

Work done, power and mechanical energy

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

The model answers use the sample results from the table. Your measurements will differ, but the same pattern should appear: constant work and power that rises as the time falls. Show the equation, the substitution and the unit each time.

Level: Physics grades 9-10 (GCSE · IGCSE · O Level · Class 9-10) · **Curriculum:** HS-PS3-1

Question 1 Calculate the work

$W = m g h = 48.0 \times 9.8 \times 3.85 = 470.4 \times 3.85 = 1811 \text{ J}$, so **about 1810 J**.

Question 2 Calculate a power

$P = W \div t = 1811 \div 7.8 = 232.2$, so **232 W**.

Question 3 Same work, different power

Work depends only on the weight and the height gained, $W = m g h$, which do not change. Power is work divided by time, so a shorter time gives a **larger power**.

Question 4 Plot and interpret

The values of $1 \div t$ are 0.109, 0.128, 0.179 and 0.256 s^{-1} . The graph is a **straight line through the origin** because $P = W \times (1 \div t)$. The gradient equals the work, **about 1810 J**.

Question 5 Compare with a lamp

Run: $464 \text{ W} \div 100 \text{ W} = \text{about } 4.6$, so she could light four lamps fully (and a fifth dimly). The body transfers energy at a rate similar to several bulbs.

Question 6 Uncertainty

$0.3 \div 3.9 \times 100 = 7.7 \%$. The percentage uncertainty in power is about the same, 7.7 %, because P is proportional to $1 \div t$. The fastest trial is the least precise.

Question 7 Improve the lab

Any two: use light gates or a video to time more precisely; repeat each trial three times and average; measure step height at several steps; use a longer staircase to reduce the percentage uncertainty in t . **Assumption:** only the gain in gravitational potential energy is counted; the kinetic energy of the climber and the energy to move the legs are ignored.