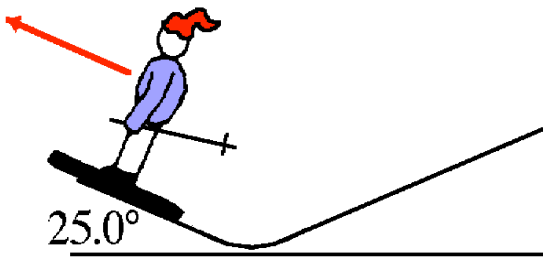
Conservation of energy problem: skier

A 60 kg skier leaves the end of a ski jump ramp with a velocity of 24 ms^{-1} directed 25° above the horizontal. Suppose that as a result of air resistance the skier returns to the ground with a speed of 22 ms^{-1} and lands at a point down the hill that is 14m below the ramp.

How much energy is dissipated by air resistance during the jump?



The path the skier follows is very complicated, but we can use conservation of energy to analyse the motion.

Set $h = 0$ at the end of the slide, so the final height is –14m.

Initial conditions:

$U_i = 0$

$K_i = ½\ mv^2 = ½ \times 60 \times (24)^2 = 17280$ J

Final conditions:

$U_i = mgh = 60 \times 9.8 \times -14 = -8232$ J

$K_i = ½\ mv^2 = ½ \times 60 \times (22)^2 = 14520$ J

Conservation of energy tells us that

$U_i + K_i = U_f + K_f + \Delta E_{th}$

so

$\Delta E_{th} = U_i + K_i - U_f - K_f$

$= 17280 - 14520 + 8232$

$= 10992$ J

$= 11$ kJ

Note that we never needed to use the angle at which the skier left the ramp: only the speed matters for working out the energy.