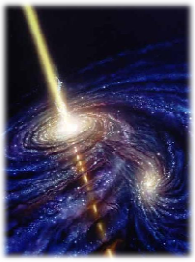
SPH4U UNIVERSITY PHYSICS

ELECTRIC, GRAVITATIONAL, & ... FIELDS

- Introduction (P.282-285)

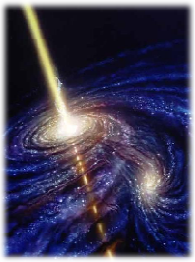
Electric, Gravitational, & Magnetic Fields

What is it about "black holes" that stretches the imagination to the limit? Is it that black holes, such as the artist's conception here, defy reason because both matter and energy seemingly disappear into nothingness?



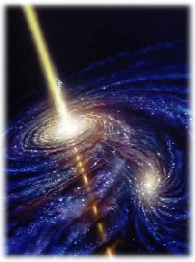
Electric, Gravitational, & Magnetic Fields

A major part of understanding the black hole phenomenon lies in the characteristics of fields, regions of space over which a force seemingly acts at a distance. You are already familiar with everyday forces that act in this manner – gravity, magnetism, and electricity. Based on straightforward laboratory studies, you can begin to answer such questions as: "How are these fields formed? How are they related to each other?"



Electric, Gravitational, & Magnetic Fields

Recent research indicates, for example, that black holes are points with almost infinite density. The gravitational field generated by this concentration of mass is so strong that not only objects but even light passing within range can never escape (i.e. the event horizon).

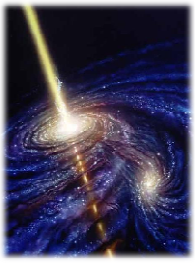


NOTE!

As our understanding of gravitational, electric, and magnetic fields increases, so too do the technological applications that use fields, from pharmaceuticals to space exploration.

Electric, Gravitational, & Magnetic Fields

For example, scientists aboard the International Space Station (ISS) have conducted studies in biotechnology. Identifying how salmonella bacteria function in space and studying proteins that regulate the genes involved in their reproduction have helped researchers develop a vaccine to curb this sometimes deadly source of food poisoning. Scientists are also developing groups of microsatellites the size of volleyballs that fly in formation and are much easier and cheaper to launch.



Overall Expectations

By the end of this unit, students will:

1. analyse the operation of technologies that use gravitational, electric, or magnetic fields, and assess the technologies' social and environmental impact;
2. investigate, in qualitative and quantitative terms, gravitational, electric, and magnetic fields, and solve related problems;
3. demonstrate an understanding of the concepts, properties, principles, and laws related to gravitational, electric, and magnetic fields and their interactions with matter.

Big Ideas

Concepts that students should retain long after this course are:

- Gravitational, electric, and magnetic forces act on matter from a distance.
- Gravitational, electric, and magnetic fields share many similar properties.
- The behaviour of matter in gravitational, electric, and magnetic fields can be described mathematically.
- Technological systems that involve gravitational, electric, and magnetic fields can have an effect on society and the environment.

Getting Started: Useful Concepts & Skills

CONCEPTS REVIEW

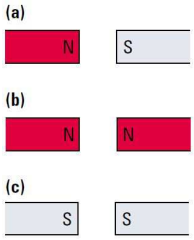
1. There are several principal methods for placing a charge on a neutral object. Describe these methods, and draw diagrams for each.

   charging by friction, contact, and induction

Getting Started: Useful Concepts & Skills

CONCEPTS REVIEW

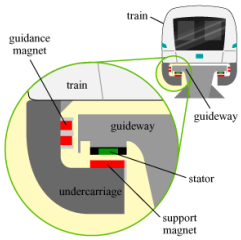
2. Each diagram shows two bar magnets with poles close to each other.
   (a) State the law of magnetic poles.
   (b) Will the magnets be attracted or repelled?
   (c) What are some substances that are attracted to magnets? Why?



Getting Started: Useful Concepts & Skills

CONCEPTS REVIEW

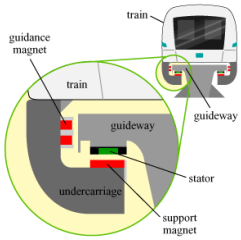
3. (a) Use what you know about magnetic fields to explain how magnetic levitation trains can hover above the tracks.



Getting Started: Useful Concepts & Skills

CONCEPTS REVIEW

3. (b) Coils along the sides of the tracks for magnetic levitation trains constantly alternate polarity. Use what you know about magnets to explain how this can cause the train to move.



Getting Started: Useful Concepts & Skills

CONCEPTS REVIEW

4. Explain how to increase the magnitude of the magnetic field in each of the following:
   (a) a bar magnet
   (b) a straight conductor with an electric current
   (c) an electromagnet

   (a) remagnetize
   (b) increase current/size of conductor
   (c) increase current/number of loops/core material

Getting Started: Useful Concepts & Skills

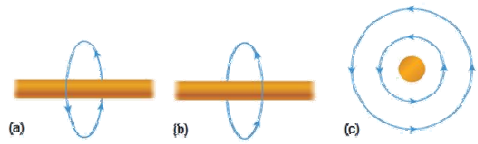
SKILLS REVIEW

5. Copy each diagram into your notebook and draw the magnetic field.

Getting Started: Useful Concepts & Skills

SKILLS REVIEW

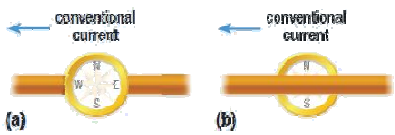
6. Copy each diagram into your notebook and label the direction of the conventional current.



Getting Started: Useful Concepts & Skills

SKILLS REVIEW

7. Which way will the compass point in the diagrams below.



Getting Started: Useful Concepts & Skills

SKILLS REVIEW

8. When a conductor with a current in it is placed in a magnetic field, it can experience a force. Under what conditions will the conductor experience a force?