

Exercise walk-through

12.2

Magnetism and Moving Charges

AP Physics 2

You must be able to

- calculate the **magnetic force** on a moving charge, $F = qvB \sin \theta$
- use the **right-hand rule** to find the direction of the force
- describe the circular path of a charge moving perpendicular to a uniform field

1

The method

Method — Force on a moving charge

$F = qvB \sin \theta$, where θ is the angle between $\vec{v}$ and $\vec{B}$. The force is **maximum** when $v \perp B$ and **zero** when they are parallel.

Exercises 2.1-2.2

2.1 A charge of 2.0×10^{-6} C moves at 3.0×10^4 m s⁻¹ perpendicular to a 0.20 T field. Find the force. [2]

2.2 State the angle between $\vec{v}$ and $\vec{B}$ that gives the maximum force. [1]

Exercises 2.1·2.2

2.1 A charge of 2.0×10^{-6} C moves at 3.0×10^4 m s⁻¹ perpendicular to a 0.20 T field. Find the force. [2]

2.1

- perpendicular, so $\sin 90^\circ = 1$ and $F = qvB$:

$$F = qvB = (2.0 \times 10^{-6} \text{ C})(3.0 \times 10^4 \text{ m s}^{-1})(0.20 \text{ T})$$

- $F = 1.2 \times 10^{-2}$ N

2.2 State the angle between $\vec{v}$ and $\vec{B}$ that gives the maximum force. [1]

2.2

- 90° (perpendicular)

Exercises 2.3-3.1

2.3 State the shape of the path of a charge moving perpendicular to a uniform magnetic field. [1]

3.1 The magnetic force on a moving charge is [1]

☐

A qE

B $qvB \sin \theta$

C $BI\ell$

D $\frac{1}{2}mv^2$

Exercises 2.3-3.1

2.3 State the shape of the path of a charge moving perpendicular to a uniform magnetic field. [1]

2.3

- a circle

3.1 The magnetic force on a moving charge is [1]

☐

A qE

B $qvB \sin \theta$

C $BI\ell$

D $\frac{1}{2}mv^2$

3.1 B

- $qvB \sin \theta$.

Exercise 3.2

3.2 A charge moving parallel to a magnetic field feels a force of

[1]

☐

A maximum size

B zero

C qvB

D qE

Exercise 3.2

3.2 A charge moving parallel to a magnetic field feels a force of

[1]

☐

A maximum size

B zero

C qvB

D qE

3.2 B

- zero.

Exercise 3.3 (a)

3.3 A proton ($q = 1.6 \times 10^{-19}$ C) moves at 5.0×10^6 m s⁻¹ perpendicular to a 0.30 T field.

(a) Find the magnetic force on it.

[2]

Exercise 3.3 (a)

3.3 A proton ($q = 1.6 \times 10^{-19}$ C) moves at 5.0×10^6 m s⁻¹ perpendicular to a 0.30 T field.

(a) Find the magnetic force on it.

[2]

(a)

$$F = qvB \sin 90^\circ = (1.6 \times 10^{-19} \text{ C})(5.0 \times 10^6 \text{ m s}^{-1})(0.30 \text{ T})$$

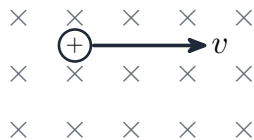
- $F = \mathbf{2.4 \times 10^{-13} \text{ N}}$

Exercise 3.3 (b)

3.3 A proton ($q = 1.6 \times 10^{-19} \text{ C}$) moves at $5.0 \times 10^6 \text{ m s}^{-1}$ perpendicular to a 0.30 T field.

(b) Describe the shape of its path.

[1]



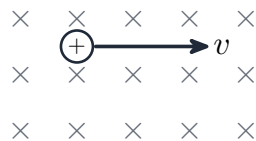
$B = 0.30 \text{ T}$ into page
 $v = 5.0 \times 10^6 \text{ m s}^{-1}$
proton

Exercise 3.3 (b)

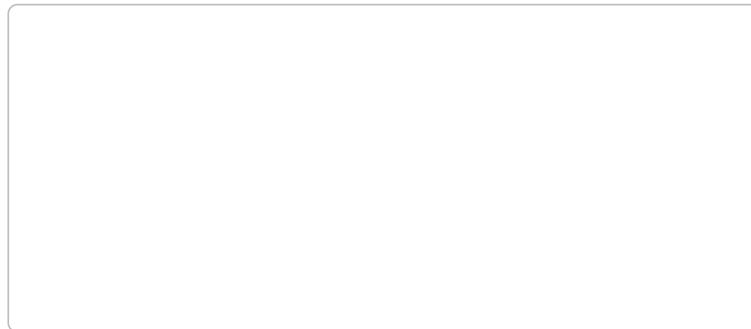
3.3 A proton ($q = 1.6 \times 10^{-19} \text{ C}$) moves at $5.0 \times 10^6 \text{ m s}^{-1}$ perpendicular to a 0.30 T field.

(b) Describe the shape of its path.

[1]



$B = 0.30 \text{ T}$ into page
 $v = 5.0 \times 10^6 \text{ m s}^{-1}$
proton



(b)

- a circle: the force is always perpendicular to the velocity, so it changes the direction but not the speed