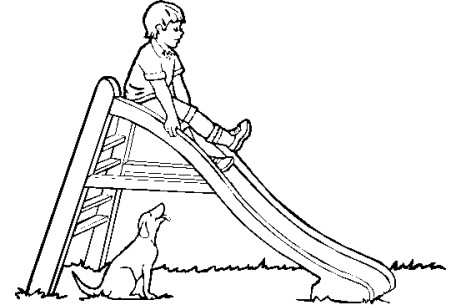


Child on a slide

A 20 kg child, starting from rest, slides down a 3m high frictionless slide.

- (a) How fast is he going at the bottom?
- (b) Now he slides down a slide with friction, and his speed at the bottom is 6.0 ms^{-1} . How much thermal energy has been produced by friction?



- (a) Calculate the energy at the top and bottom of the slide (set $h=0$ at the bottom)

Top: $K_1 = 0$

$$U_1 = mgh = 20 \times 9.8 \times 3 = 588 \text{ J}$$

Bottom: $K_2 = \frac{1}{2}mv_2^2$

$$U_2 = 0$$

So from conservation of mechanical energy,

$$K_2 = U_1$$

$$\frac{1}{2}mv_2^2 = 588 \text{ J}$$

so

$$v_2 = \sqrt{(2 \times 588/20)} = 7.7 \text{ ms}^{-1}$$

- (b) With friction: $v_2 = 6.0 \text{ ms}^{-1}$ so $K_2 = \frac{1}{2}mv_2^2 = \frac{1}{2} \times 20 \times 6.0^2 = 360 \text{ J}$

The thermal energy produced is the difference between the initial and final mechanical energy:

$$\Delta E_{\text{th}} = 588 \text{ J} - 360 \text{ J} = 228 \text{ J}$$