Unit Review: Fields

Gravitational Fields

1. Draw a sketch of Earth's gravitational field.

2. Explain how the value of Earth's gravitational field strength (g) varies with your location on the Earth.

3. When you're standing on a bathroom scale and it reads 135 lbs, is this a reading of weight or mass? What would your bathroom scale read in outer space?

4. Cartoon characters standing in elevators find themselves pasted to the ceiling after the cables are cut. Is this good humor or good physics? Explain.

5. In free fall, why are you apparently weightless?

6. What is the weight of

   a) A $75\ kg$ man? ($735\ N$)

   b) A $50\ g$ bullet? ($0.49\ N$)

7. What would be the weight of a $60\ kg$ woman on the moon ($g = 1.6\ N/kg$)? ($96\ N$)

8. A passenger in an elevator has a mass of 100 kg. Calculate the passenger's apparent weight when the elevator is

   a) at rest. ($980\ N$)

   b) moving upward with an acceleration of $0.75\ m/s^2$. ($1055\ N$)

   c) moving downward with an acceleration of $0.5\ m/s^2$. ($930\ N$)

9. A camera is accidentally dropped from the edge of a cliff and $6.0\ s$ later hits the bottom.

   a) How fast was it going just before it hit? $(59\ m/s)$

   b) How high is the cliff? $(180\ m)$

10. A rock is thrown vertically upward with a velocity of $21\ m/s$ from the edge of a bridge $42\ m$ above a river. How long does the rock stay in the air? $(5.8\ s)$

11. A platform diver jumps vertically with a velocity of $4.2\ m/s$. The diver enters the water $2.5\ s$ later. How high is the platform above the water? $(20\ m)$

12. The total distance a ball is off the ground when thrown vertically is given for each second of flight in the following table.

Time (s)	Distance (m)
0.0	0.0
1.0	24.5
2.0	39.2
3.0	44.1
4.0	39.2
5.0	24.5
6.0	0.0

a) Draw a position-time graph of the motion of the ball.

b) How far off the ground is the ball at the end of $0.5\ s$? $(13.5\ m)$

c) When would the ball again be this distance from the ground? $(5.5\ s)$

13. Define terminal velocity and explain what conditions are necessary for it to occur.

Electric Fields

14. A charge is placed in an electric field and experiences an electrostatic force. How are the direction of the field and the force related if

a) the charge is positive?

b) the charge is negative?

15. Draw each of the following electric fields.

a) Around a positive point charge.

b) Around a negative point charge.

c) Between two positive charges.

d) Between two negative charges.

e) Between two opposite charges (one positive, one negative).

f) Between parallel plates.

16. An object carries a charge of $-2.4\times10^{-17}\ C$. How many excess electrons does it carry? (150)

17. How many electrons would be required to have a total charge of 1.00 C on a sphere? $\left(6.25\times10^{18}\right)$

18. How strong would an electric field have to be to produce a force of 1.00 N on a 1000 μC test charge? $\left(1000\ N/C\right)$

19. A positive test charge of 7.0 mC experiences a $5.6\times10^{-2}\ N$ force when placed in an electric field. What is the electric field intensity? $\left(8.0\ N/C\right)$

20. A positive test charge of $6.5\times10^{-6}\ C$ experiences a force of $4.5\times10^{-5}\ N$ to the right. What are the magnitude and direction of the electric field intensity? (6.9 N/C $[Right]$)

21. A charge experiences a force of $3.0\times10^{-3}\ N$ to the left in an electric field of intensity 2.0 N/C to the left. What are the magnitude and sign of the charge? ($+1.5\ mC$)

22. An electron, moving through an electric field, experiences an acceleration of $6.3\times10^{3}\ m/s^2$.

    a) What is the magnitude of the electrostatic force acting on the electron? $\left(5.73\times10^{-27}\ N\right)$

    b) What is the magnitude of the electric field? $\left(3.58\times10^{-8}\ N/C\right)$

23. A tiny ball $\left(\text{mass} = 0.012\ kg\right)$ carries a charge of $-18\ \mu C$. What electric field (magnitude and direction) is needed to cause the ball to float above the ground? ($6.53\times10^{3}\ N/C$ $[down]$)

24. What electric field (magnitude and direction) would give the ball in Question 11 an acceleration of 1.0 m/s^2 $[up]$? $\left(7.2\times10^{3}\ N/C\ [down]\right)$

Magnetic Fields

25. Draw each of the following magnetic fields.

    a) Around a bar magnet.

    b) Between two north poles.

    c) Between two south poles.

    d) Between two opposite poles (one north, one south).

    e) Around a horseshoe magnet.

    f) Around the Earth.

26. Briefly explain the concept of a magnetic domain.

27. Explain the difference between a magnetic material and a non-magnetic material (using domain theory).

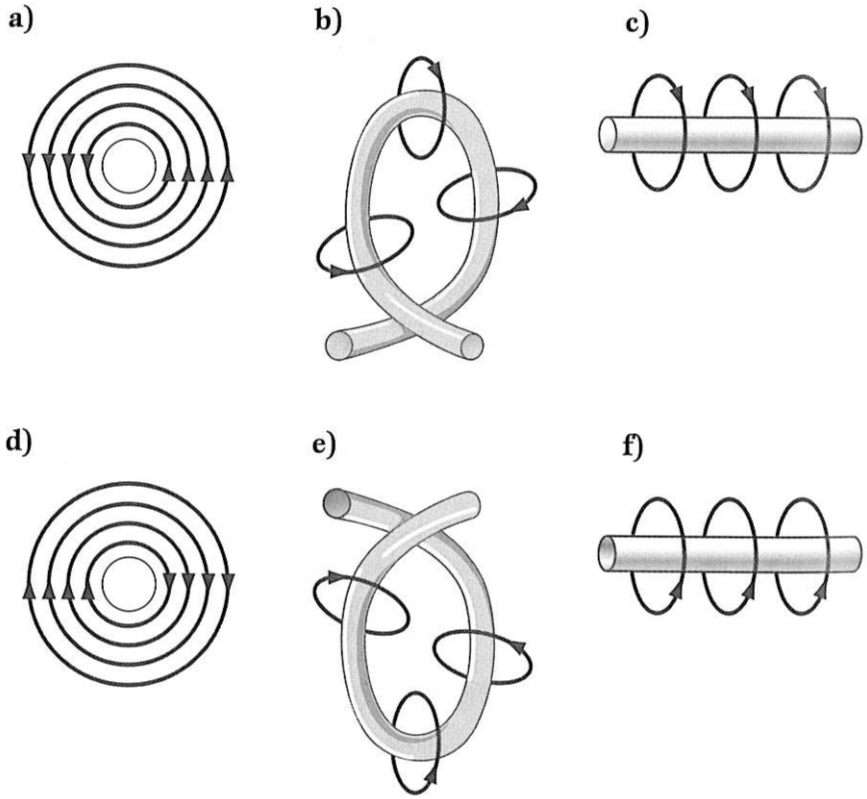
Electromagnetism

28. The current in a vertical wire is flowing upward. If you were looking down on the wire from above, would the magnetic field lines be directed clockwise or counterclockwise?

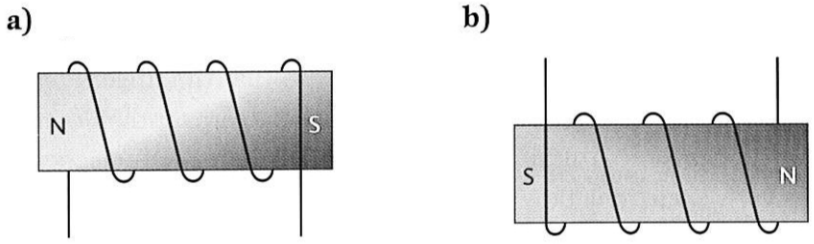
29. A horizontal wire is aligned along an east-west axis. The current in the wire is flowing east. In what direction would the magnetic field lines be pointing directly above the wire?

30. The current in a horizontal loop of wire is flowing clockwise. What is the direction of the magnetic field in the center of the loop?

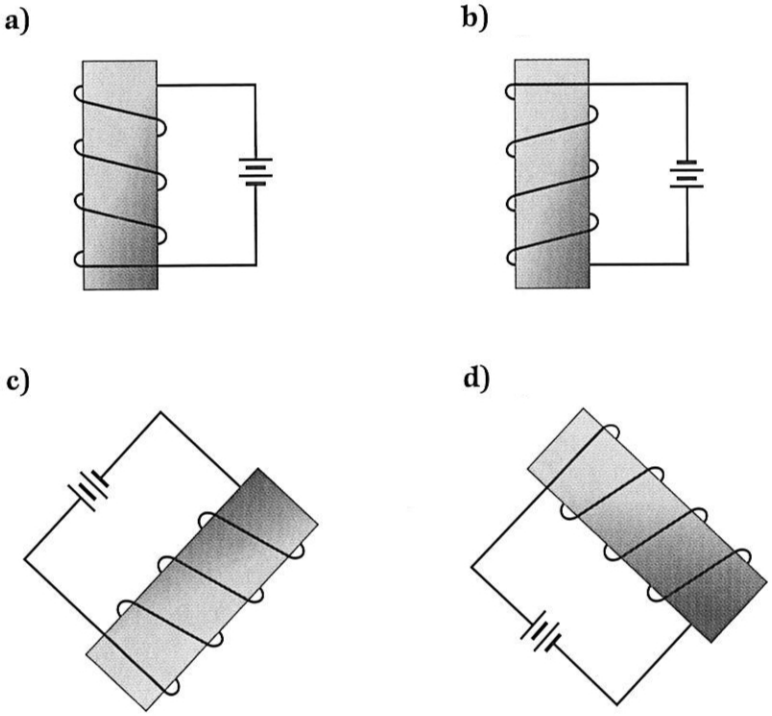
31. The following diagrams show the magnetic fields surrounding various current-carrying wires. Use the right-hand rules to label the direction that the current is flowing in each wire.



32. For each of the current-carrying solenoids shown below, label the direction that the current is flowing through the solenoid.



33. For each of the current carrying solenoids shown below, sketch the magnetic field lines around the solenoid. Label which end of the solenoid acts like a north magnetic pole and which end acts like a south magnetic pole.



34. A $5.0\ m$ long wire is aligned east-west. A current of $10\ A$ is flowing west through the wire, and a magnetic field of $5.0\times10^{-5}\ T\ [down]$ exists around the wire. Determine the magnitude and direction of the magnetic force acting on the wire.