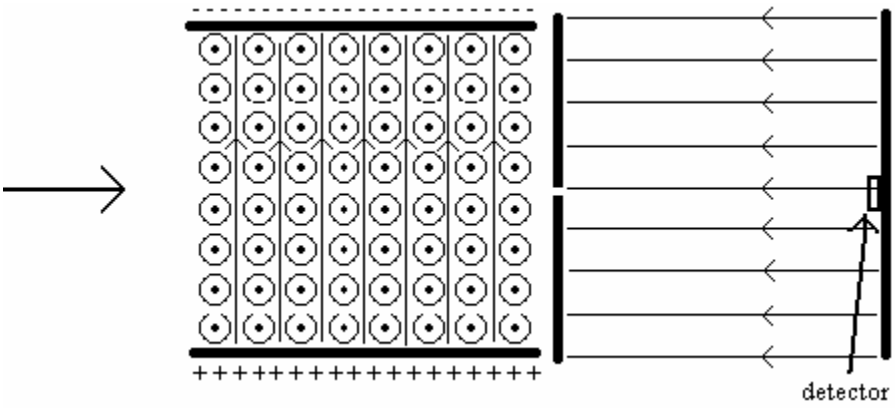
UNIT 18 EXERCISES

1) Suppose a positively charged particle left the radioactive source, went through the velocity selector and then entered a region of constant electric field to the left as shown in the picture below.



a) The initial velocity of a particle entering the region of constant electric field is v. What is the initial kinetic energy of the particle? Explain.

b) What is the direction of the electric force on the particle in the region of constant electric field? Explain.

c) Would the particles reach the detector? Under what conditions would particles just reach the detector (with velocity zero)? Explain.

d) If the electric field is adjusted so that the particle would just reach the detector with velocity zero and the potential difference between the plated is ΔV, what is the work done by the electric field on the particle while it is moving from one plate to the other in terms of the charge of the particle and the potential difference between the plates? Explain.

e) The work done on the particle by the electric field is equal to the change in kinetic energy of the particle. Write this as an equation in terms of the charge q, the potential difference ΔV, the initial velocity of the particle v, and the mass of the particle m. Solve the equation for the ratio of the charge to the mass of the particle.

2) A particle leaving a radioactive source enters a velocity selector and leaves with a velocity $v = 5.6 \times 10^7$ m/s. It enters a region of constant magnetic field B = 0.0637T out of the page and curves to the left with radius r = 0.005m. What is the ratio of the charge to the mass of the particle? Explain.

3) During an archaeological dig an old campfire is discovered. The charcoal in it has one one-hundredth the normal amount of ^{14}C. (One part in 10^{14} rather than one part in 10^{12}.) Calculate the approximate age of the charcoal. The decay constant is $\lambda = 3.8 \times 10^{-16} s^{-1}$.