

Energy stores, Sankey diagrams and efficiency

Physics grades 9-10 (GCSE · IGCSE · O Level · Class 9-10) · Lab answers

The model answers use the sample table. Your own results will differ, but the order of the surfaces should be the same. Always show the equation, the substitution and the final result with its unit, and explain where the wasted energy goes.

Level: Physics grades 9-10 (GCSE · IGCSE · O Level · Class 9-10) · **Curriculum:** GCSE P1, HS-PS3-4

Question 1 Energy at release

$GPE = m g h = 0.058 \times 9.8 \times 1.00 = \mathbf{0.568 \text{ J}}$ (0.5684 J).

Question 2 Concrete result

Energy returned = $0.568 \times 0.58 = 0.330 \text{ J}$. Energy wasted = $0.568 - 0.330 = \mathbf{0.239 \text{ J}}$ (about 0.24 J).

Question 3 Where does the energy go?

Sound (the bounce is audible) and thermal energy, because the ball and the surface warm very slightly as they deform. **Sound and thermal energy.**

Question 4 Rank the surfaces

Concrete (58 %) > wooden floor (52 %) > carpet (38 %) > sand (12 %). **Hard, rigid surfaces return more energy;** soft surfaces such as carpet and sand deform and absorb more energy as thermal energy.

Question 5 Predict a second bounce

Second rebound height = $0.58 \times 0.58 \times 1.00 = 0.336 \text{ m}$, so **about 0.34 m**.

Question 6 Reading uncertainty

Concrete: $0.02 \div 0.58 \times 100 = 3.4 \%$. Sand: $0.02 \div 0.12 \times 100 = 17 \%$. The **sand result is less reliable** because the uncertainty is a larger fraction of the value.

Question 7 Improve the lab

Any two: use slow-motion video for the reading; repeat five times and average; use a ball of the same temperature; release without spin; use a long, vertical, well-lit rule; a second

observer at the same level as the top of the bounce. **Two justified improvements are enough.**