PP|186

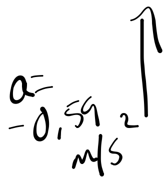
21.

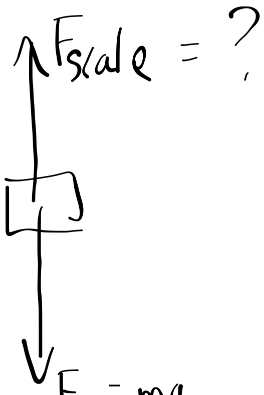
$m = 64 kg$

$a = -0.59 m/s^2$

(going up|slowing down)

$F_{scale} = ?$





$F_g = mg$

$F_g = (64 kg)(9.81 m/s^2)$

$F_g = 627.84 N$

$$\vec{F}_{net} = m\vec{a}$$

$$F_{scale} - F_g = ma$$

$$F_{scale} = ma + F_g$$

$$F_{scale} = (64 kg)(-0.59 m/s^2) + 627.84 N$$

$$F_{scale} = -37.76 N + 627.84 N$$

$$F_{scale} = 590.08 N$$

$$F_{scale} = 5.9 \times 10^2 N$$

↑ feel lighter (negative acc)

§5-4 Momentum + Newton's Laws (p195)

Momentum - the product of an object's mass and its velocity; a vector quantity; units: kg·m/s

$$\vec{p} = m\vec{v}$$

where $\vec{p}$ is the momentum (kg·m/s)
m is the mass (kg)
$\vec{v}$ is the velocity (m/s)

MP/197

$m = 0.300\,kg$
$\vec{v} = 5.55\,m/s\,[N]$
$\vec{p} = ?$

$\vec{p} = m\vec{v}$
$\vec{p} = (0.300\,kg)(5.55\,m/s\,[N])$
$\vec{p} \doteq 1.66\,kg \cdot m/s\,[N]$

Impulse - the product of the force (unbalanced) acting on an object and the time interval over which it acts.
A vector quantity ; units: N·s

$$\vec{J} = \vec{F}\Delta t$$

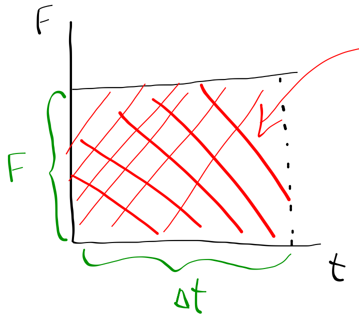
where $\vec{J}$ is the impulse (N·s)
$\vec{F}$ is the unbalanced force (N)
Δt is the time interval over which the force acts (s)

mp/199

$\vec{F} = 5.25 \times 10^3 N [W]$
$\Delta t = 5.45 \times 10^{-4} s$
$\vec{J} = ?$

$\vec{J} = \vec{F}\Delta t$
$\vec{J} = (5.25 \times 10^3 N [W])(5.45 \times 10^{-4} s)$
$\vec{J} = 2.86 \text{ N·s } [W]$

Consider a Force acting on an object:



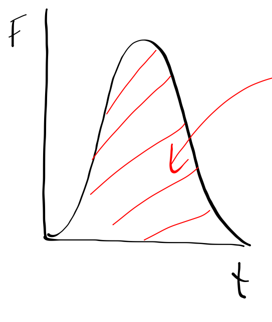
Area of rectangle = l x w

Area = $F\Delta t$

But impulse ($J = F\Delta t$)

So Area (F-t) = IMPULSE

Often the F-t looks like this: (hitting golf ball, hockey puck, etc)



Area = Impulse

Find area:
1. count squares
2. use Calculus
3. use technology.

The Impulse-Momentum Theorem

Recall Newton's Second Law:

$F = ma$

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

$F\Delta t = m\Delta v$

$F\Delta t = m(v_2 - v_1)$

$F\Delta t = mv_2 - mv_1$

$F\Delta t = p_2 - p_1$

$F\Delta t = \Delta p$

Impulse-momentum Theorem: Impulse = change in momentum

$\vec{F}_{net}\Delta t = m\Delta\vec{v}$ ← practical

$\therefore \vec{J} = \Delta\vec{p}$ ← concept

MP|201

$m = 0.060$ kg

$\vec{v}_1 = 48$ m/s [towards wall] (+)

$\vec{v}_2 = 35$ m/s [away from wall] (−)

a) $\vec{J} = ?$

b) if $\Delta t = 25$ ms, $\vec{F}_{\text{wall on ball}} = ?$

a) According to the Impulse-Momentum Theorem, the impulse is equal to the change in momentum

$\vec{J} = \Delta\vec{p}$ → $p_2 - p_1$

$\vec{J} = m\Delta\vec{v}$ — $mv_2 - mv_1$, $m(v_2 - v_1)$, $m\Delta v$

$\vec{J} = 0.060\text{kg}\,(-35\text{m/s} - 48\text{m/s})$

$\vec{J} = -4.98$ kg·m/s (N·s)

$\vec{J} = 5.0$ kg·m/s [away from the wall]

N·s = $\frac{\text{kg}\cdot\text{m}}{\text{s}^2}\cdot\text{s}$ = $\text{kg}\cdot\frac{\text{m}}{\text{s}}$

b) $\vec{J} = \vec{F}\Delta t$

$\vec{F} = \frac{\vec{J}}{\Delta t}$

$\vec{F} = \frac{5.0\text{ kg}\cdot\text{m/s [away from wall]}}{25\times10^{-3}\text{ s}}$

$\vec{F} = 2.0\times10^{2}$ N [away from wall]

↑ the force of the wall on the ball

Newton's 3rd Law → the force of the ball on the wall is equal but opposite: 2.00×10^{2} N [towards the wall]

TO DO

1. PP|197 (momentum)
2. PP|200 (impulse)
3. PP|203 (imp-mom)