Oxford Cambridge and RSA

A level Physics B

H557/03 Practical skills in physics

Question Set 7

1 In 1917 Robert Millikan investigated the motion of tiny oil drops in an electric field and used this to determine the charge on the electron. He sprayed tiny oil drops between two parallel metal plates connected to a high voltage power supply and observed their motion. The experiment was set up as shown in **Fig. 1**.

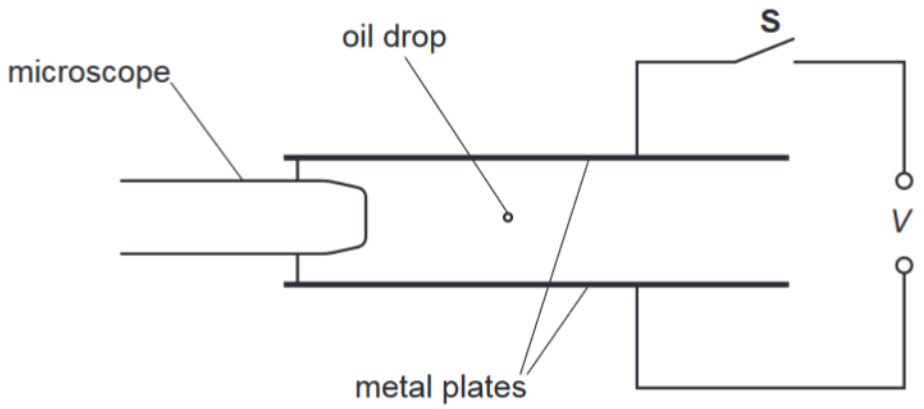

Fig.1

As the oil drops are forced through a spray nozzle they become negatively charged.

With switch **S** open there is no potential difference between the plates and the oil drop is observed to be falling at constant velocity through the air.

(a) Explain why the oil drop falls at constant velocity through the air.

[3]

(b) The switch **S** is closed and the potential difference is adjusted until the oil drop remains stationary between the two parallel plates.

The following data are recorded:

potential difference $V = 390\ \text{V}$
distance between the plates $d = 6.0\ \text{mm}$
mass of an oil drop $m = 2.15 \times 10^{-15}\ \text{kg}$.

(i) Calculate the electric field strength E between the two parallel plates. Include a suitable unit.

E = ……. unit……..

[2]

(ii) Calculate the charge q carried by each oil drop.

q = ……C

[3]

(iii) This calculation does not take into account the effect of buoyancy from the displaced air. This effect produces an additional upwards force on the oil drop. Explain what effect this would have on the value calculated for charge.

[2]

(c) The charge on the parallel metal plates is reversed. Explain the effect this has on the motion of the oil drop. **[2]**

Total Marks for Question Set 7: 12