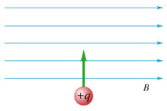
4.2 Magnetic Field Strength, Force

Particles in Magnetic Fields

Charged particles moving through magnetic fields experience a force, greatest when perpendicular:

$\vec{F}_M = q\vec{v} \times \vec{B}$ AP Equation	q = charge (C) v = velocity (m/s) B = magnetic field unit = teslas T (N/(A•m))



For any other direction:

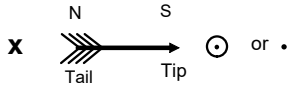
$\lvert\vec{F}_M\rvert = \lvert q\vec{v}\rvert\lvert\sin\theta\rvert\lvert\vec{B}\rvert$ AP Equation	θ = angle

You could merge these two equations!

Absolute values adjust the variables' signs: charge, direction, angle, and B-field (SHOULD be on first equation)

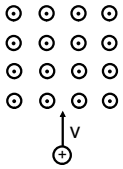
Notation

Arrows denote B-fields:
This looks like an arrow from archery.

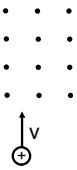


If a B-field goes into or out of a plane, here's what it looks like:

B-field out of page



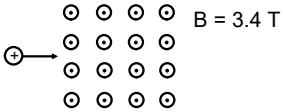
Or:



1. Force Example

A 3.4 E -6 kg particle (charge = + 1.3 nC) travels 14,000 m/s into a 3.4 T uniform magnetic field as shown.

What force acts upon it within the field?



$$F_M = qvB$$
$$= 1.3E-9C \bullet 1.4E4\,m/s \bullet 3.4T$$
$$= 6.2E-5N$$

2. Acceleration Example

What acceleration does the particle experience?
(Remember Newton's 2nd Law?)

$$F = ma$$
$$a = \frac{F}{m} = \frac{6.2E-5N}{3.4E-6kg} = 18\,m/s^2$$

Right-Hand Force Rules

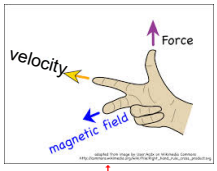
Like the R-H rule of circular motion, but weirder!

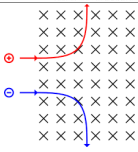
Direction of moving particle's deflection relates to charge and B-field orientation.

Defined as positive charge.
(If charge negative, use Left-Hand rule!)

Right hand's index finger is velocity, the middle finger is B-field: thumb points in force's direction.

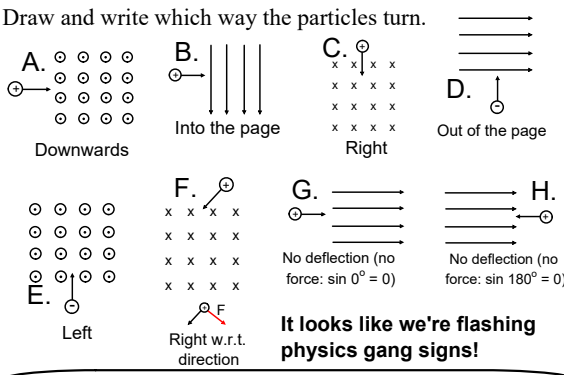
Particles turn right or left!





3. Direction Examples

Draw and write which way the particles turn.



It looks like we're flashing physics gang signs!

Homework 4.2 Problems 4.2 in your Booklet
Due: Next Class