

Exercise walk-through

12.3

Magnetism and Current-Carrying Wires

AP Physics 2

You must be able to

- describe the field around a long straight **current-carrying wire** ,
$$B = \frac{\mu_0 I}{2\pi r}$$
- calculate the force on a current-carrying wire in a field, $F = BIl \sin \theta$
- explain the attraction or repulsion between two parallel wires

1

The method

Method — Field around a wire

$B = \frac{\mu_0 I}{2\pi r}$, with $\mu_0 = 4\pi \times 10^{-7} \text{ T m A}^{-1}$; the field circles the wire and weakens with distance.

Exercises 2.1-2.2

2.1 A wire of length 0.20 m carries 3.0 A perpendicular to a 0.50 T field. Find the force. [2]

2.2 State what happens to two parallel wires carrying current in the same direction. [1]

Exercises 2.1·2.2

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2.1

$$F = BI\ell = (0.50 \text{ T})(3.0 \text{ A})(0.20 \text{ m})$$

- $F = \mathbf{0.30 \text{ N}}$

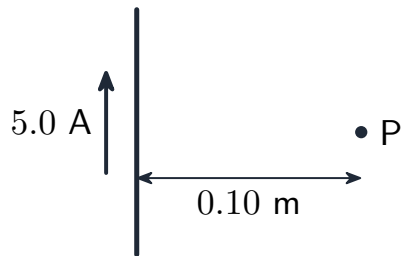
2.2 State what happens to two parallel wires carrying current in the same direction. [1]

2.2

- they attract each other

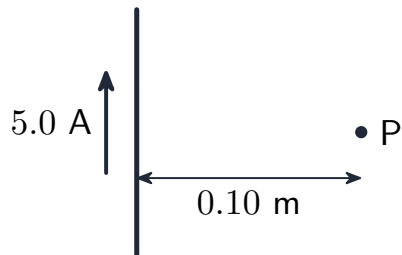
Exercise 2.3

2.3 Find the magnetic field 0.10 m from a long wire carrying 5.0 A ($\mu_0 = 4\pi \times 10^{-7} \text{ T m A}^{-1}$)



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2.3

$$B = \frac{\mu_0 I}{2\pi r} = \frac{(4\pi \times 10^{-7} \text{ T m A}^{-1})(5.0 \text{ A})}{2\pi(0.10 \text{ m})}$$

- $B = 1.0 \times 10^{-5} \text{ T}$

Exercises 3.1-3.2

3.1 The force on a current-carrying wire in a magnetic field is

[1]

☐

A qvB

B $BI\ell$

C $\frac{\mu_0 I}{2\pi r}$

D V/R

3.2 Two parallel wires carrying current in **opposite** directions

[1]

☐

A attract

B repel

C do nothing

D always melt

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3.2 B

- repel.

Exercise 3.3 (a)

3.3 A 0.50 m wire carries 4.0 A at 90° to a 0.25 T field.

(a) Find the force on the wire.

[2]

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(a)

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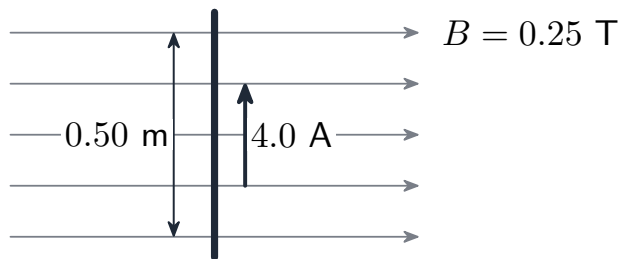
- $F = \mathbf{0.50 \text{ N}}$

Exercise 3.3 (b)

3.3 A 0.50 m wire carries 4.0 A at 90° to a 0.25 T field.

(b) State what happens to the force if the current is doubled.

[1]

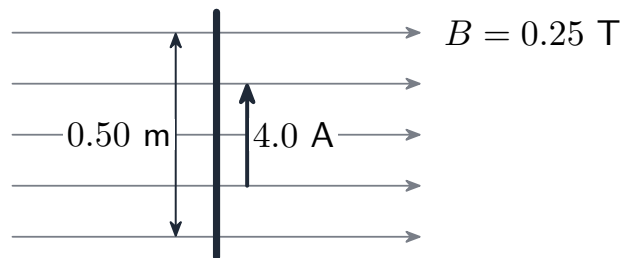


Exercise 3.3 (b)

3.3 A 0.50 m wire carries 4.0 A at 90° to a 0.25 T field.

(b) State what happens to the force if the current is doubled.

[1]



(b)

- it doubles to 1.0 N ($F \propto I$)