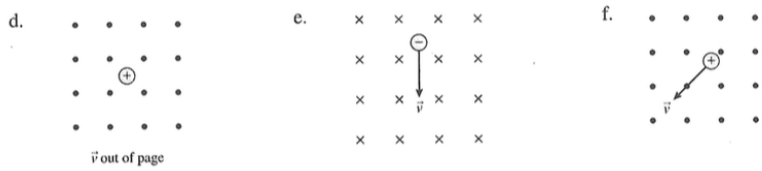
In-class problems, Fri Apr 20 2018

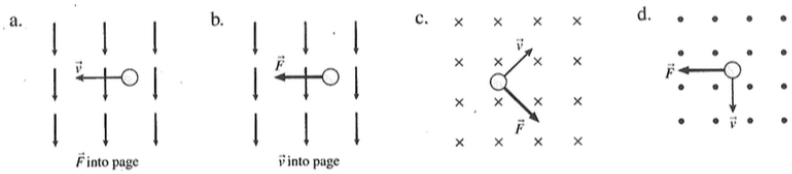
magnetic force on charge

1. From the workbook: 29.27def, 29.28 and 29.29

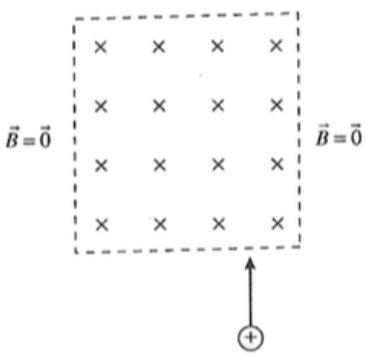
   Determine the direction of the magnetic force in each of the following



   Determine the sign of the charge in each of the following



   Sketch and label the trajectory of the charge for (1) a weak field and (2) a strong field.



2. Calculate the magnitude of the magnetic force on a proton moving at 3×10^5m/s when it's

   (a) perpendicular
   (b) at 30°
   (c) parallel
   to a 0.5T magnetic field.

   (d) Sketch the situations for (a)(b)(c)

3. (a) Derive the equation for the radius of the circle that a charge sweeps out in a uniform magnetic field.

$$r = mv/qB$$

   Write down Newton's second law, $\Sigma\vec{F} = ma$. Substitute in $F = qvB$ and $a = \frac{v^2}{r}$. Solve for r.

   (b) Derive the cyclotron frequency, the number of times the charge circles in one second.

$$f = \frac{qB}{2\pi m}$$

   Write the definition $f \equiv 1/\text{period}$. Substitute in an expression for period, the time it takes to go around the circle once: $\frac{\text{distance}}{\text{speed}} = \frac{2\pi r}{v}$. Simplify.

4. Radio astronomers detect EM radiation at 42MHz from an interstellar gas cloud. If the radiation results from electrons spiraling in a magnetic field, what's the field strength?

Due next time, beginning of class

magnetic force on currents, current loops

1. (a) Write down the equation for the magnetic force on a current carrying wire. Use the vector form. That is, $\vec{F} = \ldots$

(b) Write down the equation for the *magnitude* of the magnetic force on a current carrying wire. That is $F = \ldots$

(c) Sketch the relative directions of $I\vec{\ell}, \vec{B}$, and $\vec{F}$. How are these directions related?

2. (Review). (a) Write down the general equation for torque. Refer to Chapter 12.

(b) Sketch one example that illustrates the relationship between $\vec{r}$, $\vec{F}$, and $\vec{\tau}$.