4 In a particular experiment, a high voltage is created by charging an isolated metal sphere, as illustrated in Fig. 4.1.

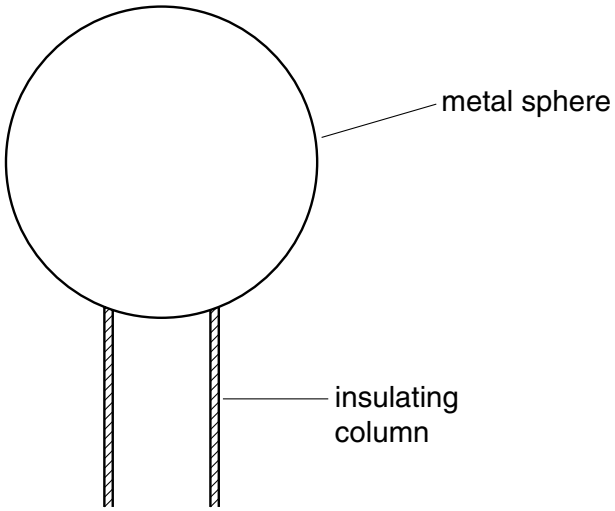

Fig. 4.1

The sphere has diameter 42 cm and any charge on its surface may be considered as if it were concentrated at its centre.

The air surrounding the sphere loses its insulating properties, causing a spark, when the electric field exceeds 20 kV cm^{-1}.

(a) By reference to an atom in the air, suggest the mechanism by which the electric field causes the air to become conducting.

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.....

.....

..... [3]

(b) Calculate, for the charged sphere when a spark is about to occur,

(i) the charge on the sphere,

charge = ... C [3]

(ii) its potential.

potential = ... V [2]

(c) Under certain conditions, a spark sometimes occurs before the potential reaches that calculated in **(b)(ii)**. Suggest a reason for this.

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..... [1]