4 **(a)** **(i)** Define the term *electric potential*.

……

……

…… [2]

(ii) Write down the relationship between electric field strength and electric potential.

……

…… [1]

(b) Fig. 4.1 is a map of equipotential lines drawn to scale. The potentials in the region mapped are set up by a system of small stationary charged spheres in a plane, three of which carrying charge of q_1, q_2 and q_3 are shown. All the charged spheres are fixed in their locations.

Potential values are given in volts (V). Note the signs (+/–).

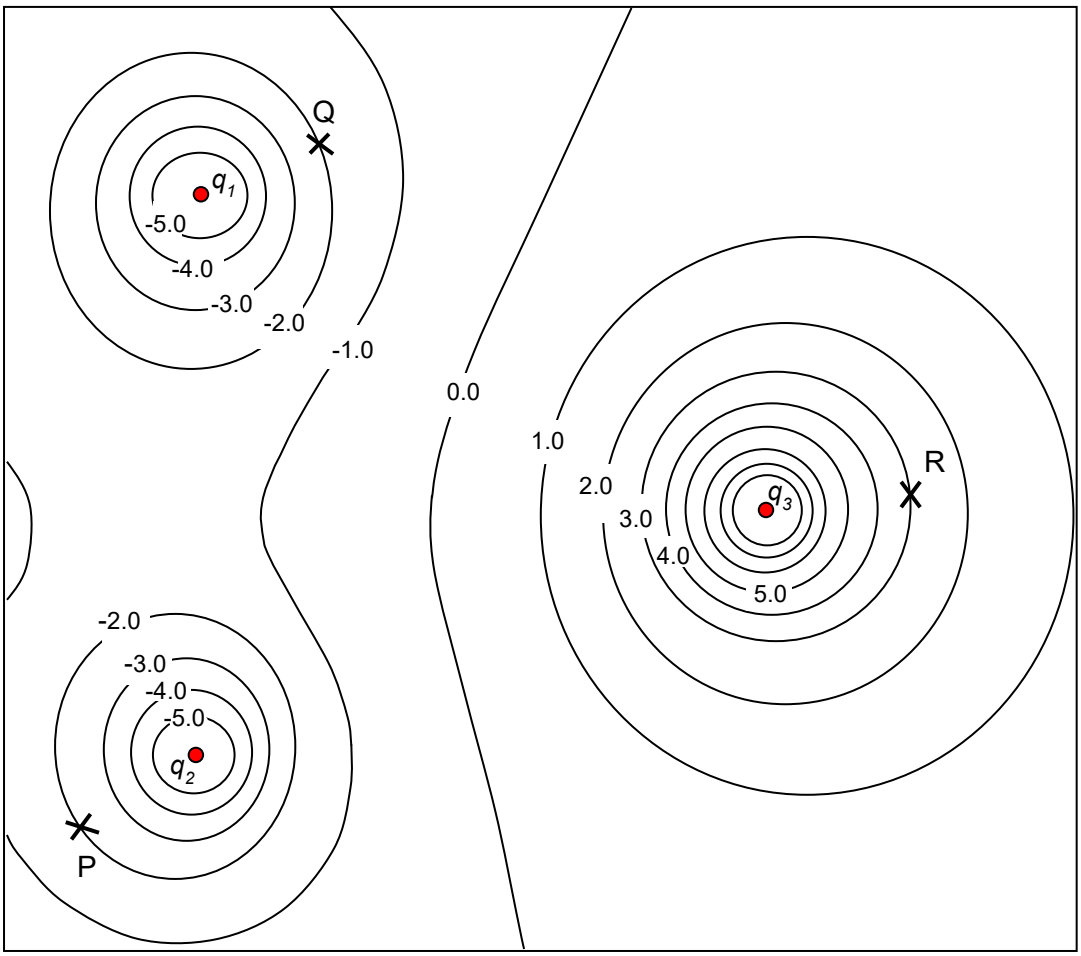

Fig. 4.1

Based on Fig. 4.1, state with reasons whether the charge q_1, q_2 and q_3 are positive or negative.

……

……

……

…… [2]

(c) **(i)** Draw on Fig. 4.1 an arrow at P to indicate the direction of the electric field strength at P. Label the arrow as *E*. [1]

(ii) Estimate the magnitude of electric field strength at point P.

magnitude of electric field strength = …….…….. Vm^{-1} [1]

(d) Calculate the work required to move an electron from point P to point R without a gain in kinetic energy.

work = …….…….. J [2]

(e) Sketch on Fig. 4.2 the variation of the electric field strength E along a straight line from the sphere carrying charge q_1 to the sphere carrying charge q_3.

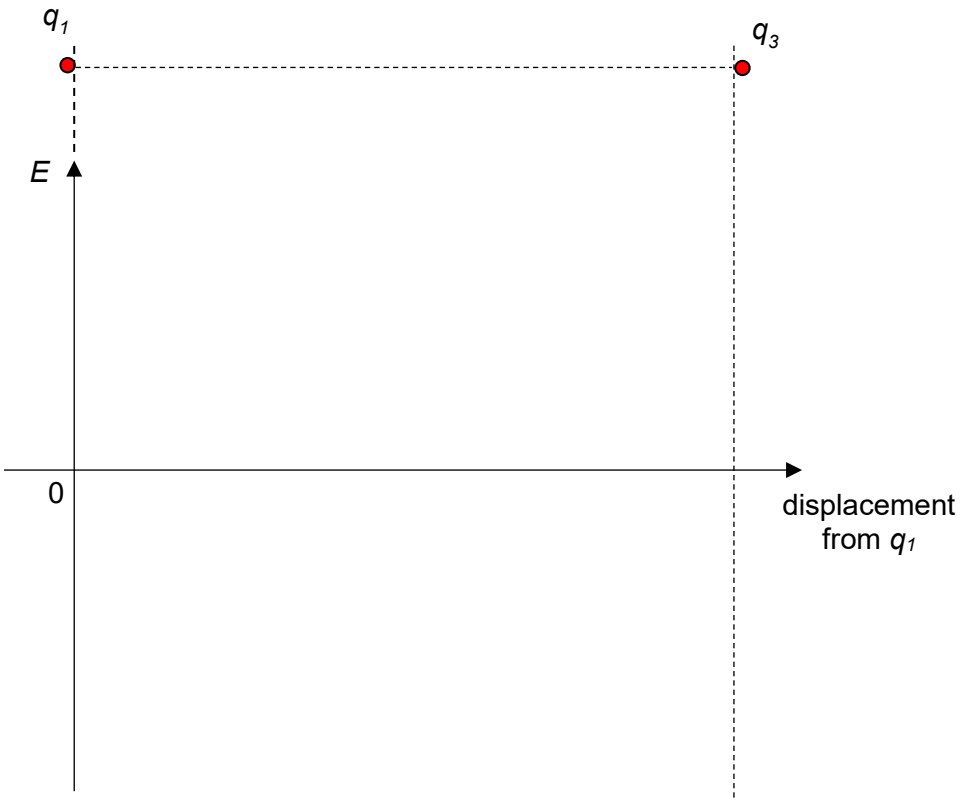

Fig. 4.2

[3]