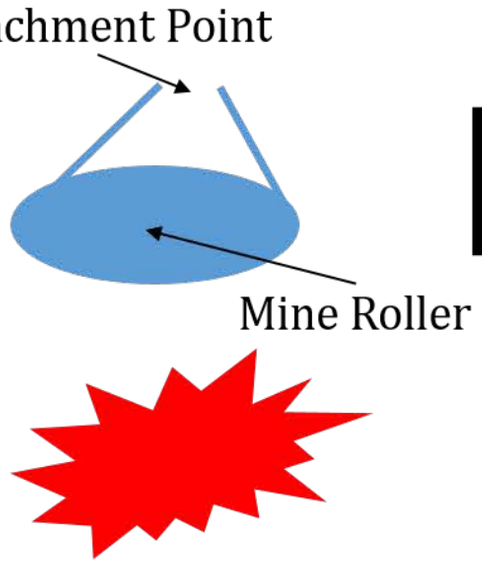
The Scenario

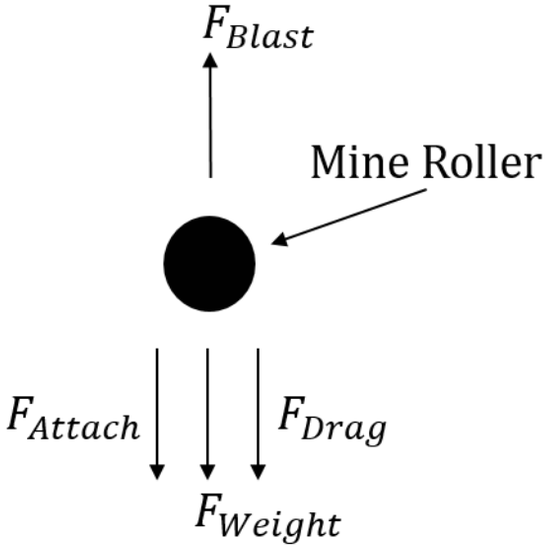
The Scenario Simplified

Simplify



Model

The Free Body Diagram



$$mx'' = \sum Forces$$

Variables and Parameters

$x \equiv Verticle\ displacement\ of\ the\ roller$

$t \equiv Time$

$m \equiv Mass$

$g \equiv Gravity$

$\gamma \equiv Damping\ Constant$

$T \equiv Estimate\ for\ the\ Time\ the\ Roller\ Breaks\ From\ its\ Mount$

The Model

$$mx'' = F_{Blast} - F_{Attachment} - F_{Weight} - F_{Drag}$$

3 Versions of a Model:

$$mx'' = Ae^{-bt} - Ce^{-dt} - mg - \gamma x'$$

Or

$$mx'' = Ae^{-bt} - C - mg - \gamma x', \qquad t < T$$

$$mx'' = Ae^{-bt} - mg - \gamma x', \qquad t \geq T$$

Or

$$mx'' = -Ce^{-dt} - mg - \gamma x', \qquad x'(0)\ from\ the\ blast$$

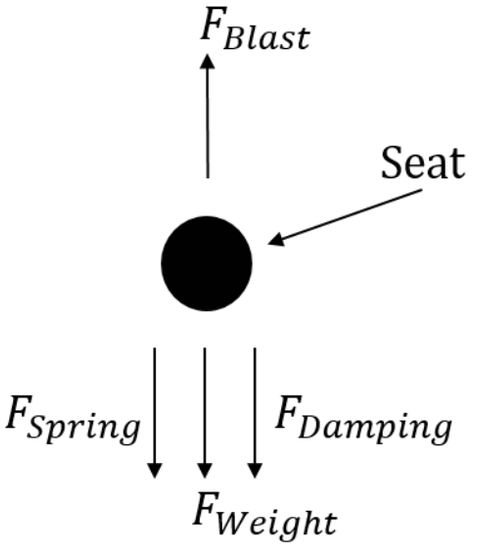
The Scenario

Simplify

The Scenario Simplified

Model

The Free Body Diagram



$$mx'' = \sum Forces$$

Variables and Parameters

$x \equiv Verticle\ displacement\ of\ the\ seat$
$t \equiv Time$
$m \equiv Mass$
$g \equiv Gravity$
$\gamma \equiv Damping\ Constant$
$k \equiv Spring\ Constant$
$H \equiv Time\ the\ Blast\ Ends$

The Model

$$mx'' = F_{Blast} - F_{Spring} - F_{Weight} - F_{Damping}$$

$$mx'' = F_{Blast} - k(x + L) - mg - \gamma x'$$

$$mx'' + \gamma x' + kx = F_{Blast}$$

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2 Versions of a Model:

$$mx'' + \gamma x' + kx = Ae^{-bt}$$

Or

$$mx'' + \gamma x' + kx = D \qquad t < H$$

$$mx'' + \gamma x' + kx = 0 \qquad t \geq H$$

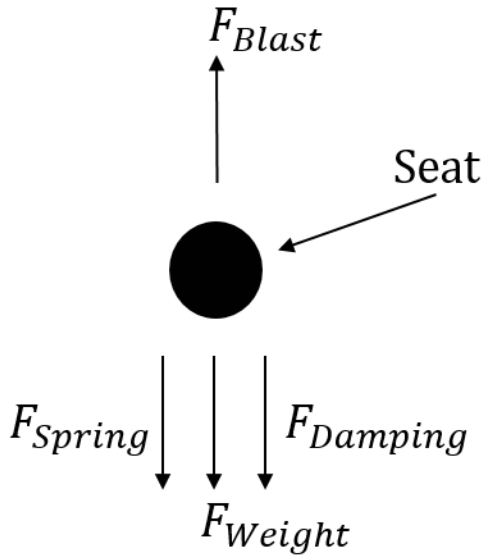
The Scenario

The Scenario Simplified

Simplify

The Free Body Diagram

Model



$$mx'' = \sum Forces$$

Variables and Parameters

$x \equiv Verticle\ displacement\ of\ the\ seat\ [cm]$
$t \equiv Time\ [ms]$
$m \equiv Mass\ [kg]$
$g \equiv Gravity\ [m/s^2]$
$\gamma \equiv Damping\ Constant\ [kg/ms]$
$k \equiv Spring\ Constant\ [kg/ms^2]$
$T \equiv Time\ of\ the\ Blast\ [ms]$

$$u_T = \begin{cases} 1, & t \geq T \\ 0, & t < T \end{cases}$$

The Model

$$mx'' = F_{Blast} - F_{Spring} - F_{Weight} - F_{Damping}$$

$$mx'' = F_{Blast} - k(x + L) - mg - \gamma x'$$

$$mx'' + \gamma x' + kx = F_{Blast}$$

$$mx'' + \gamma x' + kx = 100(u_T - u_{T+20}), x(0) = 0, x'(0) = 0$$