Year 11 Science: A physics investigation: planning and processing evidence

Name: _____ Date: _____

Try these without your notes first, then check the answer key.

Practice

1. A class drops a tennis ball from different heights and measures how high it bounces. Name the independent variable, the dependent variable and two controlled variables.

2. A group timed 10 swings of a pendulum as 14.2 s, 14.4 s and 12.9 s, and they think they miscounted once. Find the mean period and its uncertainty.

3. A spring's total length was measured with masses from 0 g to 300 g hung on it. The best-fit line passes through (0 g, 12.0 cm) and (300 g, 18.0 cm). Find the gradient, and say whether length is proportional to mass.

4. A class measured the current through different resistors from the same battery pack: 10 Ω gave 0.59 A, 20 Ω gave 0.30 A, 30 Ω gave 0.20 A and 40 Ω gave 0.15 A. Name the relationship and give the evidence.

5. Explain why timing 10 swings and dividing by 10 gives a better period than timing one swing.

Fix the mistake

6. Correct this statement: "Joining each point to the next with a ruler to make a zigzag graph."

7. Correct this statement: "The graph goes up in a straight line, so the quantities are proportional."

8. Correct this statement: "Averaging all three repeats, including the reading that was clearly a mistake."

9. Correct this statement: "Gradient = 4.0, with no unit."

Answer key (for parents and tutors)

1. A class drops a tennis ball from different heights and measures how high it bounces. Name the independent variable, the dependent variable and two controlled variables.
   Independent: drop height. Dependent: bounce height. Controlled, for example: the same ball, the same floor surface, measuring both heights to the bottom of the ball.

2. A group timed 10 swings of a pendulum as 14.2 s, 14.4 s and 12.9 s, and they think they miscounted once. Find the mean period and its uncertainty.
   12.9 s is the outlier (about one swing short), so the mean is (14.2 + 14.4) ÷ 2 = 14.3 s and the period is 1.43 s. Half the range is (14.4 − 14.2) ÷ 2 = 0.1 s for 10 swings, so T = 1.43 ± 0.01 s.

3. A spring's total length was measured with masses from 0 g to 300 g hung on it. The best-fit line passes through (0 g, 12.0 cm) and (300 g, 18.0 cm). Find the gradient, and say whether length is proportional to mass.
   Gradient = (18.0 − 12.0) ÷ (300 − 0) = 0.020 cm/g, or 2.0 cm per 100 g. The relationship is linear but not proportional, because the line crosses the length axis at 12.0 cm, not at 0.

4. A class measured the current through different resistors from the same battery pack: 10 Ω gave 0.59 A, 20 Ω gave 0.30 A, 30 Ω gave 0.20 A and 40 Ω gave 0.15 A. Name the relationship and give the evidence.
   Inverse: resistance × current stays about the same (10 × 0.59 = 5.9, 20 × 0.30 = 6.0, 30 × 0.20 = 6.0, 40 × 0.15 = 6.0), so doubling the resistance halves the current.

5. Explain why timing 10 swings and dividing by 10 gives a better period than timing one swing.
   Reaction time adds about the same error when starting and stopping however long you time for, so spread over 10 swings it is ten times smaller per swing, and the percentage uncertainty in the period drops.

6. Correct this statement: "Joining each point to the next with a ruler to make a zigzag graph."
   Draw one smooth line or curve of best fit through the trend; data points scatter a little around the true pattern.

7. Correct this statement: "The graph goes up in a straight line, so the quantities are proportional."
   Proportional needs a straight line through the origin; a straight line that cuts the axis elsewhere is only linear.

8. Correct this statement: "Averaging all three repeats, including the reading that was clearly a mistake."
   Leave an outlier with a known cause out of the mean, and record in your write-up which reading you dropped and why.

9. Correct this statement: "Gradient = 4.0, with no unit."
   A gradient has the y unit over the x unit, here s^2/m, and it means something physical, so always write and explain the unit.