2011 USATF Coaching Education Level 2 Biomechanics Fundamental Concepts Review

Mass –

Center of Mass –

Force –

Torque –

Displacement –

Velocity –

Acceleration –

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Mass – the amount of matter in an object
> **Units: Kilogram**, *ounce, slug*
> **In Formulas: m**

Center of Mass – an imagined "average" location of the mass in an object
> **Shorthand**: **CoM**

Force – something that tends to change the state of motion of an object
> **Units: Newton**, *pound*
> **In Formulas: F**

Torque – a rotational force often seen as a linear force applied on a line away from the CoM
> **Units: Newton-Meters**, *foot-pounds*
> **In Formulas: τ**

Displacement – change in position of an object described by the linear distance or angle between its initial and final positions and the direction from the initial position to the final position
> **Units: meters**, *feet, or* **radians**, *degrees*
> **In Formulas: s or θ**

Velocity – the rate of change of displacement **($\Delta s/\Delta t$ or $\Delta\theta/\Delta t$)**
> **Units: meters per second (m/s)**, *mph,*
> *or* **radians per second**, *revolutions per minute (rpm)*
> **In Formulas: v or ω**

Acceleration – the rate of change of velocity **($\Delta v/\Delta t$ or $\Delta\omega/\Delta t$)**
> **Units: meters per second per second (m/s^2),**
> *or* **radians per second squared**, *degrees per second per second*
> **In Formulas: a or α**

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Newton's (3) Laws of Motion

Moment of Inertia –

Momentum –

Impulse –

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Newton's (3) Laws of Motion

Newton's First Law – on object will maintain a constant state of motion unless acted upon by an unbalanced external force.

Newton's Second Law – an unbalanced force applied to an object will cause the object to accelerate at a rate directly proportional to the force and inversely proportional to the mass or moment of inertia of the object **(F=ma or $\tau=I\alpha$)**

Newton's Third Law – for every force exerted on an object, the object in turn exerts an equal force simultaneously in the opposite direction

Moment of Inertia – an object's resistance to a change in its state of rotational motion determined by the mass of the object and its distribution relative to the axis of rotation
     In Formulas: *I*

Momentum – the product of an object's mass or Moment of Inertia and velocity **(mv or $I\omega$)**
     In Formulas: *p*

Impulse – something that changes an object's momentum; the product of force or torque and time **(F*Δt or τ*Δt)**