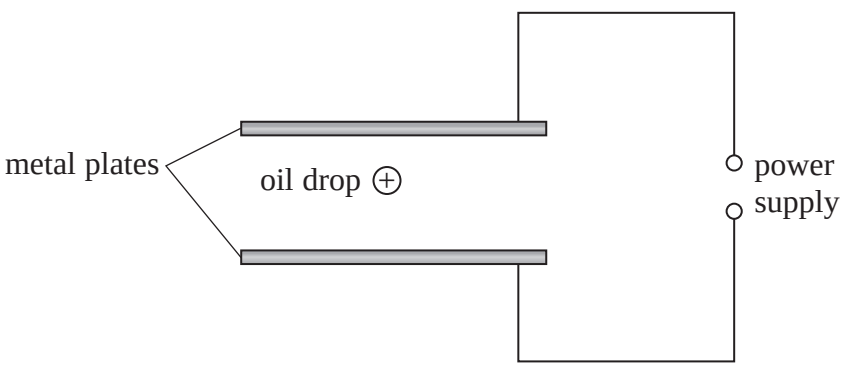
9 A student investigated the behaviour of small, positively charged oil drops in an electric field.

He introduced an oil drop between two horizontal metal plates. A potential difference V was applied to bring the oil drop to rest as shown.



(a) (i) Add to the diagram to show the polarity of the power supply when the oil drop is at rest.

(1)

(ii) The oil drop was at rest when $V = 4870\,\text{V}$.

The student expected the charge on the oil drop to be a whole number multiple of the charge on an electron.

Deduce whether this is confirmed by the experimental data.

distance between top plate and bottom plate = 1.55 cm
density of oil = $920\,\text{kg}\,\text{m}^{-3}$
radius of the oil drop = $1.78 \times 10^{-6}\,\text{m}$

(6)

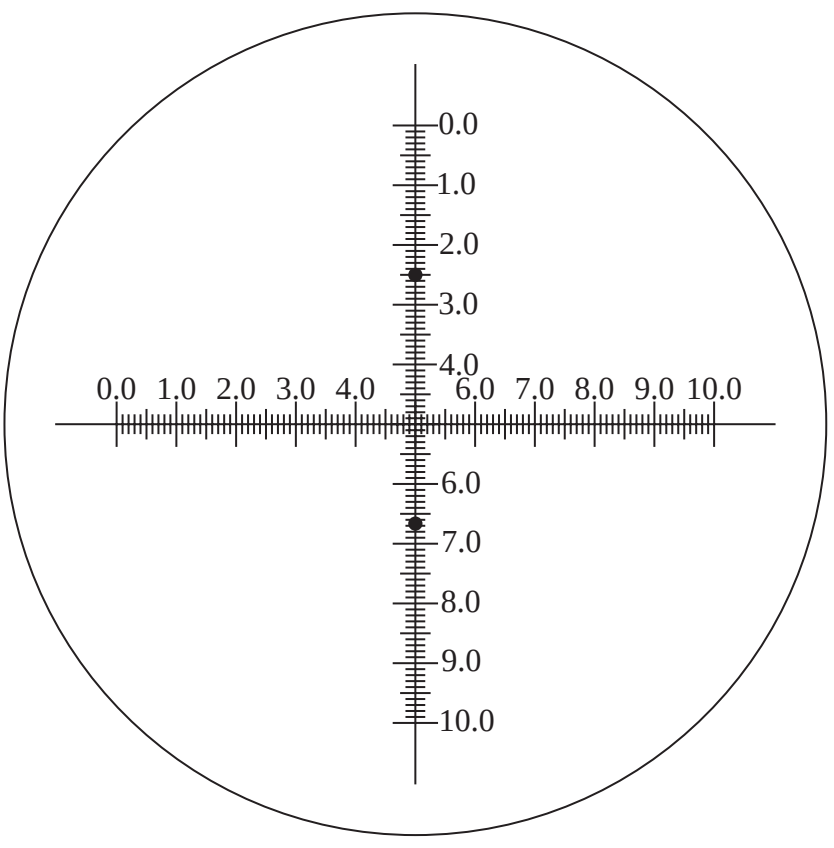
(b) The student determined the terminal velocity of the oil drop in order to obtain a value for the weight of the oil drop.

He disconnected the power supply and the oil drop fell downwards. He viewed the oil drop through a microscope.

(i) Explain why the student should wait a short while before starting to take measurements.

(2)

(ii) The view through the microscope is shown below. The scale is in millimetres.



The position of the oil drop at the start and end of a 120 s time interval is indicated by the black dots.

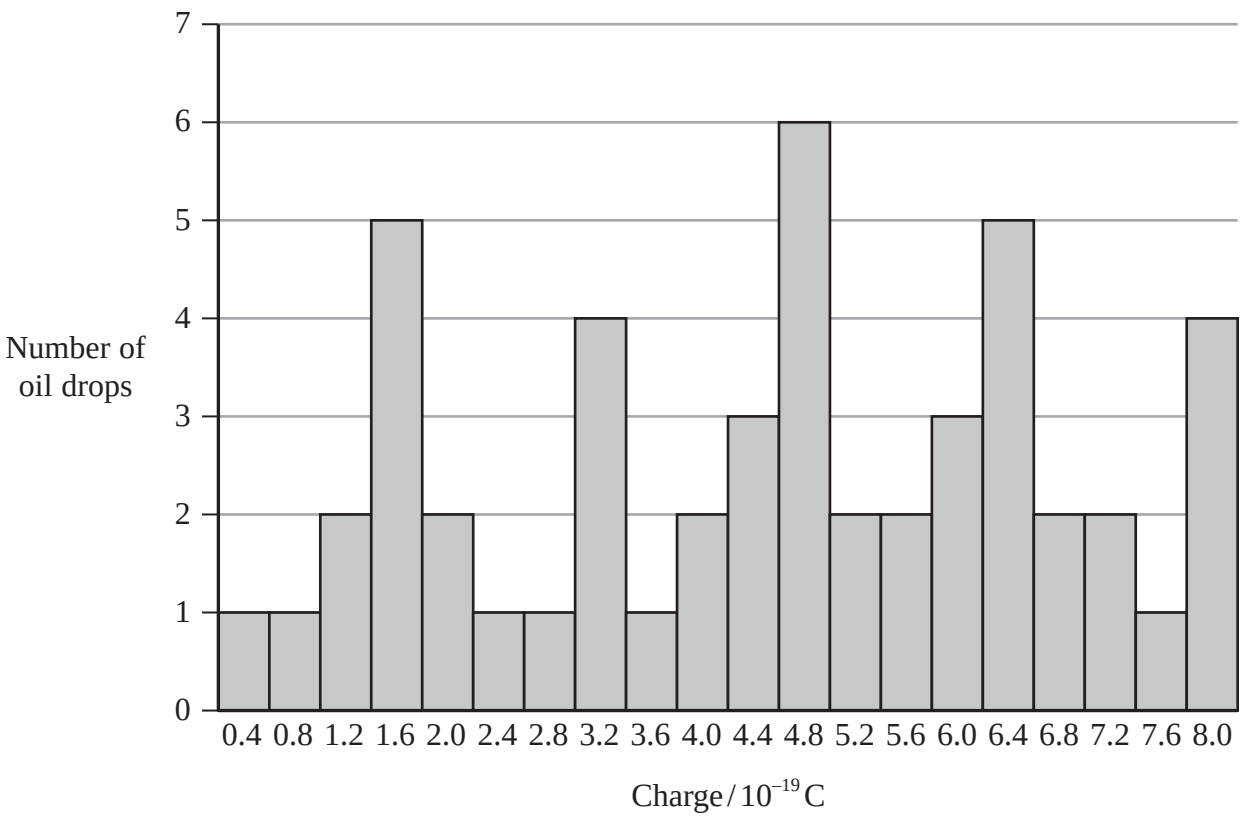
Determine the terminal velocity of the oil drop.

(3)

Terminal velocity = ...

(c) The student repeated the measurements on fifty oil drops. For each drop the student calculated the charge on the oil drop.

His results are shown in the bar chart.



The student predicted that the charge on each oil drop would be a whole number multiple of the charge on an electron.

Comment on the extent to which the bar chart supports the student's prediction.

(3)

(Total for Question 9 = 15 marks)