(3.5) In a Dempster type (constant B and V) type spectrograph utilising 180 degree focusing, the ions $^{12}C^+$ and $^{11}BH^+$ are recorded simultaneously, the latter ion having a slightly larger orbit diameter. The separation between the lines recorded on the photographic plate is 0.0143 cm and the orbit diameter for the $^{12}C^+$ ion is 20 cm. What is the atomic mass of ^{11}B?

Designate the orbit diameter for ion no 1 by r and the separation to the second ion by x. Then eqn. (3.12) gives the following relation when applied to both ion no 1 and ion no 2:

$m_1=q_1*r^2*B^2/2*V$ and $m_2=q_2*(r+x)^2B^2/2V$; hence by division $m_2/m_1=(q_2/q_1)*((r+x)/r)^2=M_2/M_1$

$amu := 1.6605402\cdot 10^{-27}\cdot kg$

$M_e := 5.485799\cdot 10^{-4}\cdot amu$ The mass of an electron is M_e

$r := \frac{20}{2}\cdot 0.01\cdot m$

$M_1 := 12\cdot amu - M_e$ Because the ^{12}C-ion lacks 1 electron

$x := \frac{0.0143}{2}\cdot 0.01\cdot m$

$q_1 := 1$ $q_2 := 1$

$M_2 := M_1\cdot\left(\frac{q_2}{q_1}\right)\cdot\left(\frac{r+x}{r}\right)^2$ $M_2 = 12.016617\cdot amu$ The mass of BH^+ ions

In order to obtain the mass of the ^{11}B-atom we must subtract the mass of a H^+ ion as follows:

$M_H := 1.007825\cdot amu$

$M_B := M_2 - \left(M_H - M_e\right)$ $M_B = 1.82815\cdot 10^{-26}\cdot kg$

or $M_B = 11.00934\cdot amu$