

**Chapter 16**  
**Short answer questions**

In the Millikan experiments to measure the charge of an electron, a pair of horizontal parallel plates is connected to a variable voltage power supply and a switch S (Fig. 1).

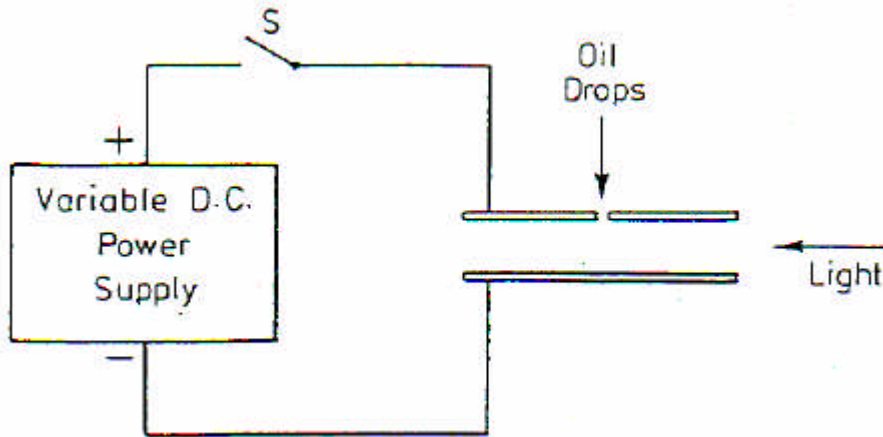


Fig. 1

The space between the plates is strongly illuminated. A very few tiny oil drops are allowed to enter this space through a small hole in the upper plate. The drops are viewed with a microscope. They appear as pin-points of light.

- (a) With switch S open, an oil drop falls slowly with a steady speed. Draw a labelled diagram showing the drop and the forces acting on it. Explain why it moves with a steady speed.
  
- (b) With switch S closed, it is possible to adjust the output of the power supply so that a drop appears stationary. Explain why the drop is stationary.
  
- (c) If the pin-point of light is watched carefully, it is seen to be 'jiggling' in a random fashion. Explain why this happens.
  
- (d) When  $\beta$ -particles are allowed to enter the space for a few moments, the drop may suddenly start to move. Explain.

- (e) The drop may be brought to rest again by changing the voltage of the power supply. Would you increase or decrease the voltage? Explain.

The process of admitting  $\beta$ -particles and changing the voltage to balance the drop is carried out several times, each time the potential difference across the plates being measured and the charge on the drop calculated. The results are shown in the table.

<b>p.d. across the plates (volts)</b>	<b>Charge on drop (<math>10^{-19}</math> coulomb)</b>
200	3.2
100	6.4
133	4.8
$x$	12.8

- (f) (i) Explain how these results suggest that the electron has a definite charge.

(ii) What is its probable value?

(iii) What is the missing voltage  $x$  in the table?

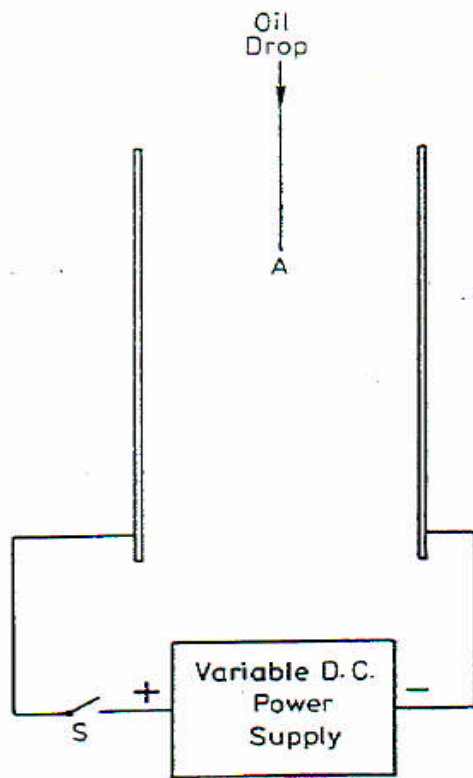


Fig. 2

Imagine the plates now set vertically and the oil drops introduced from above (Fig. 2). With S open, a charged drop falls as far as A and S is then closed.

- (g) Copy the plates from Fig. 2 and complete the diagram of the path you would expect the drop to follow. Explain.