SQA Higher **Physics**
Formula Sheet

Force, Mass & Acceleration

This equation is a simple statement of Newton's 2nd Law of of Motion.

$$F = ma$$

Where F is the force acting on an object and is measured in Newtons (named for the man himself – **read about him here**). m is the mass of the object in kg and a is the acceleration of the object in meters per second per second or m s^{-2}.

So we can see that the force gets larger if you increase the mass of an object or the acceleration of an object. In other words the more mass, the more force you need to accelerate an object – that's useful just to keep in your mind.

One of the key things to remember is that if a force is being applied to an object **it is accelerating.** If an object is still, or if it is moving at a constant speed, then no force is being applied.

That is why we keep having to apply the accelerator in a car. The friction between the tyres and the road are a force that is causing the car to slow, so it needs a constant force, being provided by the petrol being burned in the engine, to keep it moving forwards.

An example…

This Boeing 747 has a mass of 117,000 kg. It accelerates down a runway with a force of 468,000 N.

How fast is it accelerating?

$$F = ma$$

$$\frac{F}{m} = a$$

$$\frac{468000}{117000} = 4\ ms^{-2}$$

This equation has a very close relation…

So have you made this link in your brain already? We know that mass and weight are related but different and that weight is different depending on which planet you are on because of gravity. We also know weight is measured in Newtons and that means it's a Force (F). We also know that g is the acceleration due to gravities pull on a body, so that's the equivalent of a in F = ma. So this is an example of the vertical application of the horizonal version, F = ma!

$$W = mg$$