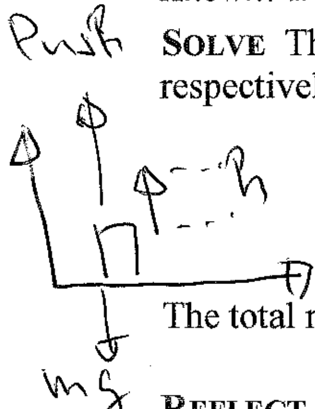
32. **ORGANIZE AND PLAN** The work is the vertical displacement against gravity, i.e., the work is equal to the work done by gravity (Equation 5.5) but with the opposite sign. The first block does not require any work — it can be left on the floor — but the second block must be lifted the height of the first block. The third block must be lifted the combined height of the first two blocks, etc.

Known: $m = 25.0\ \text{kg}; h = 0.305\ \text{m}.$



SOLVE The required work to lift the second, third, fourth, and fifth block, respectively, is:

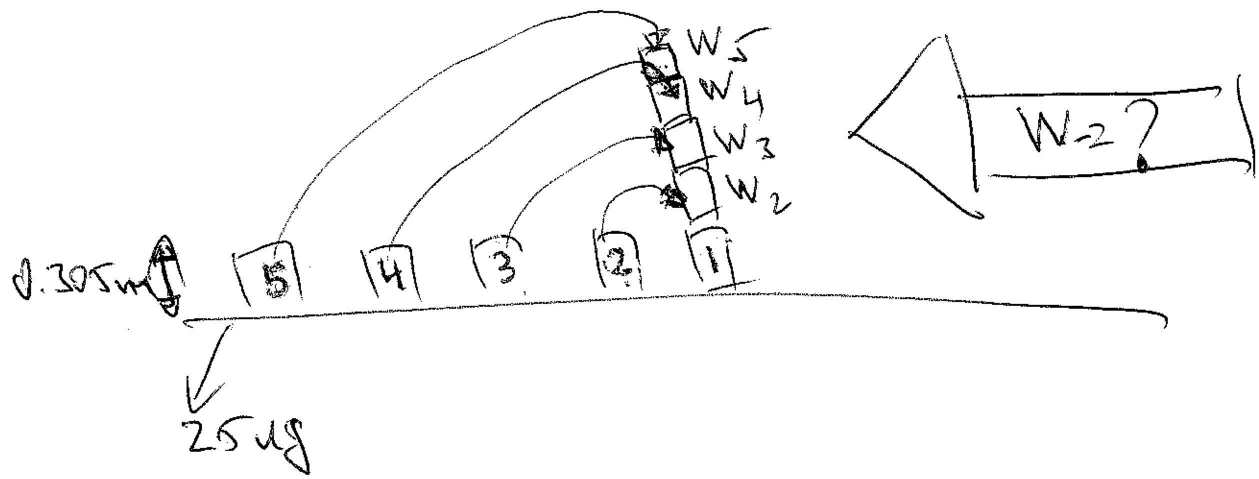
$$W_2 = mgh = (25.0\ \text{kg})(9.80\ \text{m/s}^2)(0.305\ \text{m}) = 74.7\ \text{J}$$
$$W_3 = mg(2h) = (25.0\ \text{kg})(9.80\ \text{m/s}^2)(2\times 0.305\ \text{m}) = 149.5\ \text{J}$$
$$W_4 = mg(3h) = (25.0\ \text{kg})(9.80\ \text{m/s}^2)(3\times 0.305\ \text{m}) = 224.2\ \text{J}$$
$$W_5 = mg(4h) = (25.0\ \text{kg})(9.80\ \text{m/s}^2)(4\times 0.305\ \text{m}) = 298.9\ \text{J}$$

The total required work to stack the blocks is:

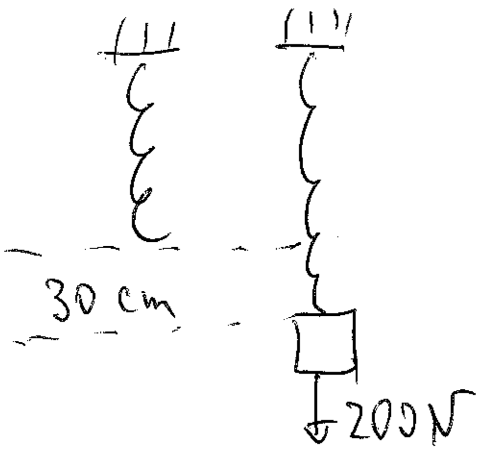
$$W = W_2 + W_3 + W_4 + W_5 = 747\ \text{J}$$ $\neq 5 * W_2\ (373.5\ \text{J})$

REFLECT The final answer can be generalized for stacking N blocks:

$$W_N = \sum_{i=1}^{N-1} mg(ih) = mgh\sum_{i=1}^{N-1} i$$



A spring stretches by 30.0 cm when a 200 N object is attached. What work would stretch the spring by 40.0 cm?



$F = k.\Delta x$ (Hook's laW)

$200\ N = k.(0.3m)$

$k = 200/0.3 = 600\ N/m$

$W = ?$ so $\Delta x = 0.4\ m$

$W = (600\ N/m)*(0.4\ m)^2 * \frac{1}{2}$ $\left(W = \frac{1}{2}kx^2\right)$

$= 48\ J$

67. ORGANIZE AND PLAN The average force does work equal to the force times the displacement. This work must equal the original kinetic energy of the bullet but with the opposite sign. If we first find the kinetic energy, we can easily calculate the average force.

Known: $m = 25\text{ g};\ v = 310\text{ m/s};\ \Delta x = 15\text{ cm}.$

SOLVE We can calculate the kinetic energy of the bullet using Equation 5.10:

$$K = \tfrac{1}{2}mv^2 = \tfrac{1}{2}(25\text{ g})(310\text{ m/s})^2 = 1.2\text{ kJ}$$

$W_{NET} = K_f - K_i$ ($K_f = 0$)

The force does work $W_f = -K = -1.2\text{ kJ}$ on the bullet. We can calculate the average force from Equation 5.1:

$$F_{fr} = \frac{W_f}{\Delta x} = \frac{(-1.2\text{ kJ})}{(15\text{ cm})} = -8.0\text{ kN}$$

$W_{fr} = F_{fr}\Delta x = -1.2\text{ kJ}$

REFLECT The force is a drag force and all drag forces are negative, i.e., in the opposite direction of the displacement.

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73. **ORGANIZE AND PLAN** The gravitational potential energy equals the work done by gravity but with the opposite sign.

Known: $m = 60$ kg; $\Delta y = 4390$ m.

SOLVE We calculate the gravitational potential energy using Equation 5.13:

$$\Delta U = mg\Delta y = (60\ \text{kg})(9.80\ \text{m/s}^2)(4390\ \text{m}) = 2.6\ \text{MJ}$$