3.3 Work and energy

Name: _____ Class: _____ Date: _____ **Total: 13 marks**

KEY WORDS work • potential energy • spring constant

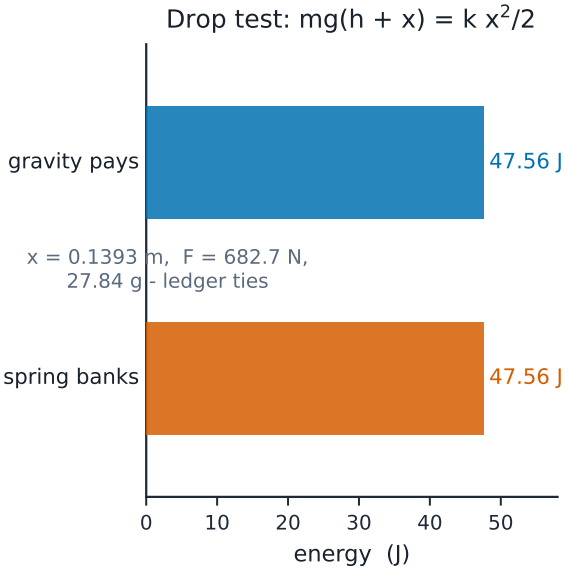
Objective

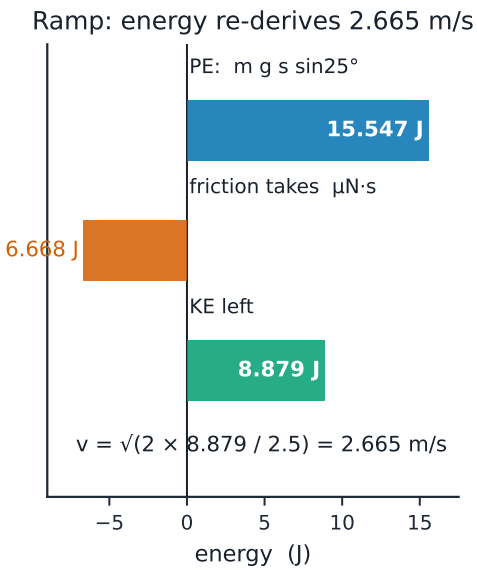
Close an energy ledger: gravity pays, springs bank, friction burns - and both sides tie to the joule.

1 Key knowledge and worked examples

■ The ledger

$T_1 + V_1 + U_{1\to 2} = T_2 + V_2$; gravity mgh, springs $\frac{1}{2}kx^2$, friction $-\mu_k N s$. The drop test keeps the $+x$: gravity works through the deflection.





*Both ledger sides must tie

■ Worked example. The drop test

$mg(h + x) = \frac{1}{2}kx^2$ with $k = 4900$, $h = 1.80$ m: $x = 0.1393$ m, $F = 682.7$ N, 27.84 g, and 47.56 J = 47.56 J ✓.

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2 Practice

A 3.0 kg module in its mount ($k = 3600$ N/m) is drop-tested from $h = 1.20$ m onto the certified floor.

2.1 The energy balance equation with the $+x$ term explained, and the maximum deflection (metres, four significant figures). [4]

2.2 The peak force and the peak deceleration in g (one decimal for the force, two for the g-load). [3]

2.3 The same module slides 2.00 m down the 20° ramp of sheet 3.2 ($\mu_k = 0.25$). The potential energy released, the friction work, and the speed at the end (three decimals). [4]

2.4 One sentence: why does halving the drop height NOT halve the peak force? [2]

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