# 2   Internal Resistance

In this experiment you are going to carry out an experiment to investigate the relationship between the potential difference across the terminals of a 1.5 V 'AA' battery and the current through it.

You will use several different resistors, each of which will draw a different current through the battery.

1. Set up the circuit as show in the diagram below, using the 22 Ω resistor.

1.5 V 'AA' battery

22 Ω
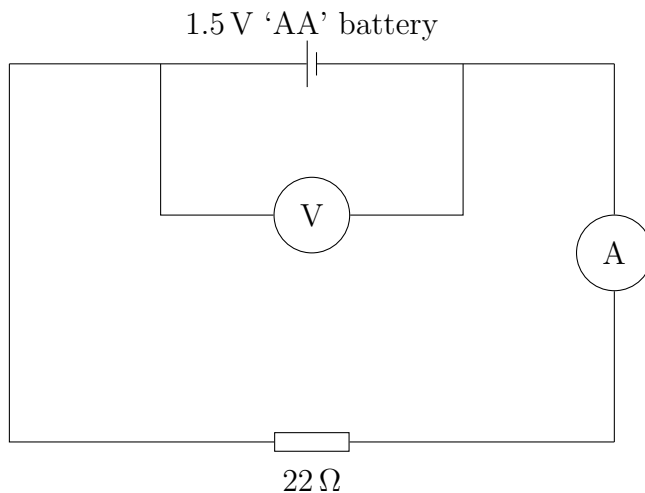
2. Record the current shown on the ammeter.

2. _____

3. What is the precision of the ammeter?

3. _____

4. Using the instrument precision, work out the percentage uncertainty in the ammeter reading.

5. Explain why using resistors with very high values would be unsuitable in this experiment.

6. Substituing each resistor into the circuit in turn—start by replacing the 22 Ω resistor with the 10 Ω resistor—record the values of the current and terminal p.d. in the table below. *Make sure you disconnect the battery between readings.*

Resistor value / Ω	Current I / mA	Terminal p.d. / V
22		
10		
6.8		
4.7		
3.3		
2.2		
1.5		
1.0		

7. Plot a graph of terminal p.d. on the y-axis against current I on the x-axis.

   The equation relating terminal p.d. V and current I is

   $$V = \epsilon - Ir,$$

   where ϵ is the emf of the supply and r is the internal resistance of the supply.

8. By reference to the equation of a straight line $y = mx + c$,

   (a) what physical quantity is represented by the intercept on the p.d. axis?

   _____

   (b) what physical quantity is represented by the gradient of the graph?

   _____

9. Use a line of best fit to help you to determine the emf and the internal resistance of the battery in this experiment, showing your working clearly.

   _____

   _____

   _____

   _____

   _____

   _____

   _____
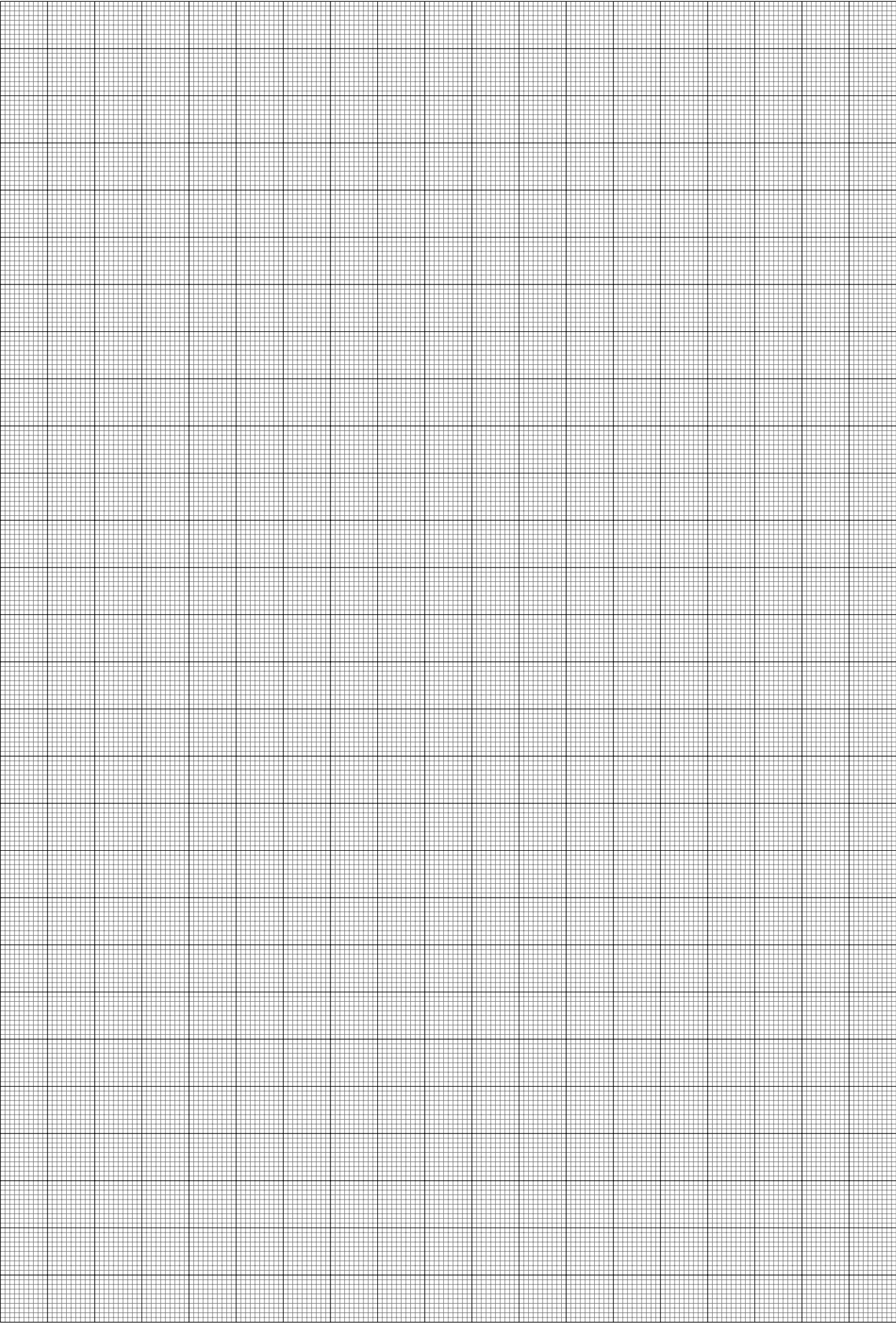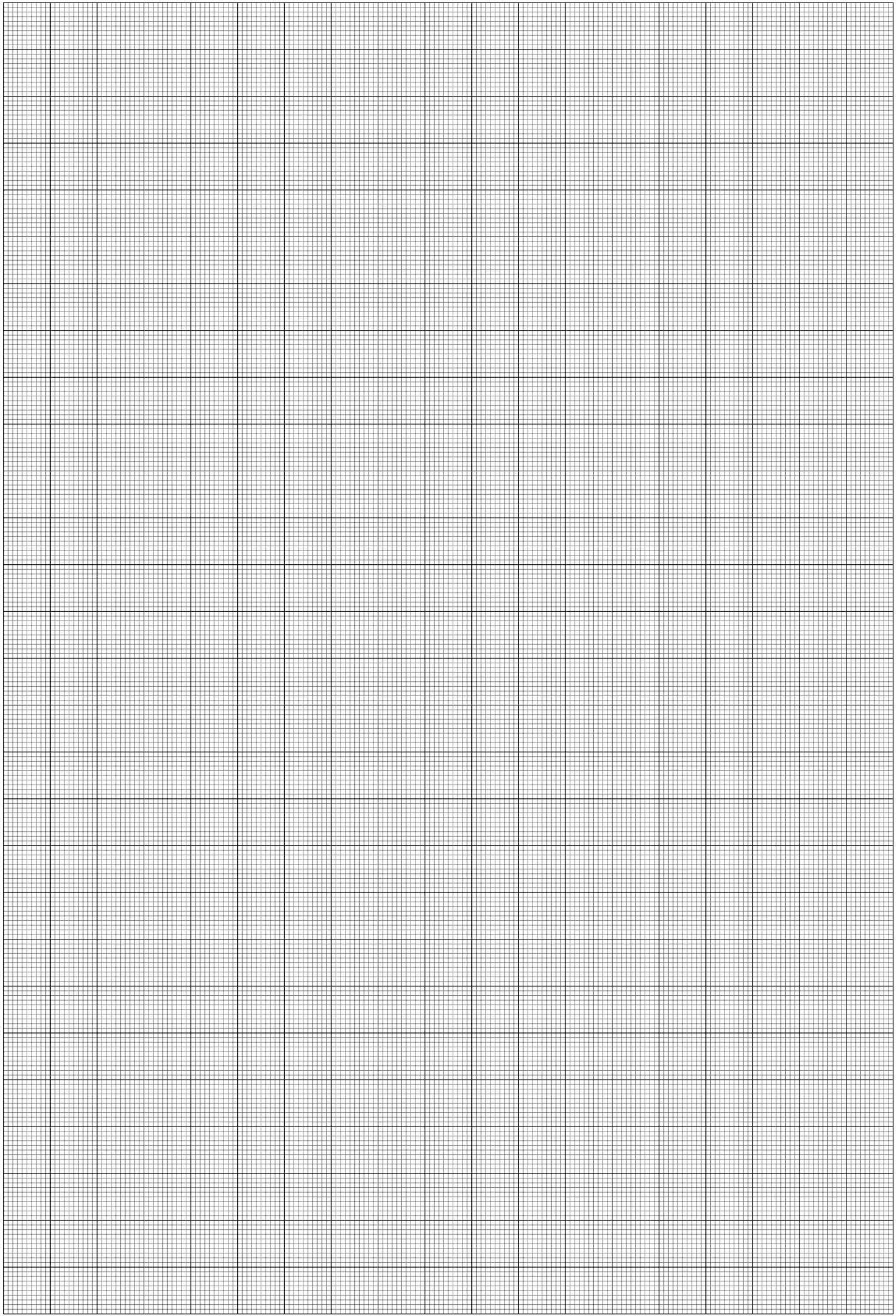
10. Why do you think you were instructed to switch off or disconnect the battery between readings?

_____

_____

_____

11. Do you think your readings are reliable? Give a reason for your answer.

_____

_____

_____

12. The manufacturer quotes the resistors used as having an uncertainty (the manufacturer's 'tolerance') of 5% .

 (a) Calculate the maximum possible value of the $6.8\,\Omega$ resistor used in this experiment.

 (a) _____

 (b) Explain why it would not have made any difference to the value of obtained in the experiment if resistors with a tolerance of only 2% had been used instead.

 _____

 _____

 _____

13. The voltmeter used in the above experiment was found to have a calibration error whereby every reading was $0.22\,\text{V}$ too high.

 (a) What is the name given to this type of error?

 _____

 (b) How, if at all, would this have affected the value obtained for the intercept of the graph?

 _____

 _____

 _____

 (c) How, if at all, would this have affected the value for the gradient of the graph?

 _____

 _____

 _____