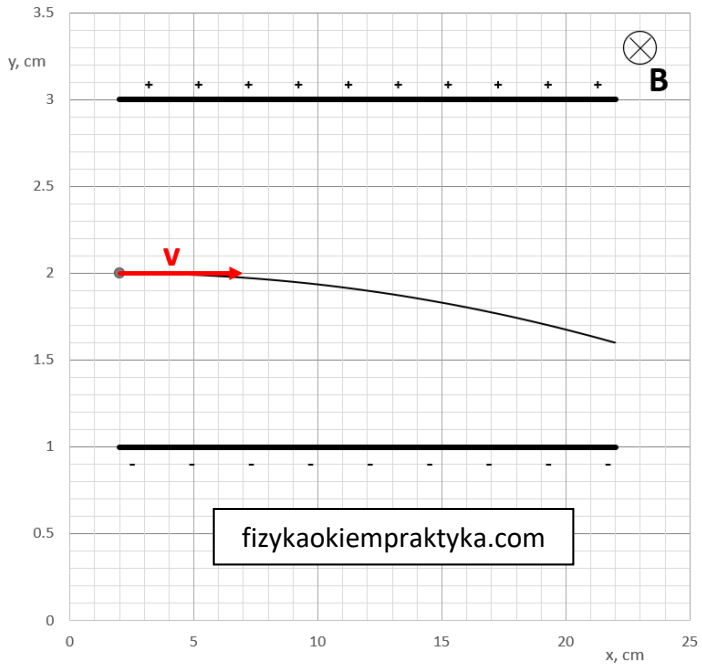
Exercise – Velocity selector

The figure shows a proton about to enter the space between two charged metal plates. Additionally this set of plates is placed in a magnetic field of strength B = 2.0 mT directed into the plane of the paper. The speed of the proton v = 9898 ms^{-1}.

In the solution, ignore the force of gravity acting on the proton.



a) State the names of forces that act on this proton.

b) Draw the vectors of forces acting on the particle in the situation shown in the figure. Keep the proportions of the vectors.

c) Calculate the time of movement of the proton through the area between the plates.
(2.02×10^{-5} s)

d) Calculate the acceleration of the particle.
(1.96×10^{7} ms^{-2})

e) Calculate the value of the resultant force acting on the proton.
(3.27×10^{-20} N)

f) Determine the magnitude of the magnetic force exerted on the proton.
(3.17×10^{-18} N)

g) Deduce that the electric field strength between the plates E = 20 NC^{-1}.

h) Determine the speed the proton should have to move along a straight line between the plates. (10 000 ms^{-1})