$^{10}/_{13}$

## H9 Energies and potentials of charges in electric fields

All answers must be given with the correct sign. Questions H9.1 to H9.3 concern the region between two large, horizontal metal plates $2.00$ mm apart that are connected to a $1.60$ kV power supply. The negative terminal is earthed and connected to the bottom plate. Ignore complications caused by the edges of the plates.

H9.1 Calculate the potential of a point:

a) $1.00$ mm above the bottom plate.

b) $0.75$ mm above the bottom plate.

H9.2 How far above the bottom plate would a point need to be if its potential was $1.35$ kV?

H9.3 Calculate the electrostatic potential energy of

a) a proton $1.85$ mm below the top plate.

b) an electron $0.32$ mm above the bottom plate.

H9.4 Calculate the electrostatic potential of a point $0.92$ m away from a very small $+24$ nC charge.

H9.5 A metal sphere with a radius of $7.4$ cm is at a potential of $1.8$ MV.

a) Calculate the charge stored on the sphere.

b) Calculate the potential of a point $13.6$ cm from the sphere's centre.

H9.6 Calculate the electrostatic potential energy when a proton is $0.43$ nm from an electron.

H9.7 An alpha particle (charge of $3.2 \times 10^{-19}$ C and mass $6.7 \times 10^{-27}$ kg) is fired directly towards a gold nucleus which has a charge of $1.26 \times 10^{-17}$ C.

a) Taking a speed of $1.8 \times 10^{7}$ m/s, and assuming negligible recoil of the gold nucleus, calculate the distance of closest approach.

b) How fast would the alpha particle have to be fired in order to have a closest approach distance of $8.0 \times 10^{-15}$ m?

H9.8 Two charges are stuck to a metre stick: a $+1.0$ pC charge is stuck to the $0.0$ cm mark, and a $-1.0$ pC charge is stuck to the $10$ cm mark.

a) Calculate the electrostatic potential at the $20.0$ cm mark.

b) Find the electrostatic potential at the $5.0$ cm mark.