Physics 102 Spring 2007: Suggested Problems # 7

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1. Problem 28-35. (**+10 pts**)

   i. +3 pts - Correct value for the speed of the particle from kinetic energy.

   $$v = \sqrt{\frac{2\,K}{m}}$$

   ii. +6 pts - Correct application of Newton's 2^{nd} law to find B.

   $$B = \frac{m\,v}{q\,r}$$

   $$B_{max} = \frac{m}{q\,R}\sqrt{\frac{2\,K_{max}}{m}} = 3.54T$$

   iii. +1 pt - Correct numerical answer above.

28-35

Given the kinetic energy, we could find the speed

$$K = \frac{1}{2}mv^2 \rightarrow v = \sqrt{\frac{2K}{m}}$$

We could find the maximum Magnetic field required to keep maximum energy particle in orbit.

$$qvB = mv^2/r \rightarrow r = \frac{mv}{qB} \rightarrow B = \frac{mv}{qr}$$

so $$B_{max} = \frac{mv_{max}}{qR} = \frac{m}{qR}\sqrt{\frac{2K_{max}}{m}}$$

$$B_{max} = \frac{1}{qR}\sqrt{2K_{max} \cdot m}$$

$$\Rightarrow B_{max} = \frac{\sqrt{2(6\times10^6\,eV)(1.6\times10^{-5}\,J/eV)\cdot 4(1.67\times10^{-27}\,kg)}}{2(1.6\times10^{-19}\,C)(0.1\,m)}$$

$B_{max} = 3.54\ T$

α-particles of smaller KE require a smaller $\vec{B}$ field.