



Projectile motion

- A projectile is any object or body that is in flight.
 - The flight path (**trajectory**) of the object is influenced by gravity and air resistance.
- There are **three key factors** that determine the path of the projectile:
1. Angle of projection
 2. Height of projection
 3. Velocity of projection
- There is a relationship in projectile motion between the vertical velocity and the horizontal velocity. This relationship and distance are dependent upon the three key factors outlined above.
 - A **parabola** is a symmetrical curve, the path of a projectile follows this curve under the influence of gravity.

Fluid mechanics – Streamlining

- Streamlining allows athletes to conserve energy and improve performance.
- Technological advancement in equipment and coaching has allowed companies and coaches to design or improve techniques that present little resistance to fluid (gas or liquid), increasing speed and ease of movement.

Fluid mechanics – Drag force

- Drag forces resist motion and therefore performance.
 - Performers need to overcome drag forces.
- Three factors affecting drag:**
- Cross sectional area – cycling in a crouched position.
 - Surface properties – swimming caps.
 - Speed of the object – increased speed = increased air resistance.

Bernoulli effect

- This principle refers to changes in fluid (water and air) speeds due to changes in pressure.
- If a fluid flows around an object at different speeds, the slower moving fluid will exert more pressure on the object than the faster moving fluid.
- The object will then be forced towards the faster moving fluid (low pressure). A product of this event is either lift or down force.

In summary:

- Where the speed of air flow is fast, pressure is low.
- Where the speed of air flow is slow, pressure is high.
- The resulting pressure differential results in a force moving from the area of high to low pressure.

Magnus effect

- This is the Bernoulli principle applied to spinning objects.
- The side of the object that is spinning in the direction of the air will result in a high velocity air flow and therefore low pressure.
- For example, curling the ball in towards the posts in a penalty kick.

Fluid mechanics – Laminar and turbulent flow

- As fluid flows past an object, the fluid nearest the object slows down because of its viscosity.
- This region is called the boundary layer.
- By altering the boundary layer, drag can be reduced.
- There is a dramatic change in drag as flow transitions from laminar to turbulent, resulting in a 65% reduction in drag.

Bernoulli effect example – Discus throw

- Air travels further over the top of the discus, moving faster than the air underneath.
- Pressure on top of the discus is lower than the pressure underneath.
- This creates a pressure differential, resulting in a lifting force, helping the discus travel further.
- The lifting force increases the horizontal range by giving the discus a non-parabolic flight path, keeping the discus in the air for longer.