Impulse – Momentum

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Newton's Laws of Motion

- Law of Uniform Motion
  - Every object continues in its state of rest or of uniform motion in a straight line unless a force changes the motion.
- Law of Acceleration
  - The rate of change of motion of an object is proportional to the force applied "on" the object and in the direction of the line of application of the force.
- Law of Action-Reaction
  - For every force applied "on" an object, there is an equal and opposite force applied "by" the object.

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Newton's Laws of Motion

- Law of Acceleration
  - When a force acts ON an object, it causes acceleration ($\Sigma F_{ON} = ma$)
  - F_{ON} = a force acting on the object
    - Force units: N or kgm/s^2
  - 'm' = mass of an object (units: kg)
  - Inertia: Object's resistance to change motion
    - Quantified by measuring mass
    - Units: kg

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$\Sigma F_{on} = m a_{com}$

$F = m a \quad a = \frac{\Delta v}{\Delta t}$

$\Delta t \cdot F = m \frac{\Delta v}{\Delta t} \cdot \Delta t$

$F \Delta t = m \Delta v$

$F \Delta t = \Delta (mv)$

Impulse (units) momentum

$F \Delta t = m v_f - m v_i$

units: $Ns = kg\,m/s$

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Impulse-Momentum

- Why go through knee flexion during landing?

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Impulse-Momentum

- Throwing / Catching

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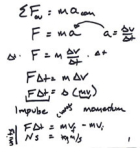
Impulse-Momentum

- $\Sigma F_{ON}\,\Delta t = (mv_f - mv_i)$



- Impulse = $F\Delta t$ (Units: Ns)
- Momentum = mv (Units: kgm/s)
- "Impulse causes a ***change*** in momentum"

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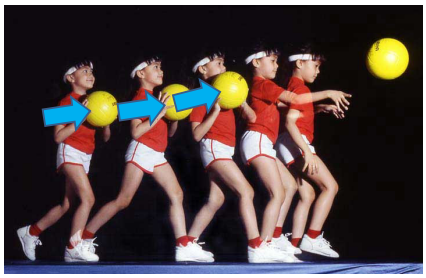

Impulse is the product of force and how long that force acts on the object.

Impulse causes a change in momentum of the object.

$F\,\Delta t = (mv_f - mv_i)$

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Unit Analysis

- Impulse units: Ns
- Momentum units: kgm/s

unit analysis

$F\Delta t = \Delta(mv)$

$Ns = \frac{kgm}{s}$

$\frac{kgm}{s^2} \cdot s = \frac{kgm}{s}$

$\frac{kgm}{s} = \frac{kgm}{s}$

Impulse unit's = Ns

momentum units = $\frac{kgm}{s}$

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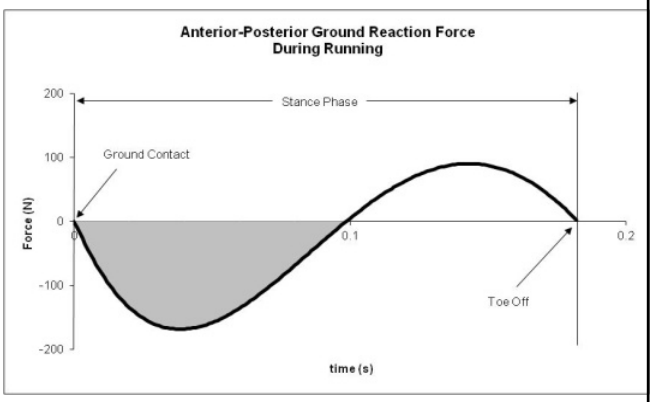

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Impulse-Momentum

- Impulse
  - Product of force applied and length of time applied
    Impulse = FΔt
    Units: Ns
- Momentum
  - Quantity of motion
    Momentum = mv
    Units: kgm/s
- Impulse causes a ***change*** in momentum
  FΔt = Δmv

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