A 20 g plastic ball is moving to the left at 30 m/s. How much work must be done on the ball to cause it to move to the right at 30 m/s?

**Solution**: Consider the energy of the ball, which is all kinetic.

Initial velocity: \( v_i = -30 \text{ ms}^{-1} \)

Final velocity: \( v_f = +30 \text{ ms}^{-1} \)

\[
\Delta K = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2 \\
= \frac{1}{2}m(v_f^2 - v_i^2) \\
= \frac{1}{2}m(30^2 - 30^2) = 0
\]

so *no work* is done on the ball.

Alternatively: consider the work done bringing the ball to a stop

\[
W_1 = \frac{1}{2}m(0 - 30^2) = 0.5 \times 0.02 \times -900 \\
= -9 \text{ J}
\]

Work done to accelerate the ball from rest to +30 ms\(^{-1}\)

\[
W_2 = \frac{1}{2}m(30^2 - 0) = 0.5 \times 0.02 \times 900 \\
= +9 \text{ J}
\]

so the total work done is

\[
W = W_1 + W_2 \\
= -9 + 9 = 0 \text{ J}
\]