Test 5.1: Magnetic Force

Which of the following statements is totally correct?

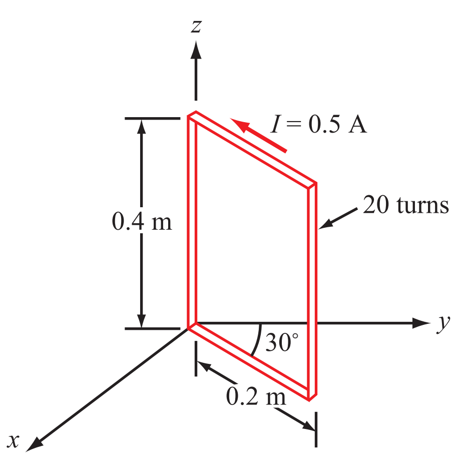
(a) An electric charge in the presence of a non-zero magnetic field $\mathbf{B}$ experiences a magnetic force $\mathbf{F}_\mathrm{m}$ acting on it, whether or not the chare is moving.
(b) An electric charge in the presence of a non-zero magnetic field $\mathbf{B}$ experiences a magnetic force $\mathbf{F}_\mathrm{m}$ acting on it so long as it is moving, regardless of its direction.
(c) An electric charge in the presence of a non-zero magnetic field $\mathbf{B}$ experiences a magnetic force $\mathbf{F}_\mathrm{m}$ acting on it so long as it is moving in a direction other than parallel to the direction of $\mathbf{B}$.
(d) None of the above three statements is correct.

Test 5.2: Magnetic Force

An electron moving in the $+y$ direction in the presence of a magnetic field $\mathbf{B}$ pointing in the $+x$ direction will experience a magnetic force in what direction?

(a) $\mathbf{F}_\mathrm{m}$ points along $-\hat{\mathbf{z}}$
(b) $\mathbf{F}_\mathrm{m}$ points along $+\hat{\mathbf{z}}$
(c) $\mathbf{F}_\mathrm{m} = 0$
(d) $\mathbf{F}_\mathrm{m}$ points along $\hat{\boldsymbol{\theta}}$ direction

Test 5.3: Magnetic Moment

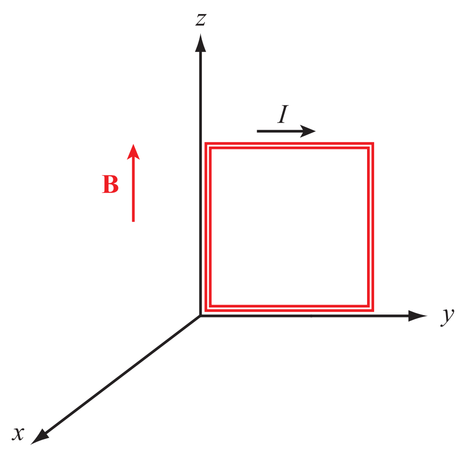


The magnetic moment of the loop shown in the figure is:

(a) $\mathbf{m} = 0$
(b) $\mathbf{m} = -\hat{\mathbf{x}}0.69 + \hat{\mathbf{y}}0.4$ (A·m^2)
(c) $\mathbf{m} = -\hat{\mathbf{x}}0.4 - \hat{\mathbf{y}}0.69$ (A·m^2)
(d) $\mathbf{m} = \hat{\mathbf{x}}0.69 - \hat{\mathbf{y}}0.4$ (A·m^2)

Test 5.4: Magnetic Torque

What is the direction of the torque acting on the current loop?



(a) $\mathbf{T}$ points in $+\hat{\mathbf{y}}$ direction
(b) $\mathbf{T}$ points in $-\hat{\mathbf{y}}$ direction
(c) $\mathbf{T}$ points in $+\hat{\mathbf{x}}$ direction
(d) $\mathbf{T}$ points in $-\hat{\mathbf{x}}$ direction

Test 5.5: Magnetic Force

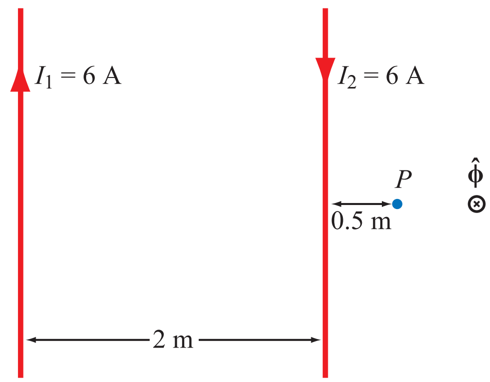
Which statement is totally correct?

Two linear conductors attract each other with maximum magnetic force only if:

(a) their currents point along orthogonal directions
(b) their currents point along parallel directions
(c) their currents point along anti-parallel directions
(d) they carry ac currents.

Test 5.6: Magnetic Force

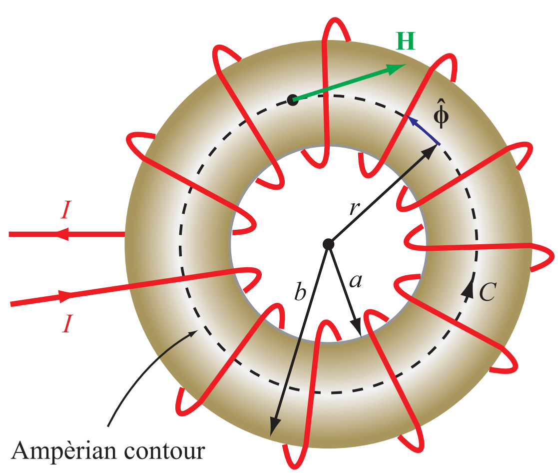
For the two infinitely long, parallel wires carrying currents in opposite directions, what is the magnetic flux density **B** at point P?



(a) $\mathbf{B} = \hat{\boldsymbol{\phi}}\, 8\, \dfrac{\mu_0}{\pi}$
(b) $\mathbf{B} = \hat{\boldsymbol{\phi}}\, 4.8\, \dfrac{\mu_0}{\pi}$
(c) $\mathbf{B} = -\hat{\boldsymbol{\phi}}\, 4.8\, \dfrac{\mu_0}{\pi}$
(d) $\mathbf{B} = -\hat{\boldsymbol{\phi}}\, 9.6\, \dfrac{\mu_0}{\pi}$

Test 5.7: Magnetic Field

For the toroidal coil shown in the figure, which statement is totally true?

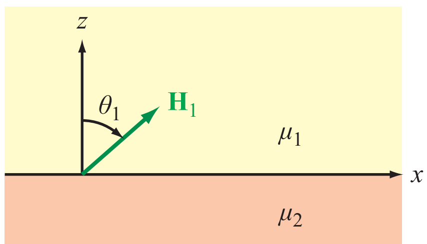


(a) $\mathbf{H} = 0$ only for $r > b$

(b) $\mathbf{H} = 0$ only for $r < a$
(c) $\mathbf{H} = 0$ only for $a < r < b$
(d) $\mathbf{H} = 0$ for $r < a$ and $r > b$

Test 5.8: Boundary Conditions

Given $\mathbf{H}_1 = \hat{\mathbf{x}}4 + \hat{\mathbf{z}}16$ (A/m) in medium 1, $\mu_1 = \mu_0$, and $\mu_2 = 8\mu_0$, determine $\mathbf{H}_2$ in medium 2. Neither medium is a perfect conductor or superconductor.



(a) $\mathbf{H}_2 = (\hat{\mathbf{x}}4 + \hat{\mathbf{z}}2)$ (A/m)
(b) $\mathbf{H}_2 = (\hat{\mathbf{x}}2 + \hat{\mathbf{z}}4)$ (A/m)
(c) $\mathbf{H}_2 = (\hat{\mathbf{x}}4 + \hat{\mathbf{z}}8)$ (A/m)
(d) $\mathbf{H}_2 = (\hat{\mathbf{x}}4 + \hat{\mathbf{z}}16)$ (A/m)

Test 5.9: LVDT

LVDT is an acronym for:

(a) Large vehicle differential torque
(b) Large vehicle differential transformer
(c) Linear variable direct transformer
(d) Linear variable differential transformer

Test 5.10: Solenoid

Consider two air-filled solenoids, both of identical radius a and $a \ll$ than the length of either solenoid. The two solenoids are characterized by:

	Solenoid 1	Solenoid 2
Current	$I_1 = 4$ A	$I_2 = 2$ A
# of turns	$N_1 = 30$	$N_2 = 45$
Length	$\ell_1 = 20$ cm	$\ell_2 = 15$ cm

Which solenoid generates a stronger magnetic field inside the solenoid?

(a) solenoid 1
(b) solenoid 2
(c) Both solenoids generate the same magnetic field.
(d) Cannot compute the magnetic fields without specifying the value of the radius a.

Test 5.11: Coaxial Line

The primary dimensions of a coaxial line are its length l and the radii of its inner and outer conductors, a and b, respectively. If the inductance of a coax with $b/a = 2$ is $L_1 = 500$ nH, what would the new inductance L_2 be if b/a is changed to 4, while keeping all other properties the same?

(a) $L_2 = 250$ nH
(b) $L_2 = 1000$ nH
(c) $L_2 = 366$ nH
(d) $L_2 = 732$ nH

Test 5.12: Boundary Conditions

The plane boundary defined by $z = 0$ separates air from a block of iron. If $\mathbf{B}_1 = \hat{\mathbf{x}}2 - \hat{\mathbf{y}}3 + \hat{\mathbf{z}}8$ in air ($z \geq 0$), find $\mathbf{B}_2$ in iron ($z \leq 0$), given that $\mu = 5000\mu_0$ for iron.

(a) $\mathbf{B}_2 = \hat{\mathbf{x}}10000 - \hat{\mathbf{y}}15000 + \hat{\mathbf{z}}8$ (wb/m^2)
(b) $\mathbf{B}_2 = \hat{\mathbf{x}}2 - \hat{\mathbf{y}}3 + \hat{\mathbf{z}}40000$ (wb/m^2)
(c) $\mathbf{B}_2 = \hat{\mathbf{x}}0.0004 - \hat{\mathbf{y}}0.0006 + \hat{\mathbf{z}}8$ (wb/m^2)
(d) $\mathbf{B}_2 = \hat{\mathbf{x}}2 - \hat{\mathbf{y}}3 + \hat{\mathbf{z}}0.0016$ (wb/m^2)

Test 5.13: Magnetic Hysteresis

Which one of the following statements is correct?

Magnetic hysteresis refers to when certain materials:

(a) become uncontrollable (hysteric) under the influence of a magnetic field.
(b) exhibit a hysteresis curve relating **B** to **H**.
(c) exhibit magnetic breakdown, similar to voltage breakdown.
(d) are permanent magnets.

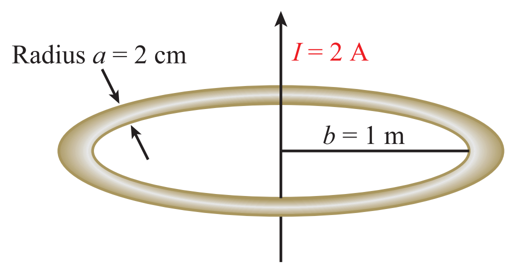
Test 5.14: Proximity Sensor

Select the most correct answer. An eddy-current proximity sensor uses coils to sense:

(a) nearby magnetic fields
(b) nearby current sources
(c) nearby conductors
(d) All of the above.

Test 5.15: Magnetic Energy

An imaginary circular tube is situated in the x–y plane and centered at the origin as shown in the figure. The tube has a circular cross-section of radius $a = 2$ cm and $b = 1$ m. How much magnetic energy is contained within the volume of the tube due to the infinitely long current-carrying conductor?



(a) $W_m = 2\mu_0 \times 10^{-2}$ (J)
(b) $W_m = 16\mu_0 \times 10^{-6}$ (J)
(c) $W_m = 4\mu_0 \times 10^{-4}$ (J)
(d) $W_m = 4\mu_0 \times 10^{-2}$ (J)