Warm-up:

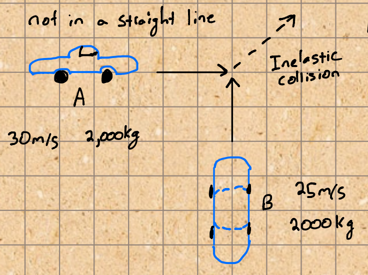
Loosen Up! II

Impulse is found by multiplying the force acting on an object by the amount of time the force acts. The amount of impulse that an object experiences is equal to the amount that its momentum changes. This means that the same change in momentum can be accomplished by exerting a large force for a short amount of time or a small force for a longer amount of time.

Seat belts are designed to give a little when they are properly fastened. If not, they would not work as well at keeping you from injury in an accident or sudden stop. Use the concept of impulse equaling the change in momentum to explain why they need to give.

$\Delta p = J = F \cdot t = p_f - p_i$

- Momentum $\vec{\text{Vectors}}$: Momentum is still conserved even when objects are not in a straight line



Find $p_f = p_{A+B}$

$p_A + p_B = \vec{p}_{AB}$

$A^2 + B^2 = c^2$

$\sqrt{(30 \cdot 2{,}000)^2 + (25 \cdot 2000)^2} = c$

$p_{A+B} = 78{,}102 \text{ kg m/s}$

- Work: measured by force across a certain distance
  - ↳ No distance = No work
  - ↳ Work = Force · Distance
    - SI unit = N·m

Practice:

1) 250 N box is lifted 2.0 m above ground, how much work is done?

$1 Nm = 1 J$

$W = F \cdot d = 250N \cdot 2m = 500 Nm$ ↳ J

2) How much work is done to carry it horizontally for 10.0 m? ✭ To counteract gravity

No net force in vertical direction = No work !

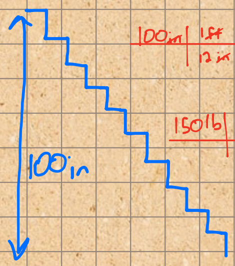
- Power: rate at which work is done
  - ↳ $\text{Power} = \frac{\text{Work}}{\text{time}} = \frac{F \cdot d}{t} \rightarrow$ units: $\frac{N \cdot m}{s} = \frac{kg\,m^2}{s^3}$ = Watt [W]

1 Horse power = 746 W

Ex: How much power is used when a 150 lb person runs up 10 stairs in 2.3 s? Each stair = 10 in

Calculate in HP [746 W = 1 Hp] [12 in = 1 ft]

[3.28 ft = 1 m] [2.2 lb = 1 kg]



$$\frac{100\,\text{in}}{} \cdot \frac{1\,\text{ft}}{12\,\text{in}} \cdot \frac{1\,\text{m}}{3.28\,\text{ft}} = 2.54\,\text{m}$$

$$\frac{150\,\text{lb}}{} \cdot \frac{1\,\text{kg}}{2.2\,\text{lb}} = 68.2\,\text{kg}$$

$$\text{Power} = \frac{\text{Work}}{\text{time}} = \frac{F \cdot d}{t} = \frac{m \cdot g \cdot d}{t} = \frac{68.2\,\text{kg} \cdot 9.8\,\text{m/s}^2 \cdot 2.54\,\text{m}}{2.3\,\text{s}} = 738.1\,\text{W}$$

$$\frac{738.1\,\text{W}}{} \cdot \frac{1\,\text{Hp}}{746\,\text{W}} = \boxed{0.99\,\text{Hp}}$$