4 **(a)** Two charged spheres of unequal sizes, carrying charges of +*Q* and -*Q*, are positioned as shown in Fig. 4.1 below.

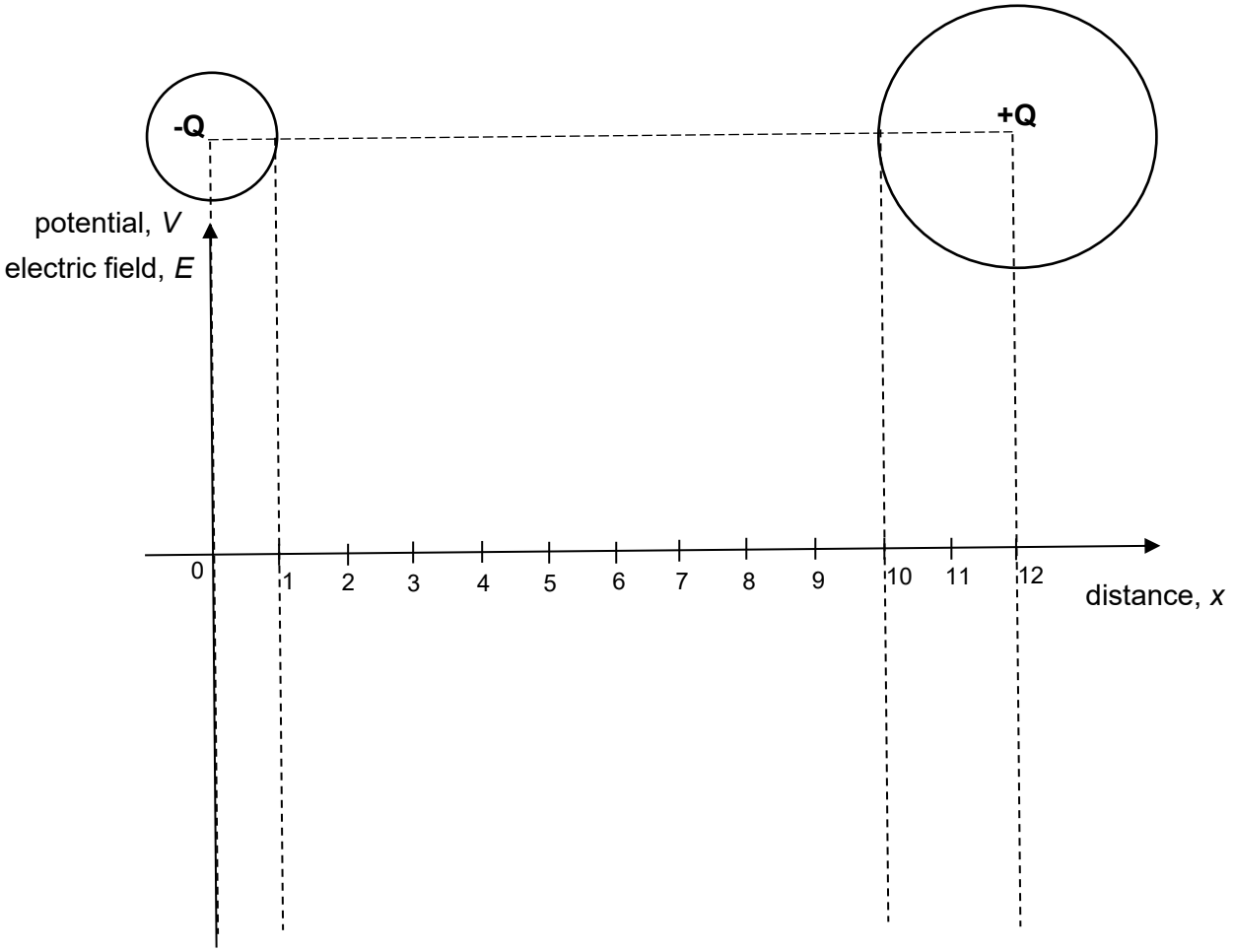

Fig. 4.1

(i) Draw the *V*-*x* graph of the two spheres on Fig. 4.1 that <u>spans from the centre of one sphere to the other</u>. Label the graph *V*. [3]

(ii) On the same figure, draw the *E*-*x* graph that spans the region <u>from 1 to 10 only</u>. Label the graph *E* and ensure that it is distinguishable from the graph in **(i)**.

Explain the position of either the turning point or the *x*-intercept of this graph.

……..

……..

…… [4]

(b) Two identical spherical drops of water, each carrying a charge of $+2.0 \times 10^{-10}$ C and with electric potential of 500 V on its surface, combine to form a single spherical drop.

Determine the approximate potential on the surface of the new drop formed.

potential = …….. V [3]

(c) Fig. 4.2 below below shows a simple current balance set-up. The midpoints of the rectangular wire rest on two knife edges at **A** and **B**, where **AB** = **CD** = 0.15 m. There is a current of 6.0 A which enters the wire via the knife edge at **B** in the direction of **BC** and exits at the knife edge at **A**. A separate current is supplied to the solenoid to create a field which has a flux density of 35 mT.

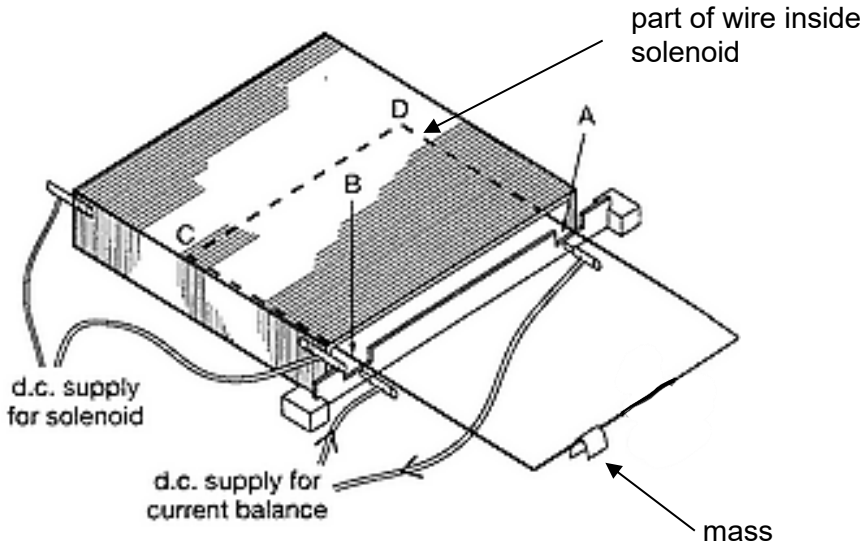

Fig. 4.2

(i) Indicate, with *an arrow*, the direction of the magnetic field on Fig. 4.2 above. [1]

(ii) Calculate the force acting on the wire at **CD**.

force = …….. N [1]

(iii) Determine the mass needed to be placed on the wire at the other end for the wire to be horizontally balanced.

mass = …….. kg [1]

(iv) The laboratory environment has a background magnetic field in the horizontal direction that may interfere with the set-up.

Suggest and explain how the effect due to the background magnetic field can be reduced without using any additional apparatus.

……...

……...

…….. [2]