6 **(a)** Two horizontal metal plates are separated by a distance of 2.0 cm in a vacuum, as shown in Fig. 6.1.

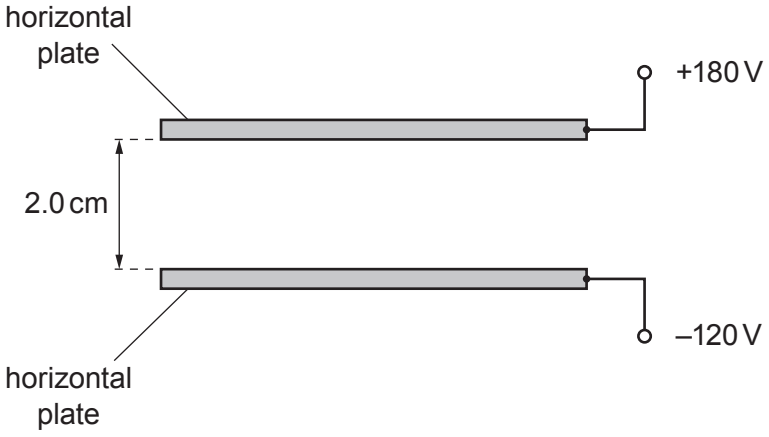

Fig. 6.1

The top plate has an electric potential of +180 V and the bottom plate has an electric potential of –120 V.

(i) Determine the magnitude of the electric field strength between the plates.

electric field strength = ... $N C^{-1}$ [2]

(ii) State the direction of the electric field.

..... [1]

(b) An uncharged atom of uranium-238 ($^{238}_{92}U$) has a change made to its number of orbital electrons. This causes the atom to change into a new particle (ion) X that has an overall charge of +2*e*, where *e* is the elementary charge.

(i) Determine the number of protons, neutrons and electrons in the particle (ion) X.

number of protons = ...

number of neutrons = ...

number of electrons = ...

[3]

(ii) The particle (ion) X is in the electric field in **(a)** at a point midway between the plates.

Determine the magnitude of the electric force acting on X.

force = ... N [2]

(iii) The nucleus of uranium-238 ($^{238}_{92}$U) decays in stages, by emitting α-particles and β^- particles, to form a nucleus of thorium-230 ($^{230}_{90}$Th).

Calculate the total number of α-particles and the total number of β^- particles that are emitted during the decay of uranium-238 to thorium-230.

number of α-particles = ...

number of β^- particles = ...
[2]

[Total: 10]