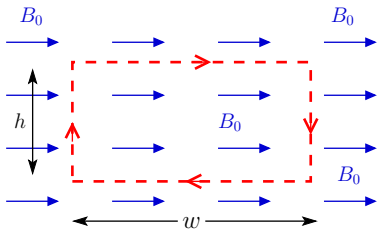
Announcements

- 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 11 at 8:00 pm, here.
- First midterm exam: Thursday, February 13 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.

Lecture 6 — Concept Test 1

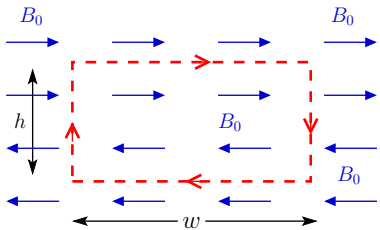
What is the circulation for the following magnetic field around the indicated rectangular curve?



1. 0
2. $B_0 w$
3. $2B_0 w$
4. $B_0 h$
5. $2B_0 h$
6. $2B_0 h + 2B_0 w$

Lecture 6 — Concept Test 2

What is the circulation for the following magnetic field around the indicated rectangular curve?

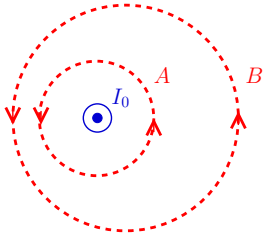


1. 0
2. $B_0 w$
3. $2B_0 w$
4. $B_0 h$
5. $2B_0 h$
6. $2B_0 h + 2B_0 w$

Lecture 6 — Concept Test 3

A wire carries a current I_0 out of the screen. Two Amperian curves are drawn on the diagram. Curve A has a radius of $1\,\text{m}$ and curve B has a radius of $2\,\text{m}$. For curve A the circulation is $\oint \vec{B} \cdot d\vec{\ell} = 2.5\,\text{T}\cdot\text{m}$.

What is the circulation of curve B?

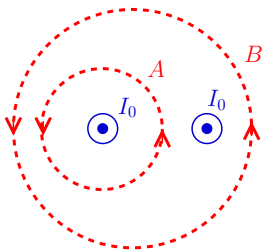


1. 0
2. $1.25\,\text{T}\cdot\text{m}$
3. $2.5\,\text{T}\cdot\text{m}$
4. $5.0\,\text{T}\cdot\text{m}$
5. $10.0\,\text{T}\cdot\text{m}$
6. Not enough information

Lecture 6 — Concept Test 4

Two wires each carry a current I_0 out of the screen. Two Amperian curves are drawn on the diagram. Curve A has a radius of $1\,\text{m}$ and curve B has a radius of $2\,\text{m}$. For curve A the circulation is $\oint \vec{B} \cdot d\vec{\ell} = 2.5\,\text{T·m}$.

What is the circulation of curve B?



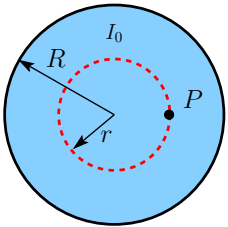
1. 0
2. $1.25\,\text{T·m}$
3. $2.5\,\text{T·m}$
4. $5.0\,\text{T·m}$
5. $10.0\,\text{T·m}$
6. Not enough information

Using Ampere's Law to find the magnetic field

1. Write down $\oint \vec{B} \cdot d\vec{\ell} = \mu_0 I_{\text{enc}}$ and draw a sketch.
2. Using symmetry and your intuition, decide what the B-field will look like, and sketch it.
3. Choose a curve that passes through the point P, and for which each piece of the curve satisfies either
   - $\vec{B} \parallel d\vec{\ell}$ and B constant magnitude $\Rightarrow \int \vec{B} \cdot d\vec{\ell} = \pm BL$
   - $\vec{B} \perp d\vec{\ell} \Rightarrow \int \vec{B} \cdot d\vec{\ell} = 0.$
4. Evaluate left side of Ampere's Law by summing the contributions above.
5. Evaluate the right side of Ampere's Law by finding the encircled current.
6. Plug into Ampere's Law (LHS = RHS) and solve for B at point P.

Lecture 6 — Concept Test 5

A wire of radius R is carrying a current I_0 that is distributed uniformly through its cross section. You are applying Ampere's Law to find the magnetic field at a point P inside the wire, a distance r from the center axis.



What is the encircled current for the Amperian loop shown in red?

1. 0
2. I_0
3. $I_0 R/r$
4. $I_0 r/R$
5. $I_0 (R/r)^2$
6. $I_0 (r/R)^2$

Nuclear Magnetic Resonance (MRI)

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