Name: Key

Physics 30 – Magnetism/Electromagnetism

Practice Questions

During a magnetism experiment, students tested a copper penny, a nickel wire, an iron nail, and a cobalt cube for attraction to a magnet. Which substances will be attracted to the magnet?

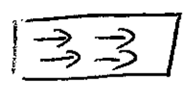
A. Copper penny and iron nail only
B. Nickel wire and cobalt cube only
C. Cobalt cube, iron nail, and nickel wire only
D. Iron nail, cobalt cube, and copper penny only

ferromagnetic

2. Value: 1

In a lodestone, domains may be defined as regions where

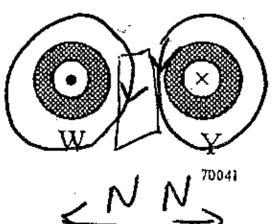
A. electric fields are lined up in the same direction
B. magnetic fields are lined up in the same direction
C. electric fields are lined up in the opposite direction
D. magnetic fields are lined up in the opposite direction



→ domain

3. Value: 1

The diagram shows two long straight and parallel conductors with currents as shown. The current is flowing into the page for Conductor Y [shown with a (×)] and flowing out of the page for Conductor W [shown with a (•)].



1st hand rule

The force that Conductor W experiences because of the presence of Conductor Y is

A. attraction due to the interaction of their electric fields
B. repulsion due to the interaction of their electric fields
C. attraction due to the interaction of their magnetic fields
D. repulsion due to the interaction of their magnetic fields

4. Value: 1

To predict the direction of the magnetic field produced by an electromagnet, one method is to grasp the coil and curl your fingers in the direction of the electron flow. If this is done, the thumb of which hand will point in which direction?

A. The thumb of the left hand will point in the direction of the north pole of the electromagnet.
B. The thumb of the left hand will point in the direction of the south pole of the electromagnet.
C. The thumb of the right hand will point in the direction of the north pole of the electromagnet.
D. The thumb of the right hand will point in the direction of the south pole of the electromagnet.

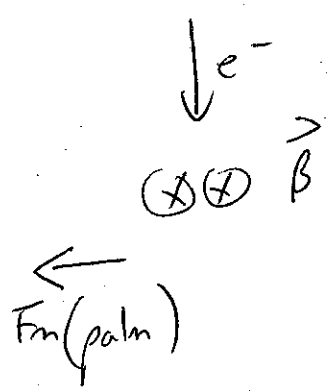
2nd hand rule

5. Value: 1

Electrons flow south through a conductor that is in a magnetic field pointing ~~downward~~ into the page ⊗. What is the direction of the force the field exerts on the conductor?

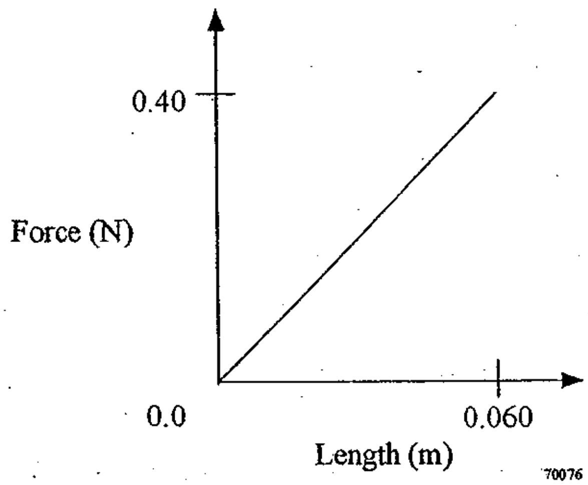
A. Up
B. East
C. West
D. Down

3rd left hand



6. Value: 1

During an experiment, students placed a conductor in a magnetic field and gave the conductor a current of 35 mA. The students recorded the results and drew this graph.



slope $\left(\frac{F_m}{l}\right) = \frac{0.40 - 0}{0.06 - 0} = 6.66 \frac{N}{m}$

What is the magnetic field strength represented by the graph?

A. 4.2×10^{-4} T

B. 1.9×10^{-1} T

C. 4.2×10^{-1} T

D. 1.9×10^{2} T

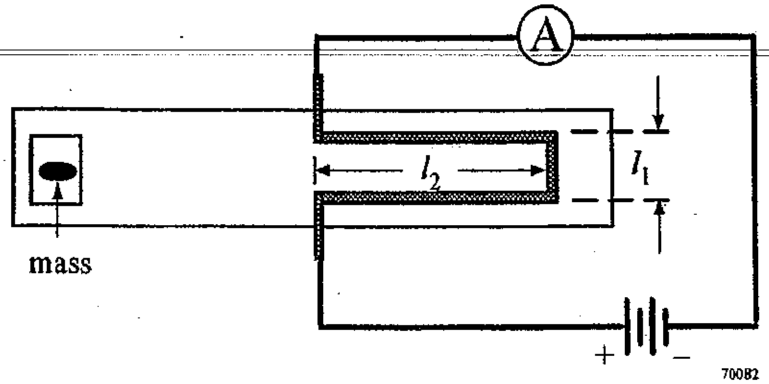
$F_m = B_\perp I l$

slope $\left(\frac{F_m}{l}\right) = B_\perp I$

$\frac{6.66}{35 \times 10^{-3}} = B_\perp$

$190\ T = B_\perp$

Use the diagram to answer the next 1 question(s).



7. Value: 1

The diagram shows a current balance loop that includes the conductor where the length of segment $l_2 = 8.60$ cm. A student places this current balance loop in a solenoid where the magnetic field strength is 3.80×10^{-1} T. He balances the current balance by placing masses totalling 3.30 g on the opposite end of the current loop. After balancing, a current of 2.60 A is read on an ammeter in the current loop circuit. What length (cm) of the conductor, l_1, is in the current loop?

$F_m = F_g$

$B_\perp I l = mg$

$.38 \times 2.60 \times l = 3.3 \times 10^{-3} \cdot 9.81$

$l = 3.3$ cm

A. 0.33 cm
B. 0.47 cm
C. 3.3 cm
D. 22 cm

8. Value: 1

While studying the effects of a magnetic field on charged particles, some students suggested observing these situations.

1. A charged particle at rest in a magnetic field.
2. A charged particle moving parallel to a magnetic field.
3. A charged particle moving perpendicular to a magnetic field.
4. A charged particle moving at an angle of 30° to the magnetic field.

Which observations will show a deflection of the charged particle by the magnetic field?

$F_m = qvB_\perp$ or $qvB\sin\theta$

A. 1 and 2
B. 1 and 3
C. 2 and 4
D. 3 and 4

9. Value: 1

The aurora borealis results from charged particles that become

A. trapped in the Earth's magnetic field and interact with gaseous atoms
B. energized in the Earth's magnetic field and reflect off of the polar caps
C. absorbed in the Earth's electric field and radiate from charged particles
D. discharged in the Earth's electric field and refract in the high atmosphere

10. Value: 1

If both the speed v and charge q of a particle moving perpendicularly to a magnetic field are doubled, then the new deflecting force compared to the original force F will be

A. $\frac{1}{4}F$
B. $\frac{1}{2}F$
C. $2F$
D. $4F$

$F_m = q\vec{v}B$
$F_m \propto q\,\vec{v}$
$4F \propto (2)(2)$

11. Value: 1

An proton is moving at a speed of 6.5×10^6 m/s perpendicularly through a magnetic field of intensity of 1.3×10^{-3} T. What force is exerted on the proton?

A. 3.2×10^{-29} N
B. 1.4×10^{-15} N
C. 2.0×10^{-10} N
D. 8.5×10^3 N

$F_m = qvB$

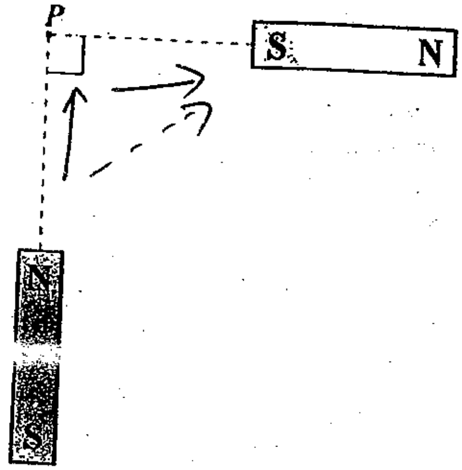
12. Value: 1

A 3.5×10^{-4} kg mass, with a charge of 3.0×10^{-6} C, enters a magnetic field of strength 2.5×10^{-4} T. The speed of the particle is 4.0×10^6 m/s perpendicular to the field. What is the radius of the particle's path?

A. 1.1×10^{-12} m
B. 1.7×10^1 m
C. 9.5×10^{11} m
D. 1.9×10^{12} m

$F_m = F_c$
$qvB_\perp = \frac{mv^2}{R}$
$R = \frac{mv}{qB}$

Two bar magnets of equal magnetic strength are placed as shown below. The point P is the same distance from each of the magnets.



mag fields N away towards S

13. The direction of the magnetic field at P due to the two bar magnets is

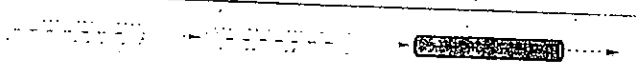
A.

B.

C.

D.

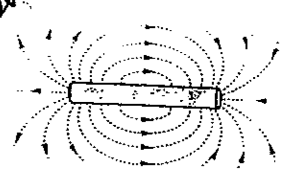
Use the following information to answer the next question.



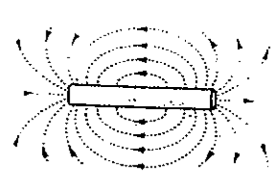
A negatively charged rubber rod is moved from left to right.

14. The magnetic field induced around the rubber rod as it moves is represented by

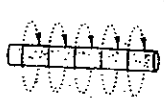
A.



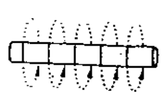
B.



C.



D.



1st left hand rule

Use the following information to answer the next five questions.

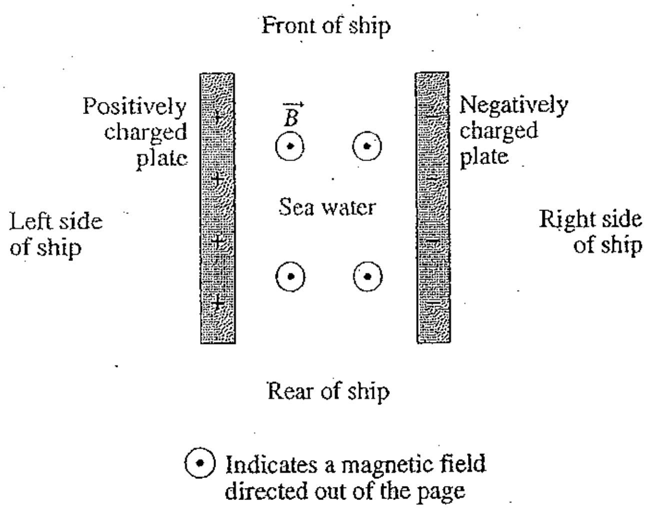
In a type of propulsion called magnetohydrodynamic (MHD) propulsion, the magnetic force on moving charges is used to propel ships and submarines. Because there are no moving parts necessary for this type of propulsion, a vessel using this system could navigate without producing noise and, so, would be very hard to locate.

This propulsion system uses perpendicular magnetic and electric fields and the charges present in seawater. The seawater is expelled out the back of the system, thereby propelling the vessel forward.

When the seawater is at rest between the oppositely charged plates and the MHD propulsion system is turned on, the positively charged ions in the seawater (for example Na^+) and the negatively charged ions in the seawater, (for example Cl^-) accelerate toward the oppositely charged parallel plates. The magnetic field, which is perpendicular to both the ion motion and the electric field direction, deflects the path of the ions. The water is then forced toward the rear of the ship.

The diagram below shows a portion of an MHD thruster from the prototype ship Yamato 1.

Top-Down View of MHD Thruster

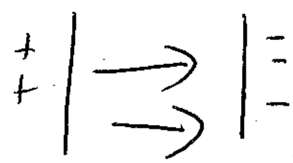


Specifications for a Prototype MHD Thruster

Distance between plates	0.140 m
Electric potential difference between plates	170 V
Magnetic field intensity in region between plates	4.0 T

15. The direction of the uniform electric field created between the charged parallel plates shown in the diagram is toward the

A. left side of the ship
B. right side of the ship
C. front of the ship
D. rear of the ship



Numerical Response

1. The electric field strength between the positively charged and negatively charged parallel plates, expressed in scientific notation, is $a.bc \times 10^d$ N/C. The values of $a, b, c,$ and d are ____, ____, ____, and ____.

(Record all **four digits** of your answer in the numerical-response section on the answer sheet.)

The direction of the electrostatic force on the positively charged ions is toward the __i__ *of the ship. The direction of the electrostatic force on the negatively charged ions is toward the* __ii__ *of the ship. The direction of the magnetic force on the sodium ions is toward the* __iii__ *of the ship. The direction of the magnetic force on the chloride ions is toward the* __iv__ *of the ship.*

16. The row that completes the four statements above is row

Row	*i*	*ii*	*iii*	*iv*
A.	left side	right side	front	front
B.	left side	right side	rear	rear
C.	right side	left side	front	front
D.	right side	left side	rear	rear

Numerical Response

2. ~~At the moment when a sodium ion, Na^+, is moving with a velocity of 3.00 m/s~~ perpendicular to the magnetic field, the magnetic force on the ion, expressed in scientific notation, is $a.b \times 10^{-cd}$ N. The values of $a, b, c,$ and d are __1__, __9__, __1__, and __8__.

$F_m = qvB$

1.92×10^{-18}

(Record all **four digits** of your answer in the numerical-response section on the answer sheet.)

Use the following additional information to answer the next question.

An electrical current in a resistor heats the resistor. In a similar manner, the ion flow between the oppositely charged plates heats the seawater. A ship using an MHD propulsion system can be detected by this electromagnetic signature left in the seawater.

Every minute, 4.61×10^{20} singly charged ions pass through the MHD thruster.

Numerical Response

3. The ion current through the MHD thruster is equivalent to __1.22__ A.

(Record your **three-digit answer** in the numerical-response section on the answer sheet.)

4.61×10^{20} ions $\times \frac{1.6 \times 10^{-19} \text{ C}}{\text{ion}} = 73.76 \frac{\text{C}}{\text{min}} \times \frac{1 \text{ min}}{60 \text{ s}}$

1.22 A $= \frac{C}{s}$