Year 11 Science: A worked physics investigation: wire length and resistance

Name: _____ Date: _____

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

Practice

1. At 60 cm one group read 1.66 V across the wire and 0.20 A through it. Find the resistance.

2. The class added a 70 cm length and got 9.8 Ω, 9.6 Ω and 9.7 Ω. Find the mean and its uncertainty, and say whether it agrees with R = 13.5 Ω/m × L + 0.3 Ω.

3. Use the line to predict the reading for a 50 cm length.

4. A student concluded: "When the wire got longer the resistance got bigger because there is more wire." Which grade is this closest to, and what two things would lift it to Merit?

5. Explain why the class's line meets the resistance axis at 0.3 Ω instead of passing through the origin.

Fix the mistake

6. Correct this statement: "The graph is a straight line, so resistance is proportional to length."

7. Correct this statement: "A longer wire has more resistance because the electrons get used up on the way."

8. Correct this statement: "Writing the physics in one paragraph and the results in another."

9. Correct this statement: "Predicting 1.50 m with the gradient 0.135 and getting 0.5 Ω."

Answer key (for parents and tutors)

1. At 60 cm one group read 1.66 V across the wire and 0.20 A through it. Find the resistance.
   R = V ÷ I = 1.66 ÷ 0.20 = 8.3 Ω.
2. The class added a 70 cm length and got 9.8 Ω, 9.6 Ω and 9.7 Ω. Find the mean and its uncertainty, and say whether it agrees with R = 13.5 Ω/m × L + 0.3 Ω.
   Mean = (9.8 + 9.6 + 9.7) ÷ 3 = 29.1 ÷ 3 = 9.7 Ω; uncertainty = (9.8 − 9.6) ÷ 2 = ± 0.1 Ω. The line predicts 13.5 × 0.70 + 0.3 = 9.75 Ω, which is inside 9.7 ± 0.1 Ω, so it agrees.
3. Use the line to predict the reading for a 50 cm length.
   R = 13.5 × 0.50 + 0.3 = 6.75 + 0.3 = 7.05 Ω, about 7.1 Ω.
4. A student concluded: "When the wire got longer the resistance got bigger because there is more wire." Which grade is this closest to, and what two things would lift it to Merit?
   Achieved at best: it describes the trend but gives no numbers and no physics. For Merit, add processed evidence (the straight-line graph with gradient 13.5 Ω/m) and explain the cause (a longer wire has more metal ions for the free electrons to collide with).
5. Explain why the class's line meets the resistance axis at 0.3 Ω instead of passing through the origin.
   The clips' contacts with the wire add about 0.3 Ω of resistance in series at every length, even a length of zero, so the whole line is lifted by that amount.
6. Correct this statement: "The graph is a straight line, so resistance is proportional to length."
   The measured line meets the axis at 0.3 Ω, so it is linear; only the wire's own resistance, with the contacts taken away, is proportional.
7. Correct this statement: "A longer wire has more resistance because the electrons get used up on the way."
   Electrons are not used up, and the current is the same all the way round; they lose energy in more collisions with ions.
8. Correct this statement: "Writing the physics in one paragraph and the results in another."
   Excellence needs them together: every physics idea should point at a number, and every number should be explained.
9. Correct this statement: "Predicting 1.50 m with the gradient 0.135 and getting 0.5 Ω."
   0.135 is in Ω per cm, so use 150 cm, or use 13.5 Ω/m with 1.50 m; both give about 20.6 Ω.