

Inertia, resultant force and reaction pairs

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

These model answers use the sample data in the results table. Your own results will differ a little, but the shape of the graph and the main conclusions should agree. Always show the equation, the substitution and the unit.

Level: Physics grades 9-10 (GCSE · IGCSE · O Level · Class 9-10) · **Curriculum:** HS-PS2-1, GCSE P5

Question 1 Calculate an acceleration

$$2 \times 1.00 \div 1.50^2 = 2.00 \div 2.25 = \mathbf{0.89 \text{ m/s}^2}.$$

Question 2 Why $a = 2d \div t^2$

For uniform acceleration from rest, $d = \frac{1}{2} a t^2$. Multiply both sides by 2: $2d = a t^2$. Divide by t^2 : $a = 2 d \div t^2$.

Question 3 Plot and describe

The points lie close to a **straight line through (or very near) the origin**. This shows that acceleration is directly proportional to the resultant force when the mass is constant.

Question 4 Gradient and mass

Gradient = $(1.49 - 0.29) \div (0.980 - 0.196) = 1.20 \div 0.784 = \mathbf{1.5 \text{ m/s}^2 \text{ per N}}$. Gradient = $1 \div m$, so $m = 1 \div 1.5 = \mathbf{0.66 \text{ kg}}$. This is about 10 % above 0.600 kg; the string, pulley wheel and friction make the system behave as if it were heavier.

Question 5 Why the total mass stays fixed

The force that pulls the system is $m \times g$ of the hanging mass. If masses were only added to the hanger, the total mass would change too, and both force and mass would vary together. Moving masses keeps the **total mass constant**, so only the force changes.

Question 6 Is the force really $m \times g$?

$T = m (g - a) = 0.100 \times (9.8 - 1.49) = 0.100 \times 8.31 = \mathbf{0.83 \text{ N}}$. The weight is 0.980 N, so the string tension is smaller than the weight, because the hanger accelerates downwards.

Question 7 Timing uncertainty

Percentage uncertainty in $t = 0.05 \div 1.16 \times 100 = 4.3 \%$. Because a depends on t^2 , the uncertainty in a is double: **about 8.6 %**.

Question 8 Improve the investigation

Any two: use light gates and a data logger for more precise times; repeat each timing more times; tilt the runway slightly to compensate for friction; use a longer track; use a lighter pulley; check the pulley and string run freely. **Two reliable improvements are enough** if each is justified.