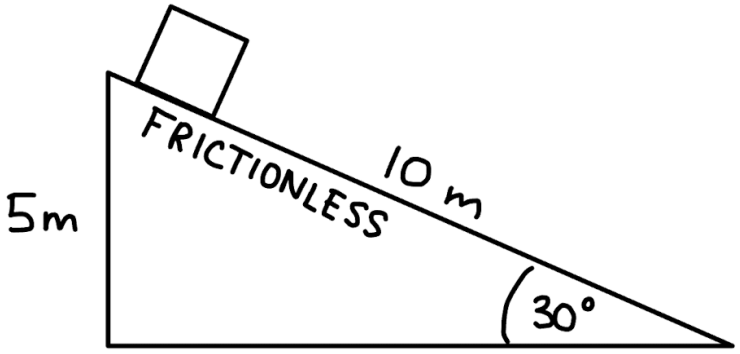
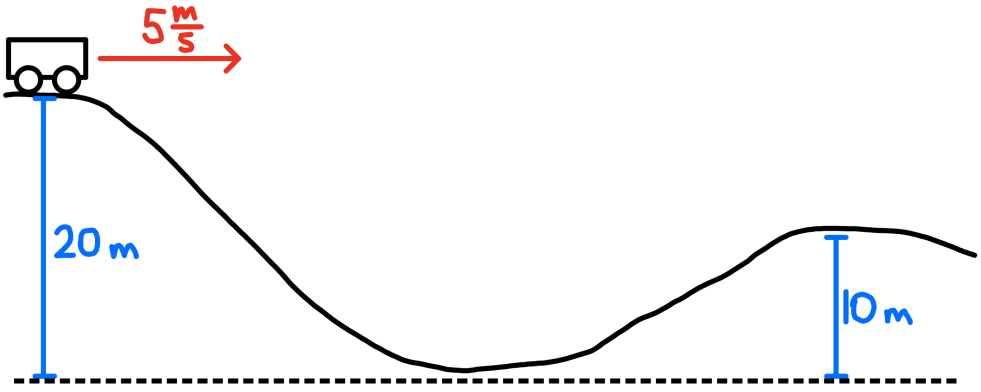
A block starts from rest and slides down a frictionless ramp. Determine the speed at the bottom of the ramp using…

a) dynamics and kinematics
b) energy



A cart has a speed of 5 m/s at the top of a 20 m high hill. What is its speed at the top of a 10 m high hill? Assume no friction forces.



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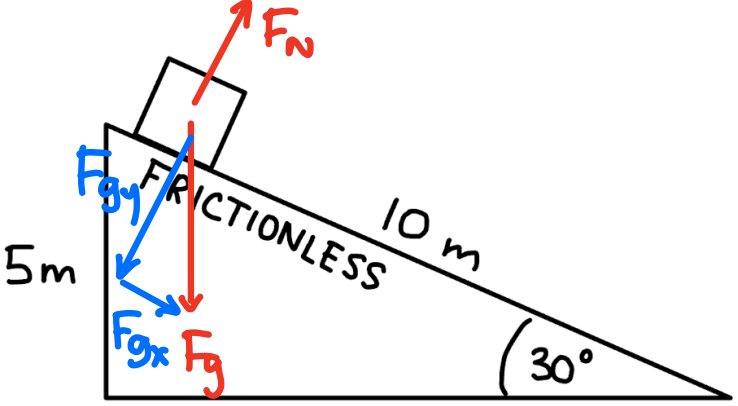

a) dynamics and kinematics

$F_{NET} = ma$

$F_{gx} = ma$

$mg\sin30^\circ = ma$

$a = g\sin30^\circ$

$= 4.9 \frac{m}{s^2}$

$F_{gx} = mg\sin30^\circ$

$v_f^2 = v_i^2 + 2ad$ ($v_i = 0$)

$v_f = \sqrt{2ad}$

$= \sqrt{2(4.9)(10)}$

$= \boxed{9.90 \frac{m}{s}}$

b) energy

$h_i = 5m$

$v_i = 0$

$h_f = 0$

$v_f = ?$

$E_i = E_f$

$E_{Pi} + E_{Ki} = E_{Pf} + E_{Kf}$ ($E_{Ki} = 0$, $E_{Pf} = 0$)

$mgh_i = \frac{1}{2}mv_f^2$

$v_f = \sqrt{2gh_i}$

$= \sqrt{2(9.8)(5)}$

$= \boxed{9.90 \frac{m}{s}}$

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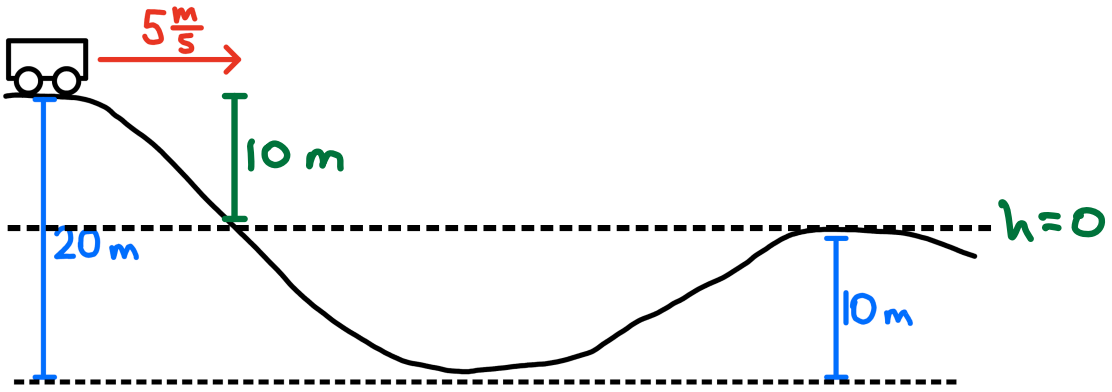

$h_i = 20\,m$

$v_i = 5\,\frac{m}{s}$

$h_f = 10\,m$

$v_f = ?$

$$E_i = E_f$$

$$E_{k_i} + E_{p_i} = E_{k_f} + E_{p_f}$$

$$\frac{1}{2}mv_i^2 + mgh_i = \frac{1}{2}mv_f^2 + mgh_f$$

$$v_f = \sqrt{v_i^2 + 2gh_i - 2gh_f}$$

$$= \sqrt{5^2 + 2(9.8)(20) - 2(9.8)(10)}$$

$$= \boxed{14.9\,\frac{m}{s}}$$

$h_i = 10\,m$

$v_i = 5\,\frac{m}{s}$

$h_f = 0$

$v_f = ?$

$$E_i = E_f$$

$$E_{k_i} + E_{p_i} = E_{k_f} + E_{p_f}$$ ($E_{p_f} = 0$)

$$\frac{1}{2}mv_i^2 + mgh_i = \frac{1}{2}mv_f^2$$

$$v_f = \sqrt{v_i^2 + 2gh_i}$$

$$= \sqrt{(5)^2 + 2(9.8)(10)}$$

$$= \boxed{14.9\,\frac{m}{s}}$$