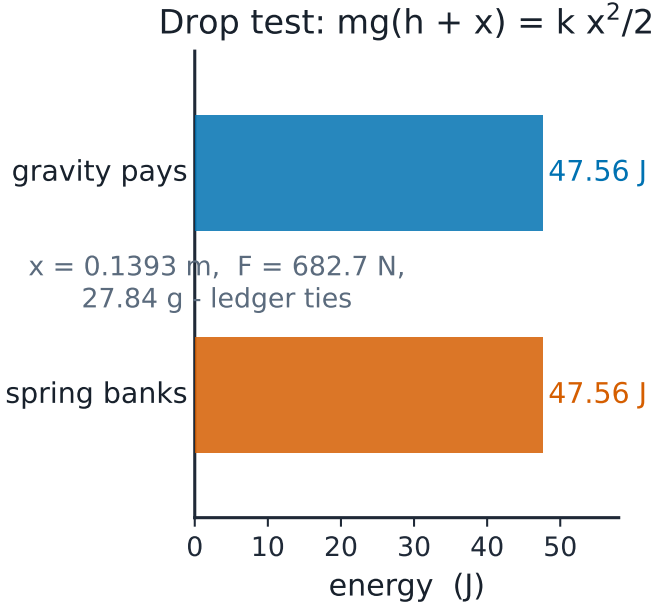
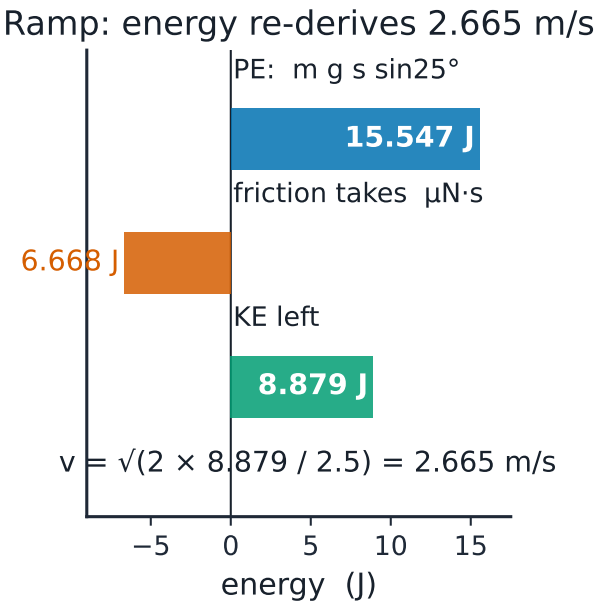
Exercise walk-through

3.2
Particle kinetics (Newton)

University Mechanical Engineering

Work and energy: the ledger must tie





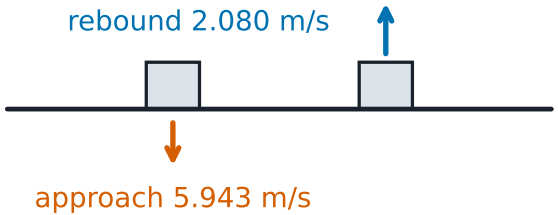
The drop ledger balances at **47.56** J; the ramp re-derives **2.665** m/s.

Impulse and momentum: the impact file

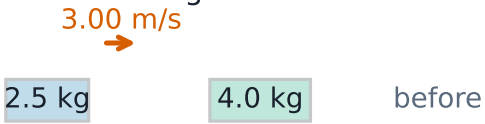
Certified impact: e = 0.35

rebound height 0.2205 m;
87.8% of arrival energy absorbed

J = 20.06 N s
F_avg = 2507 N
(8.0 ms)



Marshalling test: e = 0.60

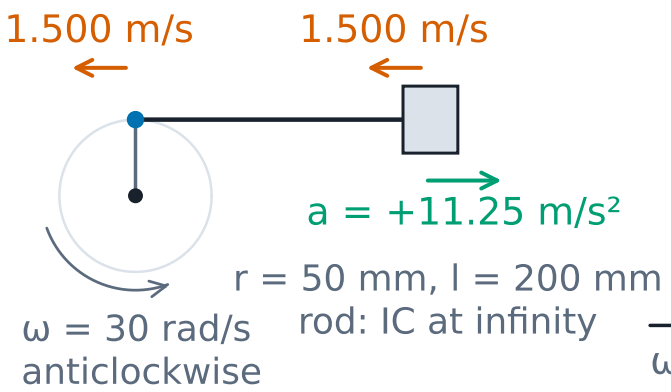


momentum 7.500 kept, 4.431 J lost;
fan: 0.120 kg/s × 8.50 m/s
= 1.020 N thrust

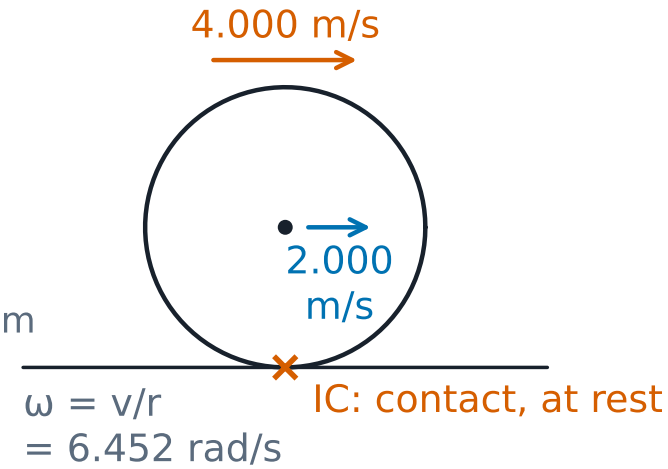
Impulse 20.06 N · s brings 2507 N over 8 ms; the carts keep momentum 7.500.

Rigid-body kinematics: constraint first

Slider-crank at 90°



Rolling wheel



At $\theta = 90°$ the slider moves at $\mathbf{-1.500}$ m/s and accelerates at $\mathbf{+11.25}$ m/s^2.

Exercises 2.1·2.2

2.1 The normal force and the friction force (two decimals), with the perpendicular equation stated. [4]

2.2 The acceleration down the slope (three decimals) and the speed after 2.00 m from rest (three decimals). [4]

Exercises 2.1·2.2

2.1 The normal force and the friction force (two decimals), with the perpendicular equation stated. [4]

2.1

- Perpendicular: $N = mg\cos 20^\circ = 36.87$ N.
- Friction $= \mu_k N = 0.25 \times 36.87 = 9.22$ N up-slope.

2.2 The acceleration down the slope (three decimals) and the speed after 2.00 m from rest (three decimals). [4]

2.2

- $a = g(\sin 20^\circ - 0.25\cos 20^\circ) = 1.051$ m/s^2.
- $v = \sqrt{2 \times 1.051 \times 2.00} = 2.050$ m/s.

Exercises 2.3·2.4

2.3 The crate rides a flat pallet braking on the test floor with $\mu_s = 0.30$. The braking acceleration at which it starts to slide, and the verdict if the pallet brakes at $2.5\ \mathrm{m/s^2}$. [3]

2.4 A spinner holds the same crate at $r = 0.450\ \mathrm{m}$, $\omega = 3.00\ \mathrm{rad/s}$, $\dot{\omega} = 2.00\ \mathrm{rad/s^2}$ (total acceleration $4.149\ \mathrm{m/s^2}$, from sheet 3.1). The friction force needed and the minimum μ (three decimals). [3]

Exercises 2.3·2.4

2.3 The crate rides a flat pallet braking on the test floor with $\mu_s = 0.30$. The braking acceleration at which it starts to slide, and the verdict if the pallet brakes at 2.5 m/s^2. [3]

2.3

- Slides when $a > \mu_s g = 2.943$ m/s^2.
- $2.5 < 2.943$: it holds, margin 15%.

2.4 A spinner holds the same crate at $r = 0.450$ m, $\omega = 3.00$ rad/s, $\dot{\omega} = 2.00$ rad/s^2 (total acceleration 4.149 m/s^2, from sheet 3.1). The friction force needed and the minimum μ (three decimals). [3]

2.4

- $F = ma = 4.0 \times 4.149 = 16.60$ N.
- $\mu_{min} = 16.60/(4.0 \times 9.81) = 0.423$.