

Work, kinetic energy and the net-work theorem

AP Physics 1 (algebra-based) · Lab answers

The sample data give a ratio close to one, as the theorem predicts. The model answers show the calculations, the shape of the graph and the main sources of error.

Level: AP Physics 1 (algebra-based) · **Curriculum:** AP P1 Unit 3

Question 1 Check one row

$W = M g d = 0.050 \times 9.81 \times 0.60 = 0.294 \text{ J}$. $K = \frac{1}{2} \times (0.500 + 0.050) \times 1.03^2 = 0.275 \times 1.0609 = 0.292 \text{ J}$. Ratio = $0.292 \div 0.294 = \mathbf{0.99}$.

Question 2 Why the total mass

The hanging mass moves at the same speed as the cart, so both carry kinetic energy. The work done by gravity on M is shared between them. **Use $m + M = 0.550 \text{ kg}$.**

Question 3 Plotting

The points lie close to a straight line through the origin with a gradient near 1. **K is proportional to W.**

Question 4 Gradient

Gradient = $\Sigma W \cdot K \div \Sigma W^2 = \mathbf{0.99}$. The theorem predicts 1.00, so the data support it within about 1 %.

Question 5 Percentage uncertainty

Percentage uncertainty in $v = 0.02 \div 0.59 = 3.4 \%$. K depends on v^2 , so double it: **about 6.8 %**.

Question 6 Friction effect

Friction would do negative work on the cart, so less than $M g d$ would become kinetic energy. **$K \div W$ would be below 1**, and the shortfall would grow with d .

Question 7 Improvement

Use several different hanging masses and a motion sensor that records the speed

continuously, so each run gives many points of K against W. **More data over a wider range.**