Exam 3: Tuesday, April 17, 5:00-6:00 PM

Test rooms:

Instructor	**Sections**	**Room**
Dr. Madision	E, G	McNutt 204
Dr. Parris	J, L	Toomey 199
Mr. Upshaw	B, H, K, N	Schrenk G3
Dr. Vojta	A, D	Physics 104
Dr. Wilemski	F, M	BCH 125

Exam Reminders

- 5 multiple choice questions, 4 worked problems
- no calculators, all problems will be symbolic!
- no external communications, any use of a cell phone, tablet, smartwatch etc. will be considered **cheating**
- no headphones
- be on time, you will not be admitted after 5:15pm

Exam Reminders

- grade spreadsheets will be posted the **day after the exam**
- you will need your **PIN** to find your grade
- test preparation homework 3 is posted on course website, will be discussed in recitation tomorrow
- problems on the test preparation home work are **NOT** guaranteed to cover all topics on the exam!!!

Exam 3 topics

Magnetic fields produced by charges and currents

Biot-Savart law

Ampere’s Law

Induction, Faraday’s law, Lenz’s Law

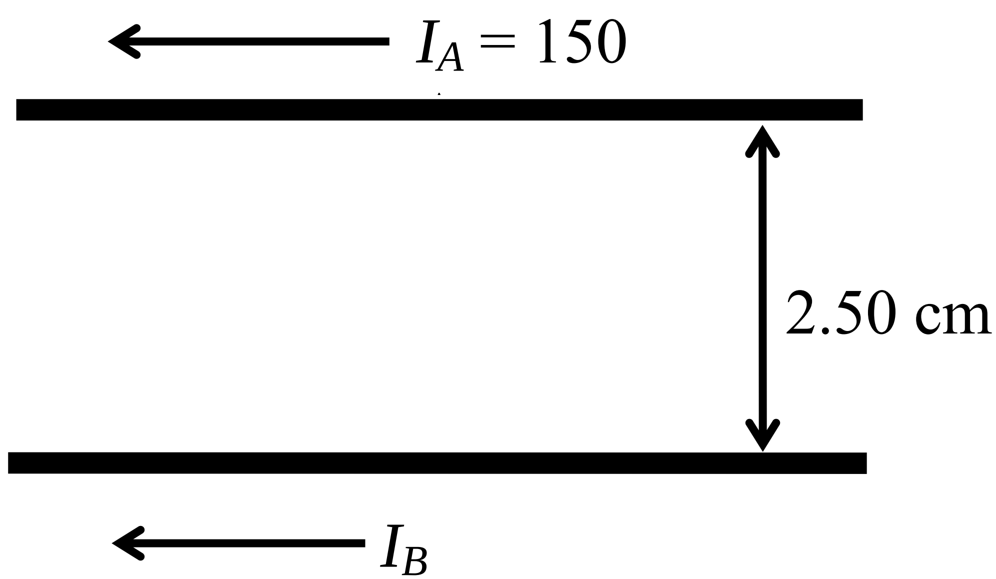
Motional emf, with gravity

Electromagnetic waves

Exam 3 topics

- don’t forget the Physics 1135 concepts
- don’t forget the material covered earlier in this course
- look at old tests (2014 to 2016 tests are on course website)
- exam problems **may come from topics not covered** in test preparation homework or test review lecture

Two long parallel conductors carry currents in the same direction as shown. Conductor A carries a current of 150 A, and is held firmly in place. Conductor B is free to move up and down. If the mass per unit length of conductor B is 0.10 kg/m what is the value of the current I_B in conductor B so that the net force on conductor B is zero when it is 2.50 cm below conductor A?



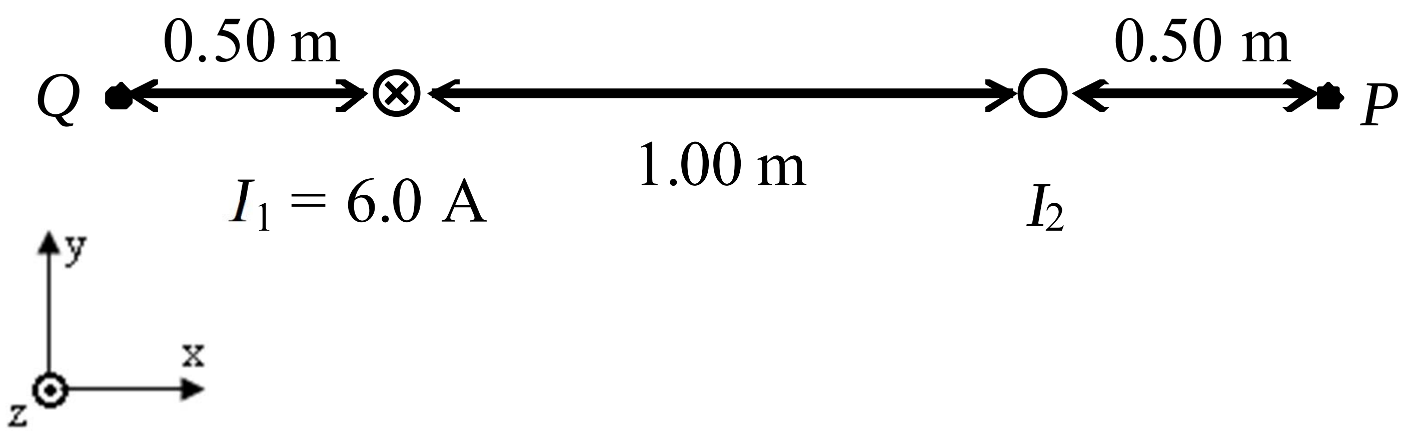
The magnetic force on wire B due to the current in wire A is

$$\vec{F}_B = I_B \vec{L}_B \times \vec{B}_A .$$

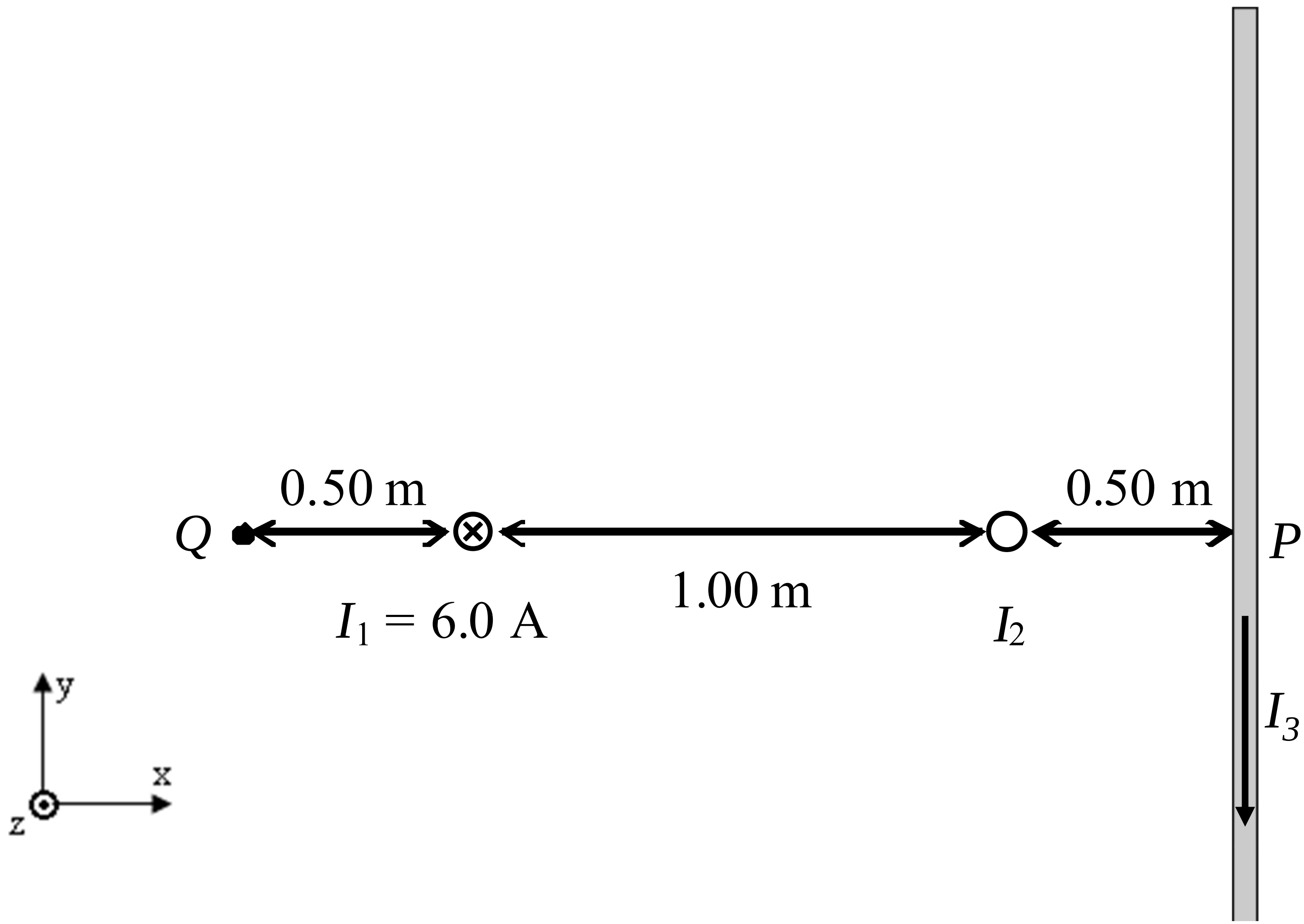
This equation was introduced before exam 2, but is "fair game" for exam 3!

Similarly, this equation is "fair game" for exam 3: $\vec{F}_q = q\vec{v}_q \times \vec{B}_{q'}$

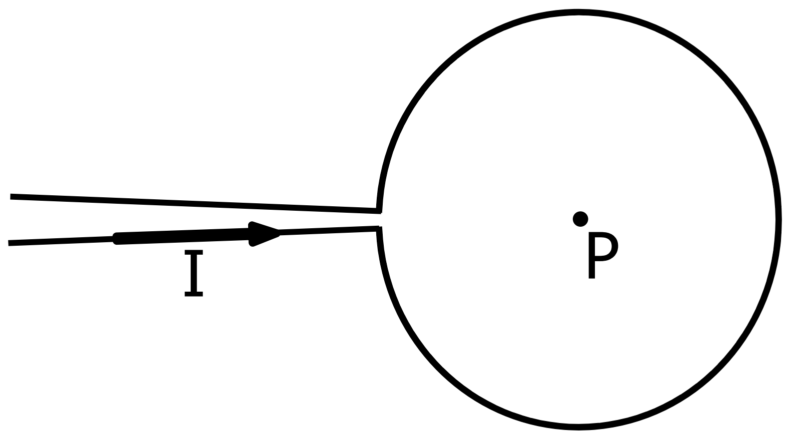
Two long parallel conductors are separated by 1.0 m. The wire on the left carries a current I_1 = 6.0 A into the page. (a) What is the direction and magnitude of I_2 in order for the net magnetic field at point P to be zero? (b) What is the magnitude and direction of the net magnetic field at point Q?



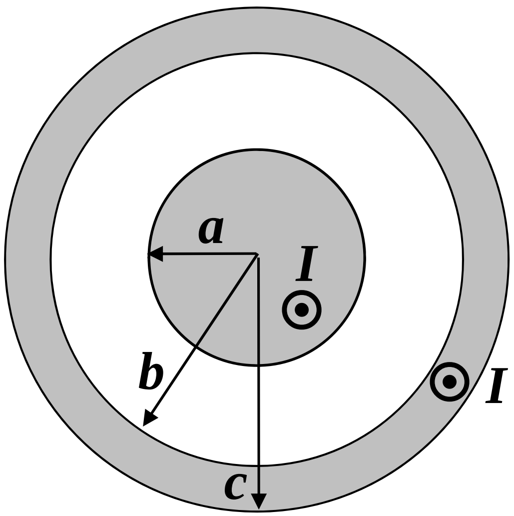
Two long parallel conductors are separated by 1.0 m. The wire on the left carries a current I_1 = 6.0 A into the page. (c) If a third long wire is placed at P and carries a current I_3 = 2.0 A in the –y direction, what is the magnitude and direction of the net magnetic field at point Q?



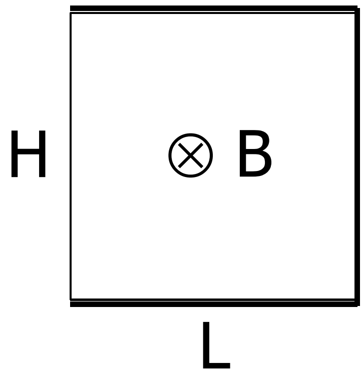
A conductor consists of a circular loop of radius R and two long straight sections as shown. The straight sections are radial. The wire lies in the plane of the paper and carries current I. Determine the magnitude and direction of the magnetic field at the center of the loop (assume the gap in the loop is negligible).



A coaxial cable consists of a solid cylindrical conductor of radius *a* which is supported by insulating disks on the axis of a cylindrical conducting tube with inner radius *b* and outer radius *c*, as shown in the figure. The central conductor and the tube carry equal currents, directed "out." The currents are uniformly distributed over the cross sections of each conductor. Calculate the magnitude of the magnetic field at a distance r (*a* < r < *b*) from the cylinder axis.



A rectangular telescoping conducting loop is being pulled open. Its height is H and its length is increasing. The length of the loop is given by $L=L_0+\alpha t$. The loop is in a uniform magnetic field as shown in the diagram. Calculate the magnitude and direction of the emf induced in the loop.



At what distance from a 100 W electromagnetic wave point source does E_{max} = 15.0 V/m? What is the average energy density of the electromagnetic wave at that point?

$$I = \langle S \rangle = \frac{1}{2} c\ \varepsilon_0 E_{max}^2 = \frac{P}{A}$$

$$\langle u \rangle = \frac{1}{2} \varepsilon_0 E_{max}^2 = \frac{1}{2} \frac{B_{max}^2}{\mu_0}$$

5.16 m

9.96×10^{-10} J/m^3

A 100 mW laser beam is perfectly reflected directly back on itself by a mirror. Calculate the force the laser beam exerts on the mirror.

$$\langle P_{rad} \rangle = \frac{I}{c} \text{ or } \frac{2I}{c}$$

6.67×10^{-10} N