Announcements

- We will be using the toy kits in problem session tomorrow. You'll be making an electromagnet!
- This is the last new material for Unit 1. Next Tuesday's class will be a review lecture.
- There will be an optional review session Tuesday, February 10 at 8:00 pm, here.
- First midterm exam: Thursday, February 12 from 7:00–9:00 pm. You can bring a 3" $\times$5" card with anything you want written on it.
- I'll announce an MCAT physics session some time after the exam.
- Toys & Tea today from 4-5pm in Olin 251A!

Lecture 6 — Concept Test 1

For the segment of wire shown, what is the direction of the magnetic field at point P?

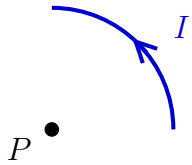
1. $\uparrow$ **3.** $\downarrow$ **5.** $\odot$ (out of page)

2. $\longrightarrow$ **4.** $\longleftarrow$ **6.** $\otimes$ (into page)

Back of card. $\vec{B} = 0$

Lecture 6 — Concept Test 2

For the segment of wire shown, what is the direction of the magnetic field at point P?



1. ↖ **3.** ↘ **5.** ⊙ (out of page)

2. ↗ **4.** ↙ **6.** ⊗ (into page)

Back of card. $\vec{B} = 0$

Lecture 6 — Concept Test 3

What is the direction of the magnetic field at the point P due to a long straight wire carrying current out of the screen, as shown?

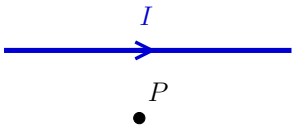
1. $\uparrow$ **3.** $\downarrow$ **5.** $\odot$ (out of page)

2. $\longrightarrow$ **4.** $\longleftarrow$ **6.** $\otimes$ (into page)

Back of card. $\vec{B} = 0$

Lecture 6 — Concept Test 4

What is the direction of the magnetic field at the point P due to a long straight wire carrying current to the right, as shown?



1. $\uparrow$

2. $\longrightarrow$

3. $\downarrow$

4. $\longleftarrow$

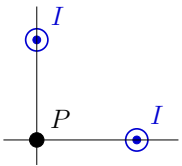
5. $\odot$ (out of page)

6. $\otimes$ (into page)

Back of card. $\vec{B} = 0$

Lecture 6 — Concept Test 5

Which of the following options best shows the direction of the magnetic field at the point P due to two wires carrying equal currents out of the screen, as shown?



1. ↖ **3.** ↘ **5.** ⊙ (out of page)

2. ↗ **4.** ↙ **6.** ⊗ (into page)

Back of card. $\vec{B} = 0$

Right Hand Rules in Magnetism

#1 Cross Product RHR

1. Put your arm in the direction of the first vector.
2. Bend your fingers to point in the direction of the second vector.
3. Your thumb points in the direction of the cross product.

This applies to:

- Magnetic force on a moving charge: $\vec{F}_q = q\vec{v} \times \vec{B}$
- Magnetic force on a current: $\vec{F}_{\text{wire}} = I\vec{L} \times \vec{B}$.
- Torque on a current loop: $\vec{\tau} = \vec{\mu} \times \vec{B}$
- Biot-Savart law: $d\vec{B} = \frac{\mu_0}{4\pi} \frac{I d\vec{\ell} \times \hat{r}}{r^2}$.

#2 Curl-Straight RHR

Fingers curl around and thumb points straight. This applies to:

magnetic moment $\vec{\mu}$

B-field of a solenoid

B-field of a long, straight wire

B-field at center of a current loop

Nuclear Magnetic Resonance (MRI)

Image from `https://4rai.com/`