4 **(a)** **(i)** Define *electric field strength*.

....

....

.... [1]

(ii) Fig. 4.1 shows a charge +q at point X in a uniform electric field of electric field strength E.
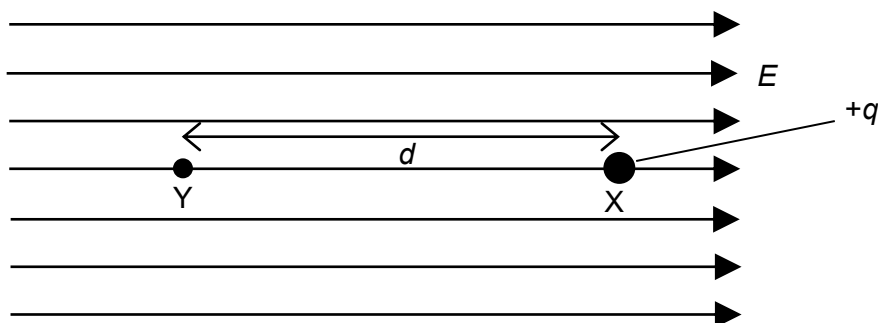

Fig. 4.1

The charge at point X is moved to point Y through a distance d. Using your answer to **(i)**, deduce an expression for the work done on the charge by the electric force.

work done by electric force = ...

[1]

(iii) The potential difference between points X and Y is *V*. Using your answer from **(ii)**, deduce an expression for *V* in terms of *E* and *d*.

V = ………………… [1]

(iv) Draw a line in Fig. 4.1 joining points which are at the same electric potential as point X.

[1]

(v) Between X and Y, state the point which is at a higher electric potential.

……………………………………………………………………………………………………….. [1]

(b) In the vacuum of an X-ray tube, electrons are accelerated from rest through a potential difference of 10 kV between the cathode and the anode.

Calculate

(i) the speed of electrons arriving at the anode.

speed = ………………….. m s^{-1} [2]

(ii) the minimum wavelength X-rays that are produced.

minimum wavelength = ……………….……….. m   [2]

[Total: 9]