4 **(a)** An insulated metal sphere of radius R is situated in a vacuum. The charge q on the sphere may be considered to be a point charge at the centre of the sphere.

(i) State a formula, in terms of R and q, for the potential V on the surface of the sphere.

..... [1]

(ii) Define capacitance and hence show that the capacitance C of the sphere is given by the expression

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

[1]

(b) An isolated metal sphere has radius 45 cm.

(i) Use the expression in **(a)(ii)** to calculate the capacitance, in picofarad, of the sphere.

capacitance = ... pF [2]

(ii) The sphere is charged to a potential of 9.0×10^5 V.
A spark occurs, partially discharging the sphere so that its potential is reduced to 3.6×10^5 V.

Determine the energy of the spark.

energy = ... J [3]

[Turn over