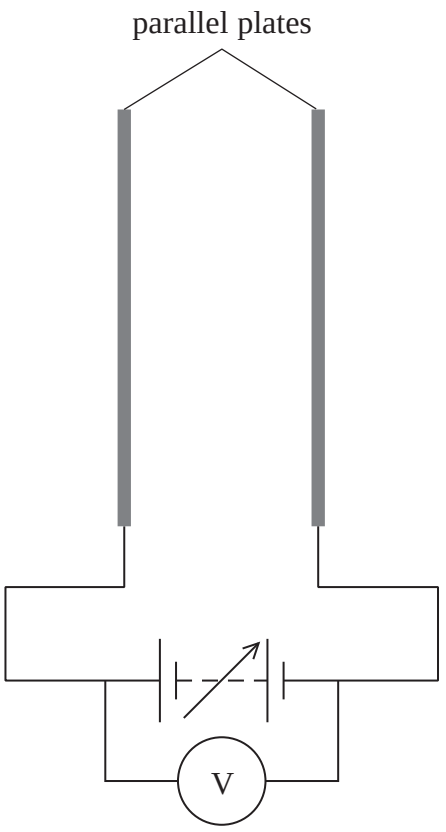
15 A teacher demonstrates the electric field produced between two parallel metal plates. The plates are connected to a variable power supply, as shown. The power supply has a very large internal resistance and includes a voltmeter that indicates its output.



(a) (i) Add to the diagram to show the electric field between the two plates.

(3)

(ii) Explain why the reading on the voltmeter indicates the e.m.f. of the power supply.

(2)

(b) The power supply output is increased until sparks are heard and are seen in the gap between the plates. Sparks form in air when the electric field strength exceeds $3.0 \times 10^6\,V\,m^{-1}$ and the air becomes conducting for a short time.

(i) Calculate the minimum potential difference across the plates for sparks to be created.

distance between parallel plates = 2.0 mm

(2)

Minimum potential difference = ...

(ii) Explain why the voltmeter reading decreases significantly whenever sparks are produced.

(3)

(Total for Question 15 = 10 marks)