Weight or Mass?

Q: Aren't "weight" and "mass" the same?

A: Not really.

An object **has mass** (say 100 kg).

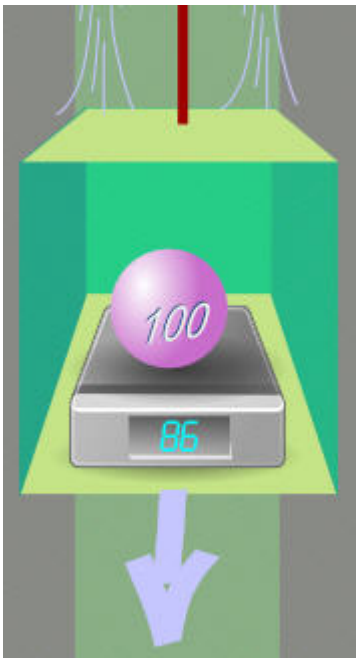
This makes it heavy enough to **weigh** 100 kg

But put the object in an elevator as its moves faster and faster downwards ...

... it **weighs less**! (in this example 86 kg)

But it still has a mass of 100 kg.

So ... they can be different!



Mass is a measure of how much matter something contains

Weight is a measure of downwards force.

An object's **mass doesn't change** (unless you remove some!), but its **weight can change**.

Just jump up and down (gently!) on your scales at home to see your weight change, while your mass stays the same.

Why Do People Say Weight instead of Mass?

People often use "weight" to mean "mass", and vice versa.

Because we usually weigh things when they are sitting still, with only gravity pulling down. So we don't notice a difference.

But remember .. they do not mean the same thing,
*and they **can** have different measurements.*

Here are some conditions where the weight might change:

- elevator (as it speeds up or slows down)
- in space (can be weightless!)
- on the moon (a 100 kg mass would weigh 16.6 kg)
- in an airplane (when rising or falling faster)
- you can even get slight differences in weight in different locations on earth!

Question: If the elevator was accelerating UP, what would happen to the weight?

Weight is a Force

Now we know that weight and mass are different, why are they both in kilograms?

Well, weight isn't really in kilograms!

I have used "kilogram" so far because that is what you would see on a pair of scales, but it is **technically wrong to talk about weight in kilograms** ...

> ... so sometimes people say "kilogram force" (kgf) or "pound force" (lbf) to show that they are talking about **the force that the mass exerts** because gravity is pulling down on it.
>
> But there is a better measurement ... **Newtons**

Newtons

The correct unit for force is the **Newton** (1 kg·m/s^2) which is abbreviated **N**.

Gravity makes a 1 kilogram **mass** exert about 9.8 Newtons of **force**

So a 100kg mass really weighs about 980 Newtons.

Why Scales Show Kilograms or Pounds

But scales show Kilograms or Pounds because that is what people understand best ...

... but it is really just an **estimate of the mass** above them.

Scales should really show Netwons, but that might confuse people!

Question: how many Newtons should the scales show when you stand on them?

Changing Speed

Have you noticed how you feel lighter when an elevator starts moving down, and you feel heavier when it slows again?

That is because the speed needs to be changing to affect the weight!

If the elevator is moving at a constant speed there is no difference in the weight compared to when it is sitting still.

Why? It takes **force** to make something move **faster (or slower)**. If something moves at the same speed you will not feel any extra force.

That is why you can sit in a speeding car or train, and everything seems normal (unless the driver speeds up or puts the brakes on).

Conclusion

- Mass is a measure of how much matter something contains
- Weight is a measure of downwards force
- Force is measured in Newtons, not kilograms or pounds
- When scales show "kg" or "lb" it is just an estimate of the mass above them

http://www.mathsisfun.com/measure/weight-mass.html