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5 An electric field is set up between a pair of large parallel plates, P and Q which are 5.0 m apart. Plate P is at a potential of −1000 V and Q is at a potential of +1000 V.

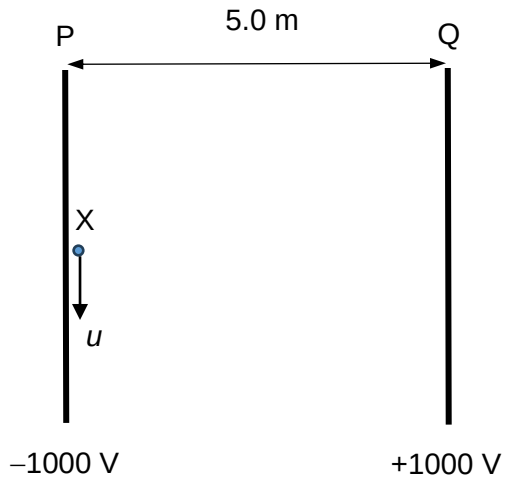

Fig. 5.1

A negatively charged particle, X of weight 4.9×10^{-4} N and charge 0.78 μC leaves plate P with a velocity *u* of magnitude 23 m s^{-1} along the vertical. The setup is assumed to be in an evacuated chamber.

(a) Determine the magnitude and direction of the electric force on particle X due to the electric field between the plates.

magnitude = …… N [1]

direction = …… [1]

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(b) **(i)** Draw a diagram to show the forces acting on particle X.

[1]

(ii) Hence, explain why the weight of particle X will affect its motion.

……

…… [1]

(c) Determine the speed of particle X just before it hits the surface of Q.

speed = …… m s^{-1} [4]

[Turn over

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(d) Explain how the path taken by particle X between the plates can be considered as parabolic.

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…… [2]

(e) Calculate the change in electric potential energy of particle X when it reaches the surface of Q from P.

change in electric potential energy = …… J [2]

[Total: 12]