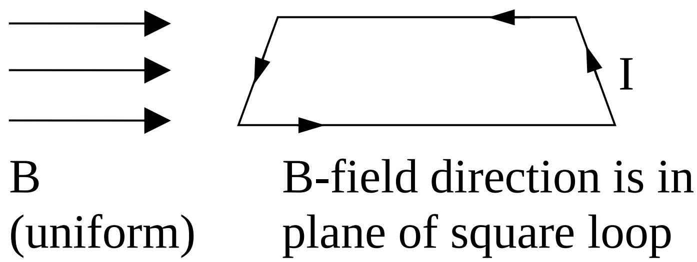
More B-field Concept Tests

B2-1. A square loop of current-carrying wire is in a non-uniform B-field as shown. Which describes the net force and the net torque on the loop due to the field?

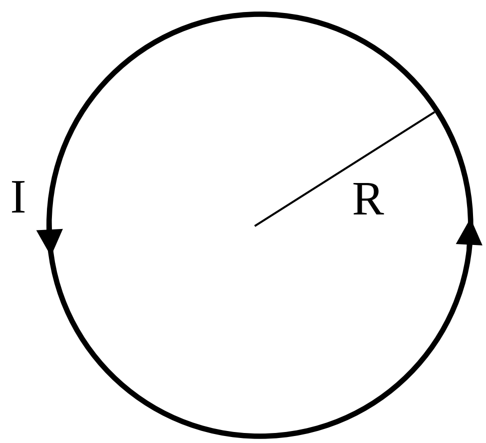


A) net force ≠ zero, net torque ≠ 0
B) net force = zero, net torque = 0
C) net force = zero, net torque ≠ 0
D) net force ≠ zero, net torque = 0

Answer: net force = zero, net torque ≠ 0

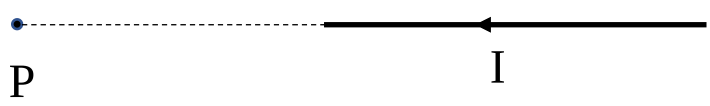
B2-2. A circular loop of wire with radius R is carrying current I as shown. The B-field at the center of a circular loop is
A) zero B) out of the page C) into the page
D) None of these

Use Biot-Savart $d\vec{B} = \frac{\mu_0 I}{4\pi} \frac{d\vec{l} \times \hat{r}}{r^2}$



Answer: out of the page

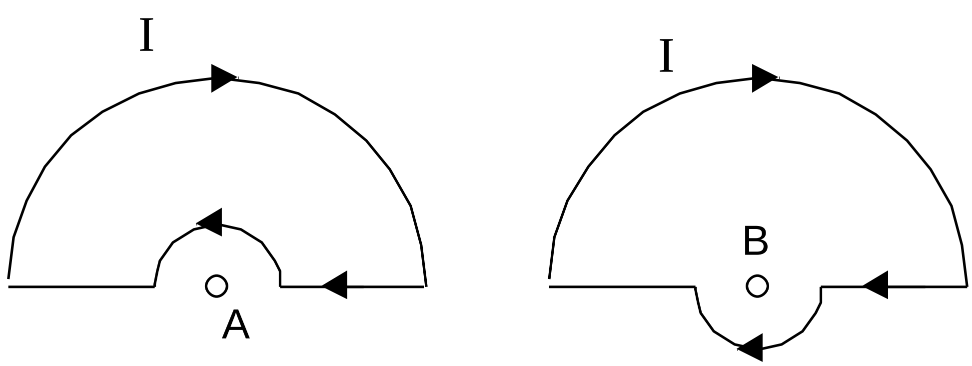
B2-3.
What is the direction of the B-field at point P, due to the segment of current-carrying wire shown? The straight segment is pointing at point P.



A) up B) down C) in D) out E) None of these

Answer: None of these. The B-field at point P due to this current segment is zero.

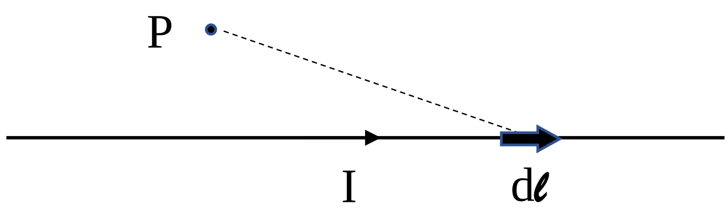
B2-4.
Which point A or B has the larger magnetic field?
A B C) The B-field is the same at A and B.



Answer: Case B has the larger magnetic field. Use the Biot-Savart Law to get the directions of the B-field due to the two semi-circular portions of the loop. In A the two fields oppose each other; in B they add.

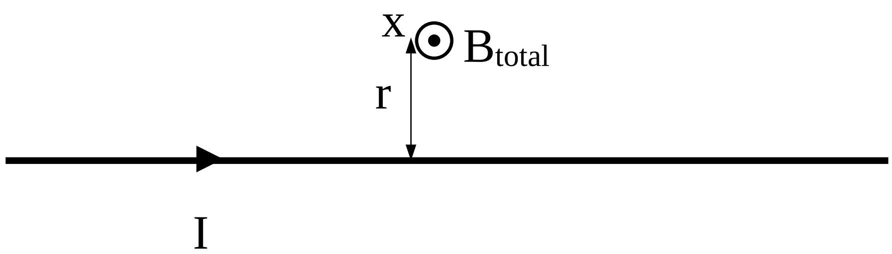
B2-5.
A long straight wire is carrying current I. What is the direction of the B-field at point P, due to the segment of wire d**l** ? The wire and point P are in the plane of the page.

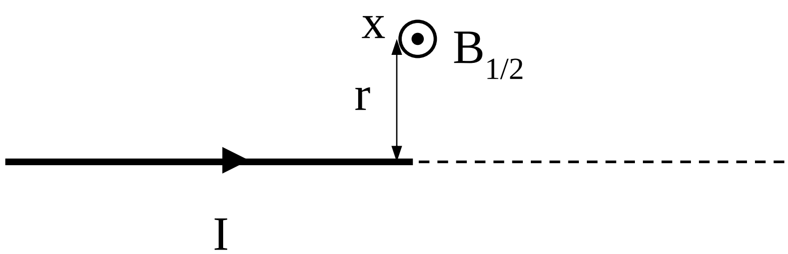
A) up		B) down		C) in		D) out		E) None of these



Answer: out of the page

B2-6.
A long straight wire is carrying current I. The magnetic field at point x has magnitude B_{total}.

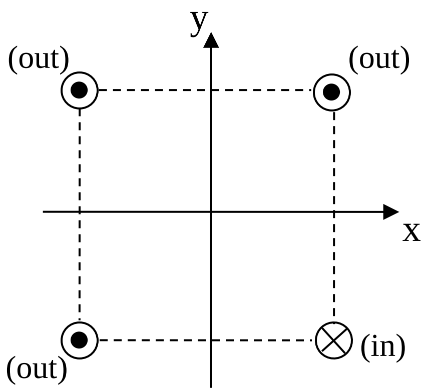


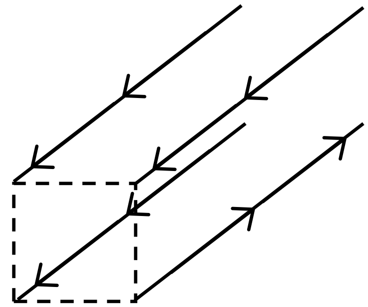


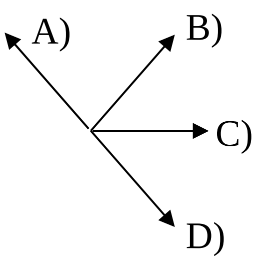
True (A) or False (B): The magnetic field $\vec{B}_{1/2}$ at point ***x due only to the current to the left of x*** points in the same direction and has 1/2 the magnitude of $\vec{B}_{total}$.

Answer: True. $\vec{B}_{tot} = \int d\vec{B} = \frac{\mu_0}{4\pi}\int I\frac{d\vec{l}\times\hat{r}}{r^2}$. The field element $d\vec{B}$ always points in the same direction, so the vectors just add like scalars (numbers). Integrating over the left half of the wire gives half the result.

B2-7.
4 parallel wires each carry a current I. 3 of the wires carry current out the page, 1 carries current into the page, as shown. What is the direction of the B-field at the **center** of the square?

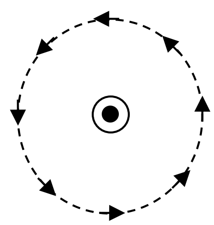




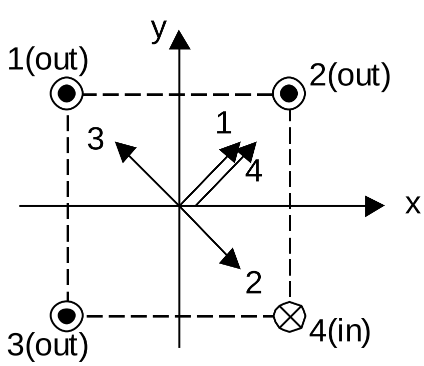


E) None of these

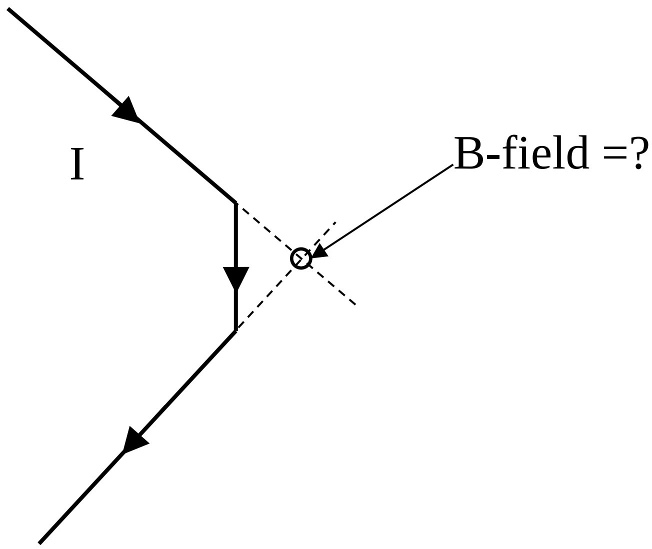
Hint:



Answer: Each of the four currents (labeled 1, 2, 3, 4 below) creates a B-field at the cent of the square. The net B-field is the **vector sum** of these 4 fields and it points to the upper right.

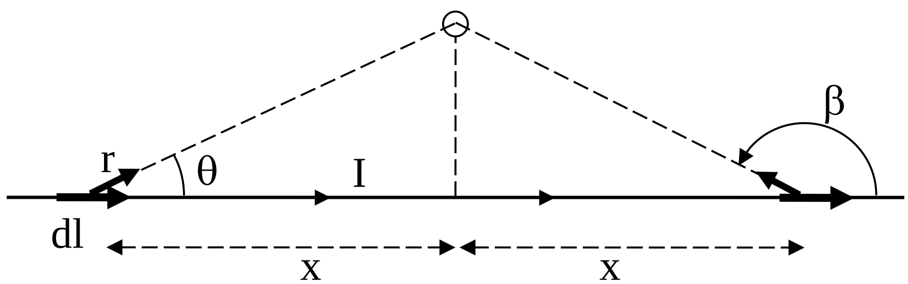


B2-8.
What is the direction of the B-field at the point indicated? The segments of wire and the point are all in the plane of the page. A) in B) out C) up D) down E)NONE



Answer: out of the page

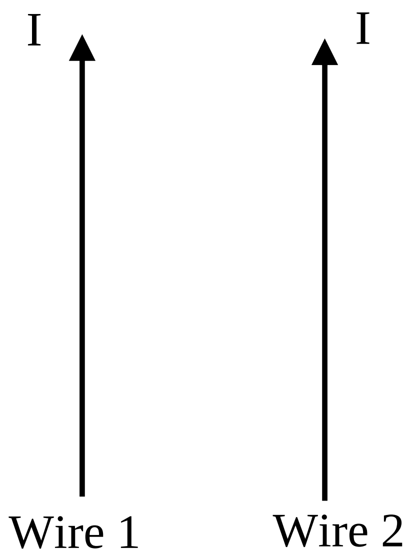
B2-9.
How are the sines and the two angles θ and β in the diagram related?



A) sinθ = sinβ B) sinθ = –sinβ
C) sinθ = sin(–β) D) sin(–θ) = sinβ
E) None of these

Answer: sinθ = sinβ

B2-10. Two parallel wires each carry a current I up. What is the direction of the B-field in the vicinity of the wire 2 on the right, CAUSED BY wire 1 on the left?
A) Up B) Down C) Left
D) into the page E) out of the page

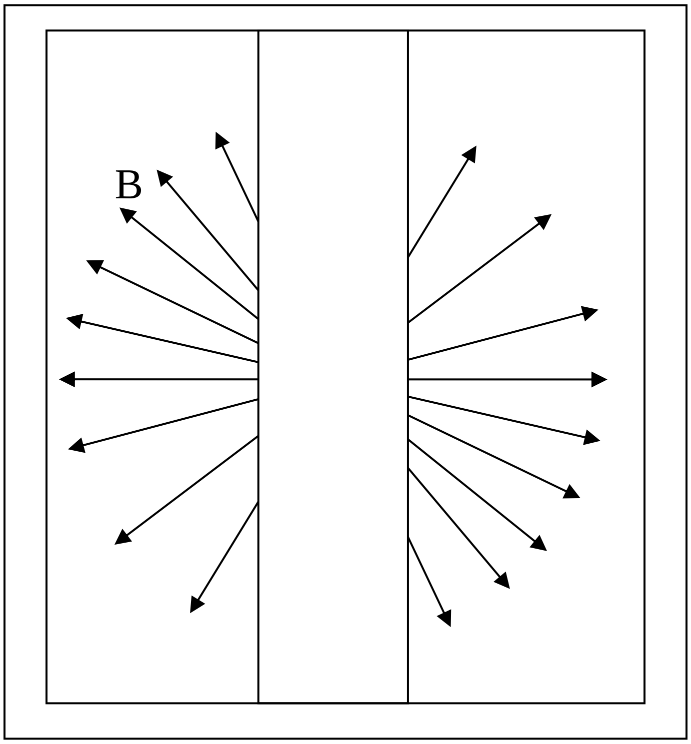


Answer: into the page

B2-11. What is the direction of the force on Wire 2 caused by Wire 1?
A) Left B) Right C) Force is zero
D) into the page E) out of the page

Answer: Left, the wires attract each other

B2-12. The (perhaps incorrect) magnetic field lines around an object are partly obscured by a screen.



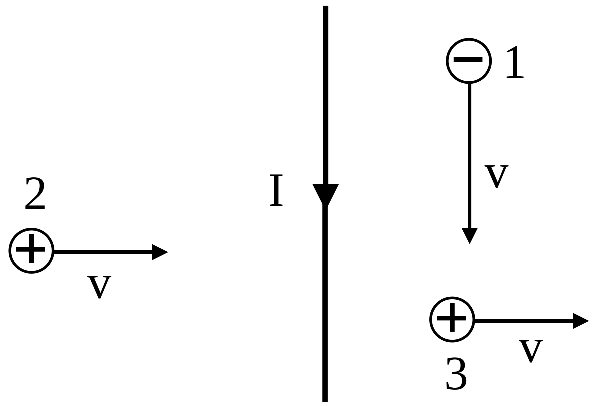
Is this partial field line diagram possible?

A) Yes
B) No

Answer: Yes. The field lines can be coming in toward the center from above and below behind the screen. This would be the case when two bar magnets have their North poles pointing toward each other.

B2-13. A wire carries a current I down as shown. Three charged particles labeled 1, 2 , and 3 are moving as shown. Particle 1 is negative, particles 2 and 3 are positive. All particles and the wire are in the plane of the page.

Part A. What is the direction of the force on particle 1 due to the wire?
A)up B)down C)left D)right E)None of these

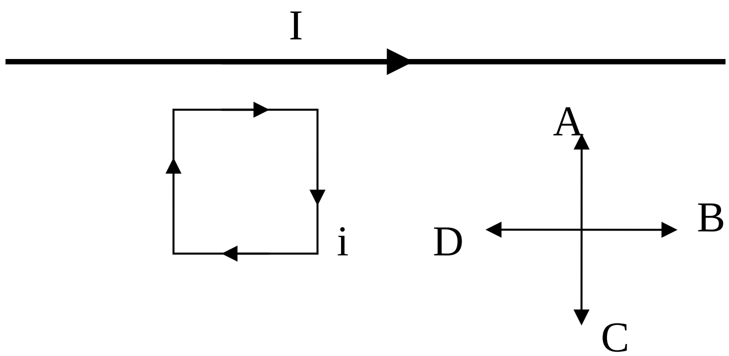


Part B. What is the direction of the force on particle 2 due to the wire?
A)up B)down C)left D)right E)None of these

Part C. What is the direction of the force on particle 3 due to the wire?
A)up B)down C)left D)right E)None of these

Answers: Part A: right Part B: up Part C: down

B2-14. A rectangular loop of wire is carrying a current i in the clockwise direction and is near a long straight wire carrying a current I, as shown. What is the direction of the net force on the rectangular loop, due to the B-field from the long, straight wire.

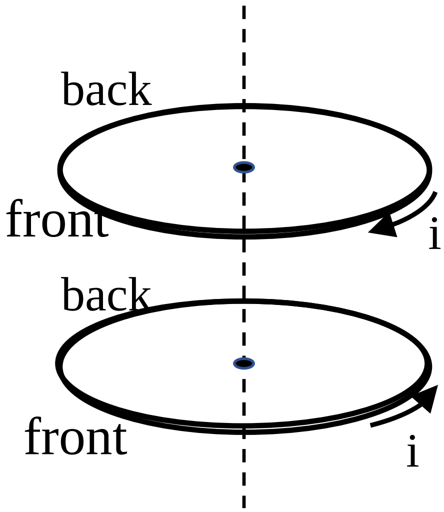


E) Net force is zero.

Answer: The net force is up. The B-field due to the long straight wire decreases in magnitude as you move further from it according to $B = \frac{\mu_o I}{2\pi r}$. So the upward force on the top of the wire loop F = ILB, is greater than the force on the bottom of the loop.

Another way to see the answer: Parallel currents attract and anti-parallel currents repel. So the upper portion of the loop feels an upward force and the bottom portion of the loop feels a downward force. But the upper portion is closer to the straight wire, so there is a bigger field, a bigger force.

B2-15. Two circular wire loops carrying current are near other as shown. The force between the loops is
A) attractive B) repulsive C) zero



Answer: repulsive. Recall that anti-parallel currents repel.
