Magnetism at Work

How magnetic fields make devices useful

HS-PSII-6.5 "Describe the practical uses of magnetism in motors, electronic devices, mass spectroscopy, MRIs, and other applications."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline each device or method, circle what its magnetic field acts on, and box the useful result.

Four Ways to Use a Magnetic Field

1. At a concert, a motor spins a cooling fan while speakers turn electrical signals into sound. In the motor, electric current flows through wire coils inside a magnetic field. The field exerts forces on these current-carrying coils, producing a turning effect that rotates a shaft and its attached fan blades. In a speaker, an audio signal sends a changing current through a coil near a permanent magnet. The magnet's field exerts a changing force on that coil, moving a cone back and forth. The moving cone pushes air, creating sound that follows the signal.

2. In a laboratory, mass spectroscopy can help identify substances in a tiny sample. First, an instrument turns some sample particles into charged ions. After the ions are accelerated, a magnetic field exerts a force on each moving ion, bending its path. Ions with different mass-to-charge ratios follow different paths under controlled conditions, so a detector can distinguish them. Scientists use the resulting measurements to determine which kinds of ions are present, for example, when testing an unknown compound. Unlike a fan motor, this device uses magnetic forces to sort moving particles rather than to turn a shaft.

3. At a hospital, magnetic resonance imaging, or MRI, produces detailed images of soft tissues without using X-rays. A strong magnetic field influences the magnetic behavior of hydrogen nuclei, which are abundant in the body's water and fat. Radio waves briefly disturb their alignment. As the nuclei return toward their earlier state, they produce signals detected by the scanner. Additional magnetic fields that vary with position help locate where the signals came from. A computer uses that location information to build images that doctors can examine. Here magnetism helps locate signals inside the body, not move a fan or separate ions.

2 ANSWER WITH EVIDENCE

Use the passage

1. How does a magnetic field help the motor spin the fan?

2. How does a speaker use a magnetic field to produce sound?

3. How does mass spectroscopy use a magnetic field to help identify a substance?

4. How do magnetic fields help an MRI scanner make an image?

3 YOUR TURN

Your own words

A recycling center needs to separate empty steel cans from empty plastic containers on a moving belt. In four sentences, propose a magnet-based method, explain what the field acts on and what happens to each material, then contrast your method with one use of magnetism in the passage.

Magnetism at Work

PART 1 · READ AND MARK

Underline each device or method, circle what its magnetic field acts on, and box the useful result. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	How does a magnetic field help the motor spin the fan?	**The field exerts forces on the motor's current-carrying coils. This produces a turning effect that rotates the shaft and fan blades.**
2	How does a speaker use a magnetic field to produce sound?	**The field exerts a changing force on the coil, moving the cone back and forth. The cone pushes air to create sound.**
3	How does mass spectroscopy use a magnetic field to help identify a substance?	**The field bends the paths of moving ions. Differences in their mass-to-charge ratios allow a detector to distinguish them.**
4	How do magnetic fields help an MRI scanner make an image?	**A strong field influences hydrogen nuclei, and fields that vary with position help locate the signals they produce. A computer uses the signals and their locations to build an image.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

Place an electromagnet beside the belt near a collection chute. Its magnetic field pulls the steel cans toward the chute, while the plastic containers continue along the belt. The cans fall into the chute for collection. Unlike the motor, this magnet separates steel from plastic rather than exerting forces on current-carrying coils to turn a shaft.

Accept methods that use magnetic attraction to separate steel from plastic and accurately contrast that action with a passage application. A response may use a permanent magnet or an electromagnet.