

Section 8.5: Applications of Electric and Magnetic Fields

Research This: Privacy Concerns Associated with RFID Technology, page 406

A. Student answers may vary depending on the application they choose, but should reflect careful consideration of the issues. For example, some people are concerned that buying items with RFID tags will allow the government or corporations to track their movements, which is considered an invasion of privacy. In the future, issues regarding privacy will arise because each RFID is associated with an object and collecting data about the object can mean collecting data about the person purchasing the object. If a person makes a purchase using a credit or debit card, your personal information is now associated with the object. Purchasing habits can be registered with companies who are interested in your business and therefore, you could then receive targeted and unwanted advertisements.

B. Student answers may vary, but should show evidence of research and thoughtful consideration. For example, if there were a way to destroy the RFID tags when an item is purchased, that would assuage those people who are concerned about being tracked.

C. RFID tags are currently being used for automated vehicle identification and registration, product tracking and theft control, public transit payments, toll roads, and electronic payment through cell phones.

D. Some privacy issues associated with RFID tags include the release of personal information such as phone numbers, addresses, and medical information. Insurance companies, employers, government institutions, and others could make decisions based on the personal information they obtain, and these decisions could impact individuals.

E. To ensure the privacy of personal information, businesses should establish privacy policies and procedures related to the use of RFID tags, conduct audits on the security of RFID technology, enforce compliance with policies and procedures, and explore technology alternatives that do not require collecting personal information.

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1. Answers may vary. Sample answer: RFID tags act as transponders to communicate data through the use of electromagnetic waves. The tag detects a specific radio signal sent by an RFID reader. When the transponder receives the radio signal, it transmits a unique numerical identification code back to the transceiver.

2. (a) (i) Fewer cashiers will be needed, since computers can read the signals all at once.

(ii) There will be less shoplifting, since detectors can read the RFID chips leaving the store.

(iii) RFID technology will improve convenience for shoppers, since check-out time will decrease.

(iv) RFID technology will improve the efficiency of inventory tracking, because grocery store staff will not need to count stock items manually.

(b) Answers may vary. Sample answer: Some negative side effects of RFID tags in stores are customers feeling their privacy is being invaded (since they are going home with radio transmitters) and an increase in theft—customers could switch RFID tags on products before checking out. Retail businesses may view the RFID tags as security against theft. Job losses could result due to a reduced need for cashiers and security personnel in the store.

3. Answers may vary. Sample answer: Some of the challenges are standardization, cost factor, and defects in manufacture and detection of tags. Stores will have to analyze the benefits of buying, programming, and installing thousands of RFID tags, especially when they will still need employees to make sure RFID tags are on the correct product and all tags are being read.

- 4.** Answers may vary. Sample answer: Under normal conditions, a magnetorheological (MR) fluid is solid, but it changes to a liquid in response to a magnetic field.
- 5. (a)** Sample answers: Magnetorheological fluid is used as a fluid damper in buildings, in car shock absorbers, in washing machines, in prosthetics, and in exercise equipment.
- (b)** Student answers will vary based upon their selection, but should reflect an understanding of the application. Sample answer: Magnetic dampers can be used in shock absorbers and appliances like washing machines to decrease noise and vibration, which, in turn, saves energy.
- 6.** A smart structure is a building constructed with MR fluids.
- 7.** Sample answer: In the 1980s, some studies showed a link between magnetic field strength and an increased risk of cancer. Since that time, however, scientists have reviewed over two decades of research involving people exposed to electric and magnetic fields. To date, they have found no clear evidence linking high exposures with cancers and only a weak association between exposure to electric and magnetic fields and childhood leukemia.
- 8.** Magnetic resonance imaging (MRI) devices use a superconducting magnet to create a large, stable magnetic field that interacts with hydrogen atoms in the human body to produce precise three-dimensional images of internal body systems.
- 9. (a)** There are two types of magnets in a magnetic resonance imaging (MRI) device. The superconducting electromagnet generates the primary magnetic field, which interacts with all the hydrogen atoms in the body. Then, three gradient magnets are activated, which are smaller and but also more precise. By altering these magnets, the magnetic field can be specifically focused on a selected area. The MRI can then gather information about the particular location.
- (b)** The hydrogen atoms will align with the magnetic field, either in the same direction or the opposite direction. The difference in the number of hydrogen atoms pointing one way or the other depends on the type of material (such as skin, bone, or organs) and whether it is healthy or abnormal and diseased. To obtain observable data, the hydrogen atoms in a specific area are given potential energy by a radio frequency pulse. After the pulse, those atoms aligned against the magnetic field release the energy, and the MRI device detects the energy release. The amount of energy tells the MRI device what type of tissue is at the location, so the MRI can create a three-dimensional map of the person in the machine.
- 10. (a)** Sample answer: Magnetophoretic technology can be used to detect and isolate cancer cells in bone marrow transplants.
- (b)** Sample answer: Magnetophoretic technology can be used to separate cells for study or stem cell research.
- 11.** Answer may vary. Students should explain that superconduction refers to conduction with almost no loss of energy. Superconduction traditionally requires very cold conditions, but some research is being conducted into exploring moderate temperatures so superconductors can be just as effective at room temperature. Students should list applications or benefits of superconductivity, including environmental impacts due to reduced waste of energy, which also saves money.
- 12.** Answer may vary. Students should report that many migratory animals, such as birds and loggerhead turtles, use geomagnetism to navigate. Scientists have exposed these animals to magnetic fields that simulate various locations on Earth and noted that the animals travel in the direction they would at the simulated location.