

Protecting your head: **Helmet crash test**

Force and energy

Helmet crash test

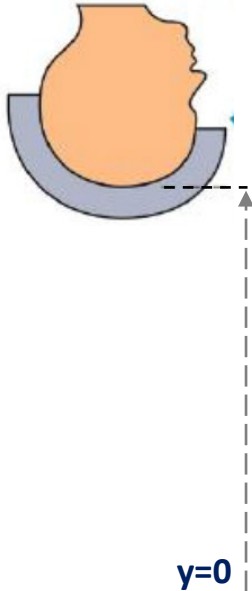
Helmet (based on foam) is strapped on a 5kg headform and dropped from 2m on anvil



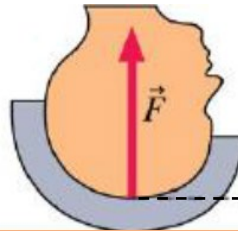
- Which force is encountered by head if impact crashes the foam by 3cm?
- Would helmet protect the rider?

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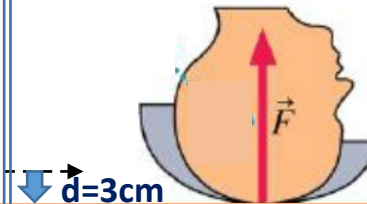
the headform is dropped
from the height of 2m



- the helmet JUST touched the anvil
- the foam is pushing on the headform



- the headform is subject to
a large force from the foam
- this force does negative work on
the headform, slowing it down

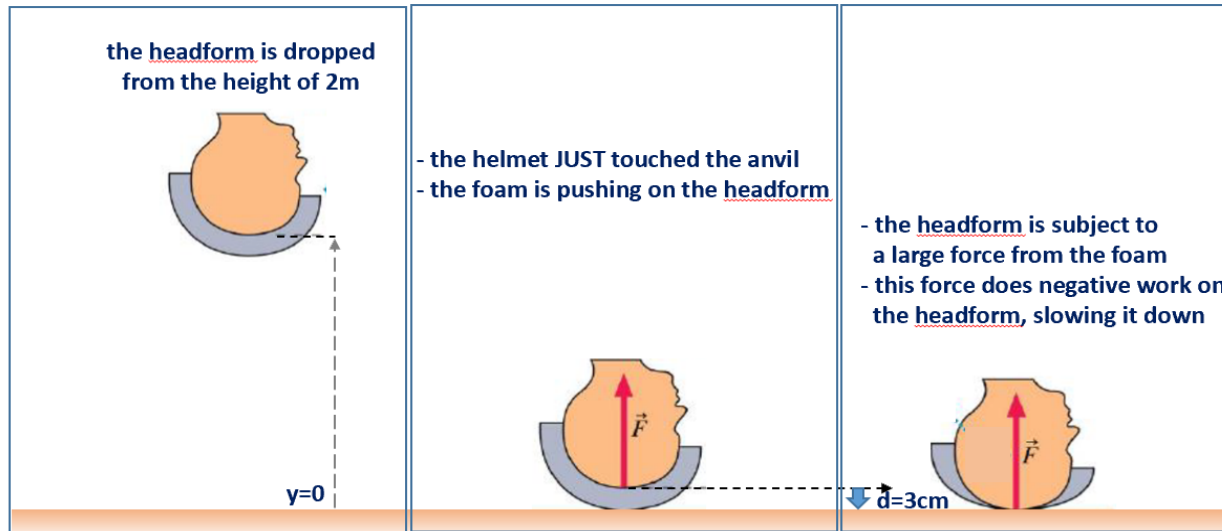


BEFORE: $y_i = 2\text{m}, v_i = 0\text{ m/s}$

AFTER: $y_f = 0\text{m}, v_f = 0\text{ m/s}$

$F=?$

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BEFORE: $y_i = 2\text{m}, v_i = 0\text{ m/s}$

AFTER: $y_f = 0\text{m}, v_f = 0\text{ m/s}$

$$K_f = K_i = 0$$

$$U_f - U_i = W$$

$$W = -Fd$$

$$\Rightarrow F = \frac{U_i - U_f}{d} = \frac{5\text{kg} \cdot 9.8 \frac{\text{m}}{\text{s}^2} \cdot 2\text{m}}{0.03\text{m}} = 3300\text{N}$$

And looking at acceleration gives: $a = \frac{F}{m} = \frac{3300\text{N}}{5\text{kg}} = 660 \frac{\text{m}}{\text{s}^2} \Rightarrow \approx 66g$

The accepted threshold for serious brain injury is around 300g

➤ The helmet would protect the rider