5 **(a)** State the relationship between electric potential and electric field strength at a point.

……

……

……[2]

(b) Two parallel metal plates A and B are situated a distance 1.2 cm apart in a vacuum, as shown in Fig. 5.1.

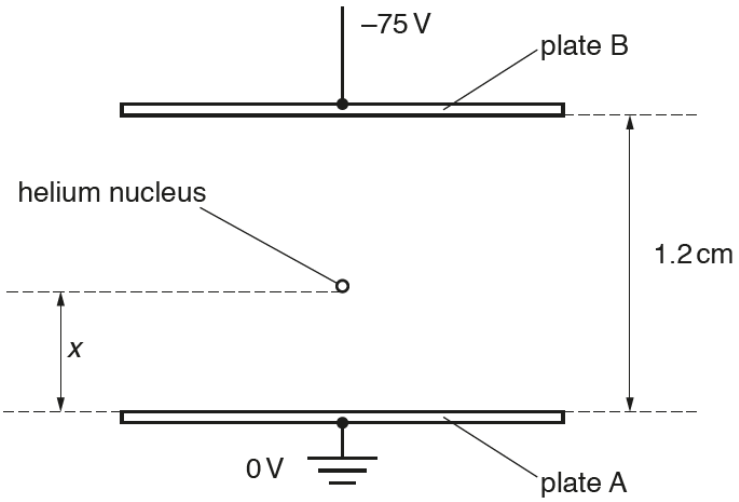

Fig. 5.1

Plate A is earthed and plate B is at a potential of –75 V.

A helium nucleus is situated between the plates, a distance *x* from plate A.

Initially, the helium nucleus is at rest on plate A where $x = 0$.

(i) On Fig. 5.1, draw an arrow to show the direction of the electric field.

[1]

(ii) Determine the magnitude E of the electric field strength.

E = ... V m^{-1} [1]

(iii) The helium nucleus is free to move between the plates. By considering energy changes of the helium nucleus, explain why the speed at which it reaches plate B is independent of the separation of the plates.

……

……

…… [1]

(iv) As the helium nucleus moves from plate A towards plate B, its distance x from plate A increases.

Calculate the speed of the nucleus after it has moved a distance x = 0.40 cm from plate A.

speed = ... m s^{-1} [3]

[Total: 8]