5 A solid metal sphere, of radius *r*, is insulated from its surroundings. The sphere has charge +*Q*.
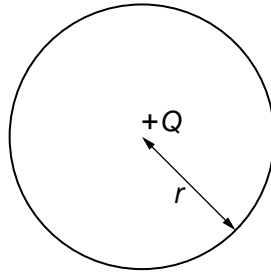
This charge is on the surface of the sphere but it may be considered to be a point charge at its centre, as illustrated in Fig. 5.1.

Fig. 5.1

(a) (i) Define *capacitance*.

....

.... [1]

(ii) Show that the capacitance *C* of the sphere is given by the expression

$$C = 4\pi\varepsilon_0 r.$$

[1]

(b) The sphere has radius 36 cm.
Determine, for this sphere,

(i) the capacitance,

capacitance = ... F [1]

(ii) the charge required to raise the potential of the sphere from zero to 7.0×10^5 V.

charge = ... C [1]

(c) Suggest why your calculations in **(b)** for the metal sphere would not apply to a plastic sphere.

....

....

....

.... [3]

(d) A spark suddenly connects the metal sphere in **(b)** to the Earth, causing the potential of the sphere to be reduced from 7.0×10^5 V to 2.5×10^5 V.

Calculate the energy dissipated in the spark.

energy = ... J [3]