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

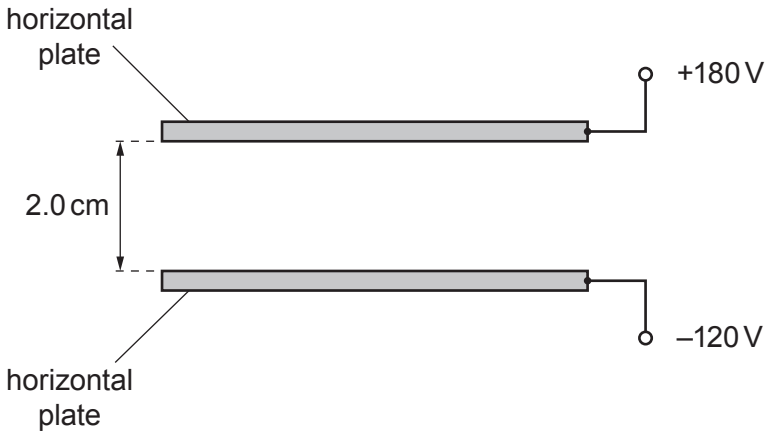


**Fig. 6.1**

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 $\alpha$-particles and $\beta^-$ particles, to form a nucleus of thorium-230 ($^{230}_{90}Th$).

Calculate the total number of $\alpha$-particles and the total number of $\beta^-$ particles that are emitted during the decay of uranium-238 to thorium-230.

number of $\alpha$-particles = .....

number of $\beta^-$ particles = .....
[2]

[Total: 10]