

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 3.2×10^{-19} C and mass 6.7×10^{-27} kg) is fired directly towards a gold nucleus which has a charge of 1.26×10^{-17} C.

- a) Taking a speed of 1.8×10^7 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 8.0×10^{-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.