

JRoo (sercle)'s Epic Test Regarding the Field of Magnetism

pin intended

The test is composed of two parts:

Multiple Choice/ Matching (20 Questions)

Free Response (3 Questions)

Multiple Choice Points (/20): _____

Free Response Points (/15): _____

Total Score (/35) _____

Each question in the multiple choice section is linked to one topic specifically stated in Part 5.b.iii. of the Maglev rules in the 2012-2013 rules manual. The parentheses next to the question numbers indicate what topic the question covers.

(Superconductors) 1. The magnetic levitation displayed by a superconductor is a direct occurrence of the:

- a. Faraday Effect
- b. Meissner Effect
- c. Barkhausen Effect
- d. Garshelis Effect

(Earth's Magnetic Field) 2. Which of the following parts of the Earth most helps to generate its natural magnetic field?

- a. Crust
- b. Mantle
- c. Outer Core
- d. Inner Core

(Polarity) 3. Consider a horizontal bar magnet with its south pole on the left and its north pole on the right. Suppose that the bar magnet is cut in the middle. Which of the following gives the four polarities (from left to right) of the ends of the magnets?

- a. South North North South
- b. North South South North
- c. South North South North
- d. 2 magnetic monopoles would form

(Electromagnetic Principles) 4. Faraday's Law states that a(n) _____ field can induce a(n) _____ field.

- a. magnetic, magnetic
- b. electric, electric
- c. magnetic, electric
- d. electric, magnetic

(Permanent magnets) 5. Which of the following is **not** a permanent magnet:

- a. Magnesium
- b. Iron
- c. Cobalt
- d. Nickel

(The history of the theories of magnetism) 6. Much like Calculus, electromagnetic induction was discovered independently by two people at around the same time. Those discoverers were:

- a. James Clerk Maxwell and Nikola Tesla
- b. Michael Faraday and John Henry
- c. Hans Christian Ørsted and André-Marie Ampère
- d. Georg Ohm and Johann Schweigger

(Magnetic Domains) Match the following types of magnetism to their description. Items listed in parentheses are examples.

7. Paramagnetic __

a. The magnetic moments of the material align in a regular pattern but with neighboring spins pointing in opposite directions (Hematite)

8. Diamagnetic __

b. The magnetic moments of the material align in a regular pattern but with neighboring spins pointing in opposite directions and having different magnitudes (Magnetite)

9. Ferromagnetic __

c. Having an attraction to an externally applied magnetic field (liquid Oxygen)

10. Antiferromagnetic __

d. Displaying an opposition to an externally applied magnetic field (Bismuth)

11. Ferrimagnetism __

e. The magnetic moments of the material align in a regular pattern with neighboring spins pointing in the same direction, i.e. permanent magnetism (Cobalt)

(Superconducting Maglev Transportation Technology) 12. A maglev train uses which of the following mechanical force(s) to move itself forward:

- a. Thrust
- b. Lift and Drag
- c. Thrust and Drag
- d. Lift and Thrust

(Magnetic force) 13. A group of positively charged particles is heading towards you. On the way, they pass through a magnetic field directed upward. From your perspective, the particles are deflected:

- a. Left
- b. Right
- c. Up
- d. Down

(Solenoids) 14. A solenoid can also be referred to as a(n):

- a. current-carrying wire
- b. non-solid magnet
- c. horseshoe-shaped magnet
- d. electromagnet

(Magnetic vs. non-magnetic materials) 15. The rules specifically restrict the use of rare-earth magnets on the car. Which of the following is an example of one?

- a. Ferrite
- b. Aluminum Foil
- c. Lead Plate
- d. Neodymium Magnet

(Ferromagnetic materials) 16. Which of the following is an everyday event that is an occurrence of ferromagnetism in action?

- a. Paper clips briefly attracted to each other
- b. A dense object resting on water
- c. Hanging a magnet on a refrigerator
- d. Turning on an electromagnet

(Common uses of magnets) 17. Which is not a common or feasible use of a magnet:

- a. Hanging a very heavy object on a refrigerator or metal wall
- b. Dispelling lightning from an area
- c. Picking up iron nails off the ground
- d. As indicators within machines

(Medical uses of magnets) 18. What is the abbreviation for the medical technique that uses very powerful magnets to align the magnetic moments of particles within the body to develop an image?

- a. X-Ray
- b. CAT
- c. MRI
- d. PET

(History of magnetic technology) 19. In 1820, Hans Christian Ørsted made history by linking the sciences of magnetism and:

- a. Electricity
- b. Biology
- c. Chemistry
- d. Geology

(Electric motors/generators) 20. An Electric motor works by converting _____ energy into _____ energy.

- a. magnetic, electric
- b. electric, magnetic
- c. mechanical, magnetic
- d. electric, mechanical

Free Response:

1. An electron travels at a velocity 4.0×10^7 m/s away from you through a uniform magnetic field directed upward with strength 1.4 Teslas. Find (a) magnitude of the force, in Newtons, exerted on the electron and (b) the direction of the force. [5 points]

(a) [4 points]

(b)[1 point]

2. Suppose a force of 12N is exerted on a 5.3 A current-carrying wire that lies perpendicular to the direction of a magnetic field with strength 1.1 Teslas. What is the length of wire that is affected? [5 points]

3. Consider a 0.17 m long solenoid that has 300 loops and carries a current of 2.7 A. A particle with charge 12×10^{-6} C moves at 950 m/s through the solenoid at an angle of 13.5° relative to the axis of the solenoid. Calculate the magnitude of the force exerted on this particle. [5 points]