

Gravitation - Lesson 14

Mass vs Weight



Mass is an *intrinsic property of an object which is a constant*, whereas **weight** is the *force experienced by the object under a gravitational field*. Weight is proportional to the mass of the object. The mass of an object remains the same everywhere, but its weight changes as g changes. But, in real life, we do interchange these words as if they mean the same. But that is not correct. Mass is something that resists the change in position or velocity of an object, meaning the greater the mass, the greater the force required to move a body. We call this property as inertia. But weight is just the force experienced by an object due to gravity. Incidentally, as acceleration due to gravity is no constant on earth, the force experienced by a body is also no a constant, it changes with loacation. That is why we interchange these, but in reality, weight is a force and is measured in Newtons (N), not Kgs or grams. We can calculate the weight of an object as,

$$W = m \times g \text{ Newtons}$$

We can read it as, $W \propto m$, and hence we use it as an indicator for the mass of the object.

Sidenote: There is no method available to measure mass as it is an intrinsic property. We can only measure its effect. One of its effects is the weight experienced by the object. Therefore

we use different methods to find the weight and then divide the weight by 9.8 to get the mass in Kgs or grams.

Let us look at a few examples:

1. **Example 1:** Weight of an object on earth is 980 *N*. What is its mass?

Answer

Weight, $W = 980 \text{ N}$,

Acceleration due to gravity, $g = 9.8 \text{ m s}^{-2}$.

We know that,

$$\begin{aligned} W &= m \times g \\ \Rightarrow m &= \frac{W}{g} \\ m &= \frac{980}{9.8} \\ m &= 100 \text{ kg} \end{aligned}$$

Thus, the mass of the object is 100 *kg*.

2. **Example 2:** Mass of an object is 50 *kg*. What is its weight on the earth?

Answer

Mass, $m = 50 \text{ kg}$,

Acceleration due to gravity, $g = 9.8 \text{ m s}^{-2}$.

We know that,

$$\begin{aligned} W &= m \times g \\ &= 50 \times 9.8 \\ &= 490 \text{ N} \end{aligned}$$

Thus, the weight of the object is 490 *N*.

3. **NCERT Example:** Mass of an object is 10 *kg*. What is its weight on the earth?

Answer

Mass, $m = 10 \text{ kg}$,

Acceleration due to gravity, $g = 9.8 \text{ m s}^{-2}$.

We know that,

$$\begin{aligned}W &= m \times g \\&= 10 \times 9.8 \\&= 98 \text{ N}\end{aligned}$$

Thus, the weight of the object is 98 N.

You should, now, be able to answer the following questions:

1. Does mass of an object depend on location?
2. Does weight of an object depend on location?
3. Calculate your weight. Will you weigh the same on the north pole?
4. Inertia is the direct measure of _____?

Conclusion

Mass is a property of an object which is directly proportional to inertia whereas weight is the force experienced by an object due to gravity, it varies with a change in acceleration due to gravity.

Note to Teacher

The goal of the text is to state the clear distinction between mass of an object versus its weight. One is the fundamental property of matter and other is just the consequence of gravity. Although, these words are colloquially interchanged, the text tries to draw a clear distinction between them.

Student Worksheet

1. What is the force experienced by any object under the influence of the earth's gravity?
2. What is the other name for this?
3. Can the mass of an object change (assuming nothing is done to the object physically)?
4. What is the SI unit of mass?
5. What is the SI unit of weight?

6. How do you calculate the weight of an object on earth?
7. Calculate your weight?
8. Will you weigh the same if you were at the north pole?

Answers

1. No
2. Yes
3. _____ *kg*. No, the weight will be more on north pole as acceleration due to gravity is more at the north pole.
4. Mass

Student Worksheet Answers

1. $F = mg$
2. Weight
3. No
4. Kilograms or *kg*
5. Newtons or *N*
6. $weight = mass \times 9.8$
7. $weight = 40\text{ kg} \times 9.8 = 392\text{ N}$
8. No