains")?
- a. newton
 - b. cm^3
 - c. kilogram
 - d. pound

6. Even though, technically, _____ is reported in units of kg and weight is reported in units of _____, scientists almost always report weight in units of _____. **Word list:** weight, kilograms, pounds, newtons, mass
7. **True or False?** Although it may seem like a somewhat minor issue, the reason that it's scientifically "OK" to report units of weight using units of mass rather than units of weight, requires a somewhat detailed explanation.
8. Choose the correct statements.
- a. Technically, weight is measured with a scale.
 - b. Technically, weight is measured with a balance.
 - c. Technically, mass is measured with a scale.
 - d. Technically, mass is measured with a balance.
 - e. The same mass of a denser object takes up less space than one that is less dense.
 - f. The same mass of a denser object takes up more space than one that is less dense.
 - g. Calibrated mass standards are used to measure mass on a scale.
 - h. Calibrated mass standards are used to measure mass on a balance.
 - i. Practically speaking, it's a lot faster and easier to measure weight on a scale.
 - j. Practically speaking, it's a lot faster and easier to measure mass on a balance.
9. Choose the correct statements. I know there are lot here, but there are many different ways of thinking about the relationship between mass, weight and gravity. I am just trying to get you to think of them from all aspects! This is an important intellectual exercise.
- a. The further away from the center of the earth an object is, the weaker earth's gravity pull is on an object; however, the practical difference that makes in weight is insignificant, which makes reporting weight in kilograms "OK".
 - b. The further away from the center of the earth an object is, the weaker earth's gravity pull is on an object, and the practical difference is so great that everyone should object to reporting weight in kilograms.
 - c. Weight is dependent upon the strength of the gravitational pull of the planet or moon that an object is being weighed on. "Weight changes".
 - d. Weight does not depend on the strength of gravitational pull of the planet of moon than an object is weighed on. "Weight never changes".

- e. Mass is dependent upon the strength of the gravitational pull of the planet or moon that an object is being weighed on. "Mass changes".
- f. Mass does not depend on the strength of gravitational pull of the planet or moon than an object is weighed on. "Mass never changes".
- g. Since the earth is more massive than the moon and the strength of an object's gravity is dependent upon the mass of the object generating the gravity, the earth's force of gravity is stronger than the moon's.
- h. The pull of gravity has nothing to do with the mass of the object generating the force of gravity: therefore, all objects have the same force of gravity pull.
- i. An object has the same weight, whether on the earth or moon.
- j. An object has different weights on the earth and on the moon.
- k. An object has the same mass, whether on the earth or the moon.
- l. An object has different mass on earth and the moon.
- m. If I report an object's weight as 100 N on earth and 16.7 N on the moon, as a physics student you would think, "That's right on. Weight is affected by gravity and the moon's gravity is 16.7% as strong as the earth's. Of course, the object weighs less on the moon".
- n. If I report an object's weight as 100 N on earth and 16.7 N on the moon, as a physics student you would think, "That isn't right because weight is not affected by changes in gravity. That object has the same weight on earth and on the moon."
- o. If I report an object's mass as 100 kg on earth and 16.7 kg on the moon, as a physics student you would think, "That's right on. Mass is affected by gravity and the moon's gravity is 16.7% as strong as the earth's. Of course, the object's mass is less on the moon".
- p. If I report an object's mass as 100 kg on earth and 16.7 kg on the moon, as a physics student you would think, "That isn't right because mass is not affected by changes in gravity. That object has the same mass on earth and on the moon."
- q. We find when dividing an object's weight by its mass the constant ratio—9.8—no matter where ON EARTH the object is weighed. That "on earth" part is very important to understand because it explains why it's OK to report "weight" in units of kilograms instead of newtons. If that ratio between mass and weight doesn't change, it's OK to report weight in units of kilograms.
- r. The 9.8 ratio of weight to mass has nothing to do with anything important. Units are units. Just use whatever.

CROSSWORD

Finish the crossword puzzle below using the words provided.



Classical
At Rest
In Motion
Incline
Principia
Speed
Vector
Direction
Static
Mass
Newton
Balance
More

Inertia
Dynamic
Weight
Scale
Gravity
First Law of Motion

ACROSS

4. Generated by the pull of gravity on an object's mass.
6. The amount of matter an object has.
9. The magnitude component of velocity.
12. Galileo's idea that matter's natural state is to be _____.
14. Tool that measures mass.
15. Another name for "Newtonian" mechanics.
17. The more mass an object has, the _____ inertia it has.
18. The tendency of an object at rest to remain at rest and of an object in motion to remain in motion.

DOWN

1. Also known as the law of inertia.
2. A stationary object with $\sum F = 0$ has this equilibrium.
3. Because velocity is composed of speed and direction, it's this kind of quantity.
5. Newton's book where he described the three laws of motion, gravity and other physics phenomenon.
7. Aristotle's idea was that matter's natural state is to be _____.
8. A moving object with $\sum F = 0$ has this equilibrium.
9. Tool that measures weight.
10. Without this, velocity would just be speed.
11. Physics-speak for "ramp".
13. The SI unit of weight (and force).
16. This pulls down and creates weight.

DEFINITIONS

Classical mechanics

The branch of physics that aims to describe the motion and interaction of macroscopic matter.

Ideal motion

A condition in classical mechanics that describes the normal state of an object in motion ignoring the effects of outside forces.

Inertia

A property of matter where stationary objects tend to remain stationary and moving objects tend to remain moving.

Mass

The quantity of matter an object contains, reported in SI units of kg (or g).

Newtonian mechanics

See classical mechanics.

Newton's first law of motion

Objects at rest stay at rest and objects in motion stay in motion at constant velocity unless acted upon by an outside force.

Rate

The distance a moving body traverses in a specified amount of time.

Speed

The rate at which something is moving, usually expressed in m/s or km/h.

Velocity

A vector composed of speed (magnitude) and direction.

Weight

The gravitational force exerted on an object/body of matter.