Terminal Velocity and Projectiles

Acceleration Due To Gravity

An object that falls freely will accelerate towards the Earth because of the force of gravity acting on it.
The size of this acceleration does not depend mass, so a feather and a bowling ball accelerate at the same rate. On the Moon they hit the ground at the same time, on Earth the resistance of the air slows the feather more than the bowling ball.
The size of the gravitational field affects the magnitude of the acceleration. Near the surface of the Earth the gravitational field strength is 9.81 N/kg. This is also the acceleration a free falling object would have on Earth. In the equations of motion **$a = g$ = 9.81 m/s.**

Mass is a property that tells us how much matter it is made of.

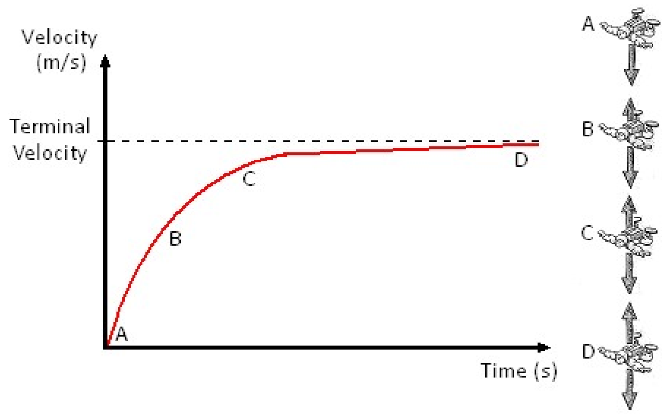
Mass is measured in kilograms, kg

Weight is a force caused by gravity acting on a mass:
weight = mass x gravitational field strength $\boxed{w = mg}$

Weight is measured in Newtons, N

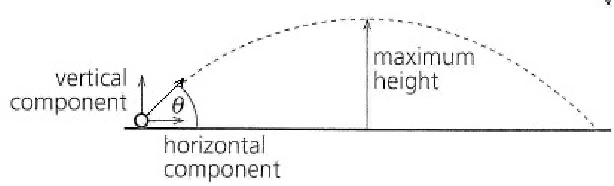
Terminal Velocity

If an object is pushed out of a plane it will accelerate towards the ground because of its weight (due to the Earth's gravity). Its velocity will increase as it falls but as it does, so does the drag forces acting on the object (air resistance). Eventually the air resistance will balance the weight of the object. This means there will be no overall force which means there will be no acceleration. The object stops accelerating and has reached its terminal velocity.



Projectiles

An object kicked or thrown into the air will follow a parabolic path like that shown to the right.
If the object had an initial velocity of u, this can be resolved into its horizontal and vertical velocity (as we have seen in Lesson 2)



The horizontal velocity will be $u\cos\theta$ and the vertical velocity will be $u\sin\theta$. With these we can solve projectile questions using the equations of motion we already know.

Horizontal and Vertical Motion

The diagram shows two balls that are released at the same time, one is released and the other has a horizontal velocity. We see that the ball shot from the cannon falls at the same rate at the ball that was released. This is because the horizontal and vertical components of motion are independent of each other.

Horizontal: The horizontal velocity is constant; we see that the fired ball covers the same horizontal (across) distance with each second.
Vertical: The vertical velocity accelerates at a rate of g (9.81m/s^2). We can see this more clearly in the released ball; it covers more distance each second.

The horizontal velocity has no affect on the vertical velocity. If a ball were fired from the cannon at a high horizontal velocity it would travel further, but still take the same time to reach the ground.