

IRON MAN: POWERED BY PHYSICS (AND A LITTLE GENIUS)

How can one man fly, fight, & fall from the sky without breaking every bone?

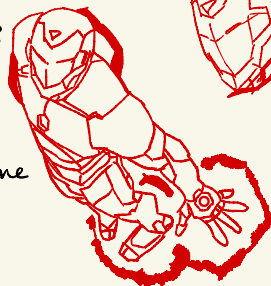
Iron man's suit may be fictional, but real-world physics helps us understand how Tony Stark pulls it off.



Newton's 3rd Law:

$$F = ma \text{ (thrust needs to overcome weight).}$$

$$\begin{aligned} \rightarrow \text{suit mass} &= 100 \text{ kg} \\ \rightarrow \text{Tony} &= 75 \text{ kg} \end{aligned} \quad \left. \vphantom{\begin{aligned} \rightarrow \text{suit mass} \\ \rightarrow \text{Tony} \end{aligned}} \right\} \text{Total} = 175 \text{ kg}$$



How does he land without shattering?

Iron Man uses shock absorbers & repulsors to slow down—like airbags for super landings.

$$W = F \cdot d \quad \left. \vphantom{W = F \cdot d} \right\} \text{By increasing stopping distance, he decreases the force on his body.}$$

How strong is the suit? $\Rightarrow P = mv$

- more mass = more force when accelerating.
- Repulsor punches are powered by electrical energy converted to kinetic energy. $\rightarrow E = \frac{1}{2}mv^2$

Why doesn't he get crushed inside?

- Pressure = $F/A \rightsquigarrow$ suit spreads impact over a large area like a mini spacecraft.

$$F = qE + qvB$$

Lorentz Force Law

Repulsors = electromagnetic punches

$$I = \sum mr^2$$

Moment of Inertia
NO spinning out in mid-air!

$\rightarrow$ rotational stability

$$F_f = \mu N$$

High-friction boots = low-friction dance moves.

As Tony would say...

