CONCEPT: IMPULSE

● When you push an object with some $\boldsymbol{F}$ over some $\boldsymbol{\Delta t}$, you *change* its momentum:

___ = _____ = ____= _____

Units: **[____] OR [_____]**

- This is called an **_____**.

- We obtain this by writing **Newton's 2nd Law** in terms of momentum:

$\boldsymbol{F = ma}$ **= _____ = _____ = _____**

EXAMPLE**:** You push a 50kg crate initially at rest on a smooth, horizontal surface with a constant 100N force for 8 seconds**.** Calculate **a)** the impulse that you deliver to the crate and **b)** the crate's speed after 8 seconds**.**

● **Impulse** is similar to **Work:**

$\boldsymbol{W \equiv F\Delta x = \Delta K}$

DEFINED AS — CAUSES

___ ≡ _____ = _____

PROBLEM: You throw a 100-g ball with 30m/s. If the ball is in your hand for 0.2s during the throw, **a)** calculate the impulse you deliver to it. **b)** Calculate the average Force that you exert on the ball.

A) **J** = 3,000 kg·m/s, F_{avg} = 15,000 N
B) **J** = 3 kg·m/s, F_{avg} = 15 N
C) **J** = 0.2 kg·m/s, F_{avg} = 1 N
D) **J** = 2 kg·m/s, F_{avg} = 10 N

MOMENTUM
$p = mv$
$J = F\Delta t = \Delta p = mv_f - mv_0$

PROBLEM: A 150-g rubber ball is moving at 40m/s to the right, when it hits a wall and bounces back. After the bounce, the ball is moving at 45m/s to the *left*. **a)** Calculate the impulse delivered to the ball during the bounce. **b)** If the wall exerts an average force of 410N during the bounce, calculate the amount of time the ball is in contact with the wall.

MOMENTUM
$p = mv$
$J = F\Delta t = \Delta p = mv_f - mv_0$

PROBLEM: You catch a 0.6 kg ball initially moving with 10 m/s. Calculate the impulse delivered to the ball during the catch.

MOMENTUM
$p = mv$
$J = F\Delta t = \Delta p = mv_f - mv_0$

PROBLEM**:** A 1200-kg car moving at 20m/s slams into a wall**.** The car comes to a stop after compressing 1.0m into the wall**.** **a)** Assuming the acceleration during this collision is *constant*, how long does this collision last? **b)** Use momentum/impulse to find the magnitude of the average force the wall exerts on the car during the collision**.**

MOMENTUM
$\boldsymbol{p = mv}$
$\boldsymbol{J = F\Delta t = \Delta p = mv_f - mv_0}$

UAM Equations
(1) $\boldsymbol{v = v_0 + at}$
(2) $\boldsymbol{v^2 = {v_0}^2 + 2a\Delta x}$
(3) $\boldsymbol{\Delta x = v_0 t + \frac{1}{2}at^2}$
(4) $\boldsymbol{\Delta x = \left(\frac{v+v_0}{2}\right)t}$