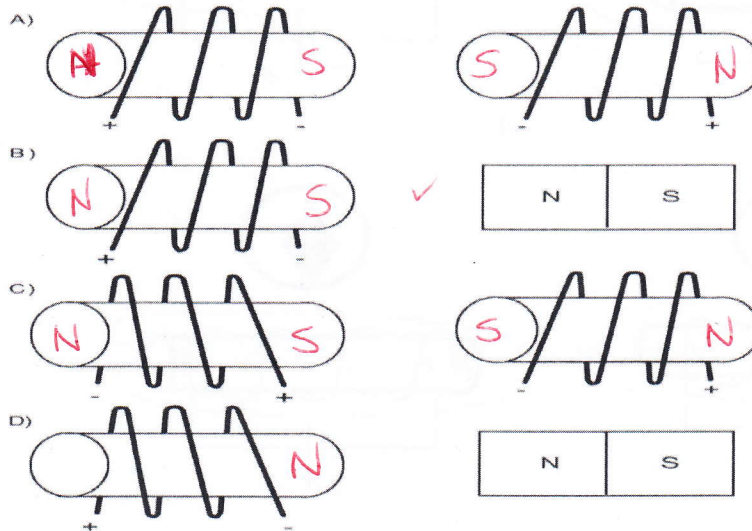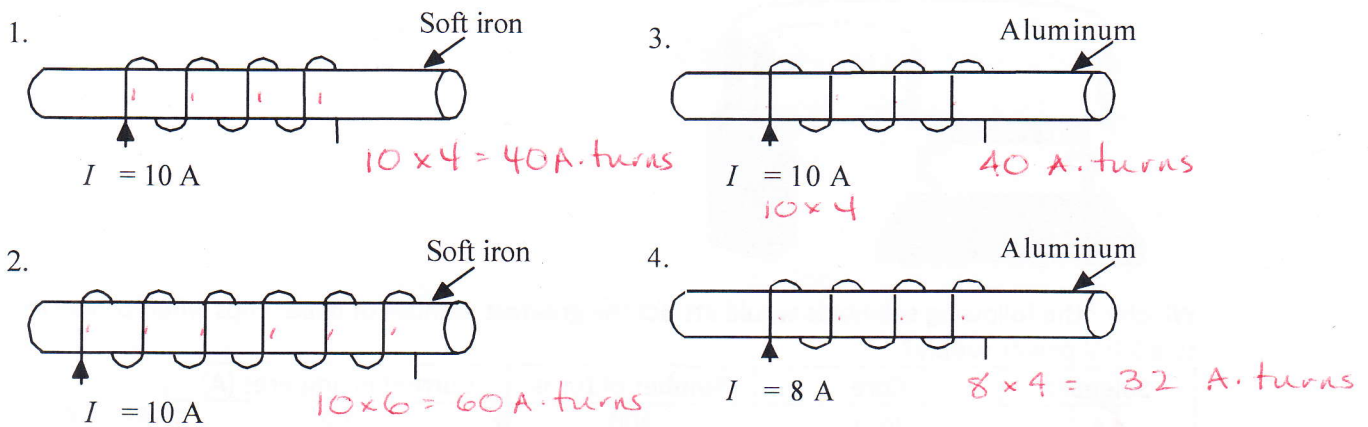# Enriched Statics and Magnetism Quest Review

1. Which of the situations illustrated below would represent a force of attraction between the two objects?

A) N S   S N

B) N S   [N | S] ✓

C) N S   S N

D)   N   [N | S]

2. The electromagnets illustrated below produce magnetic fields of different intensities. The electromagnets are to be arranged in <u>increasing order</u> of their magnetic field.

1.   Soft iron

$I = 10$ A $10 \times 4 = 40$ A. turns

3.   Aluminum

$I = 10$ A 40 A. turns
10×4

2.   Soft iron

$I = 10$ A $10 \times 6 = 60$ A. turns

4.   Aluminum

$I = 8$ A $8 \times 4 = 32$ A. turns

$4 - 3 - 1 - 2$

In what order should the electromagnets be arranged?
A) 1, 2, 4 and 3
B) 4, 3, 2 and 1
C) 4, 3, 1 and 2
D) 3, 4, 2 and 1

3. Consider the electric force between a pair of charged particles a certain distance apart. According to Coulomb's law if the charge of one of the particles is doubled, the force will be
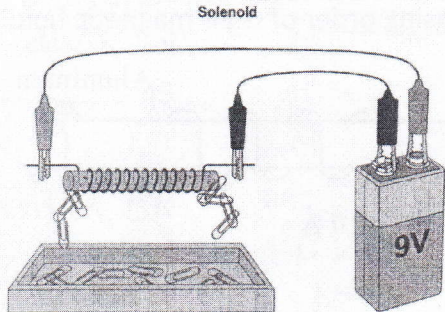A) Unchanged   B) Halved   C) Doubled   D) Quadrupled

$$F_e = \frac{k \cdot q_1 \cdot q_2 \; (\times 2)}{r^2}$$

4. Which of the following diagrams show the correct placement of the compass needle when placed within the magnetic field of a solenoid?

A)

C)

B)

D)
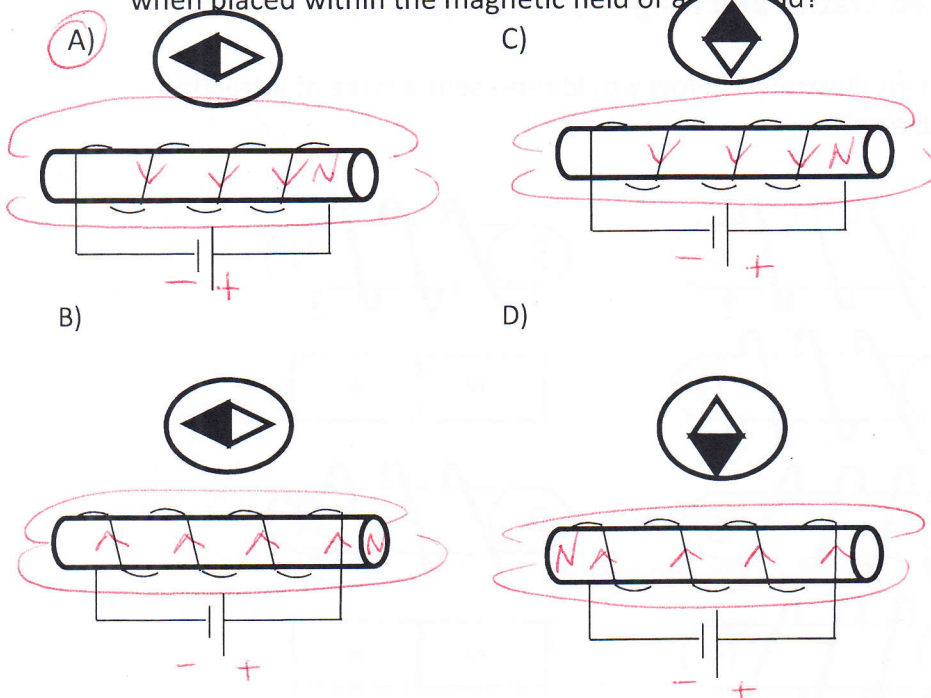
5. Andrea and Jonathan are studying solenoids in a laboratory. They use the setup shown below to compare the strength of different solenoids.

Solenoid

9V

Which of the following solenoids would attract the greatest number of paper clips when connected to a 9.0 V power supply?

Solenoid	Core	Number of turns	Current in amperes (A)	
A	Iron	200	1.2	240 A·turn
B	Iron	200	0.5	100
C	Copper	200	1.2	240
D	Copper	200	0.5	100

6. Four objects W, X, Y and Z were brought close together two at a time. One of these objects is magnetic, one is nonmagnetic and two are ferromagnetic. The results were as follows:

OBJECTS	RESULT	
ferro W and X	The objects attracted each other.	magn + ferro/~~ferro~~
X and Y	The objects attracted each other.	magn + ferro
ferro W and Y *ferro*	Nothing happened.	
magn X and Z *nonm*	Nothing happened.	

Which answer has correctly classified the objects?

	Magnet	Ferromagnet	Nonmagnet
A	W	X and Y	Z ✓
B	X	Y and Z	W
C	X	Z and W	Y
D	X ✓	W and Y ✓	Z ✓

7. What is the electrical force acting on two spheres if the charge of each is (5.00) x 10⁻⁴ C and they are placed (4.5 cm) apart? Answer must be in significant figures.

$F_e = ?$
$k = 9 \times 10^9 \ N \cdot m^2/c^2$
$q_1 = 5.00 \times 10^{-4} \ C$
$q_2 = 5.00 \times 10^{-4} \ C$
$r = 4.5 \ cm \rightarrow 0.045 \ m$

2 sig figs

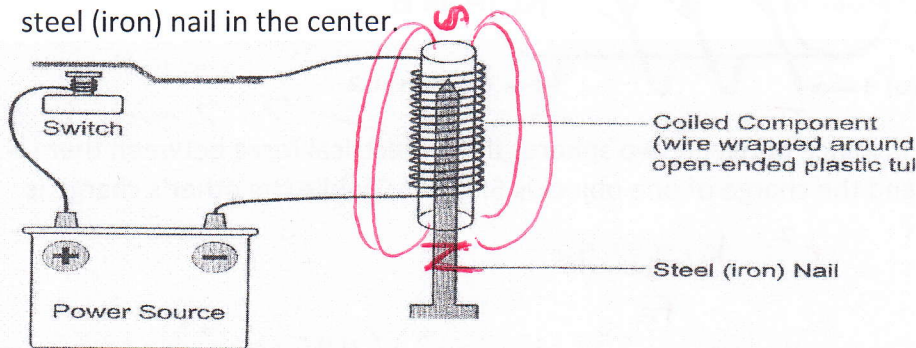$$F_e = k \cdot \frac{q_1 q_2}{r^2}$$

$$F_e = (9 \times 10^9) \frac{(5.00 \times 10^{-4})(5.00 \times 10^{-4})}{(0.045^2)}$$

$$F_e = 1111111.111 \rightarrow \boxed{1100000 \ or \ 1.1 \times 10^6 \ N}$$

8. As a part of your final; practical exam, you are asked to assemble a solenoid and insert a steel (iron) nail in the center.


Switch — Power Source — Coiled Component (wire wrapped around open-ended plastic tul — Steel (iron) Nail

a) Draw the shape of the magnetic field produced when the switch is closed.
b) Identify the poles of the magnetic field.
c) Suggest one way of increasing the strength of the magnetic field. ↑ current or ↑ # loops
d) Suggest one way of reversing the polarity of the magnetic field.

- switch ⊕/⊖ (attach wire in opp way)

- flip solenoid so the nail is at the top (that way, wire goes over rather than under)

9. The electrical force between two positively charged objects at rest is 54 N. Charged object A has a charge of 5.0×10^{-5} C and charged object B has a charge of 3.0×10^{-5}C.

Charged Objects
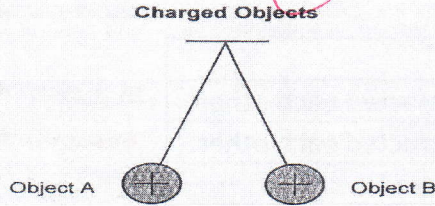
Object A ⊕   ⊕ Object B

What is the distance between the centers of charged object A and B?

$Fe = 54\,N$
$k = 9 \times 10^9\ N \cdot m^2/c^2$
$q_1 = 5.0 \times 10^{-5} C$
$q_2 = 3.0 \times 10^{-5} C$
$r = ?$

$$r^2 = \frac{k \cdot q_1 \cdot q_2}{Fe}$$

$$r^2 = \frac{(9 \times 10^9)(5.0 \times 10^{-5})(3.0 \times 10^{-5})}{(54)}$$
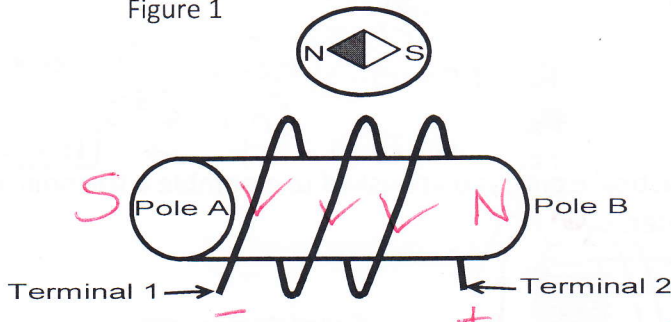
$$\sqrt{r^2} = \sqrt{0.25}$$

$\boxed{r = 0.5\,m}$

2 sig figs in answer

$\boxed{r = 0.50\,m}$

10. Refer to the illustration of the compass and electromagnet in Figure 1.
   a) Identify the positively charged terminal (+).
   b) Identify the poles as N and S.
   c) Identify the current direction.

Figure 1

N ◁ ▷ S

S (Pole A) ⋁ ⋁ ⋁ N (Pole B)

Terminal 1 →   —   + ← Terminal 2

11. What is the distance between two spheres if the electrical force between them is 6.50×10^6 N and the charge of one object is 6.0×10^{-3} C while the other's charge is 4.45×10^{-5} C.?

$Fe = 6.50 \times 10^6\ N$
$k = 9 \times 10^9\ N \cdot m^2/c^2$
$q_1 = 6.0 \times 10^{-3} C$
$q_2 = 4.45 \times 10^{-5} C$
$r = ?$

$$r^2 = \frac{k \cdot q_1 \cdot q_2}{Fe}$$

$$r^2 = \frac{(9 \times 10^9)(6.0 \times 10^{-3})(4.45 \times 10^{-5})}{(6.50 \times 10^6)}$$

$$\sqrt{r^2 = 0.000369692}$$

$r = 0.1922$

$\boxed{r = 0.19\,m}$

12. The charge of a sphere is 6.5×10^{-5}C. The electrical force of the 2 spheres is 9.00×10^3 N. The distance between the 2 spheres is 3.5 m. What is the charge of the other sphere?

2 sig figs

$Fe = 9.00 \times 10^3\ N$
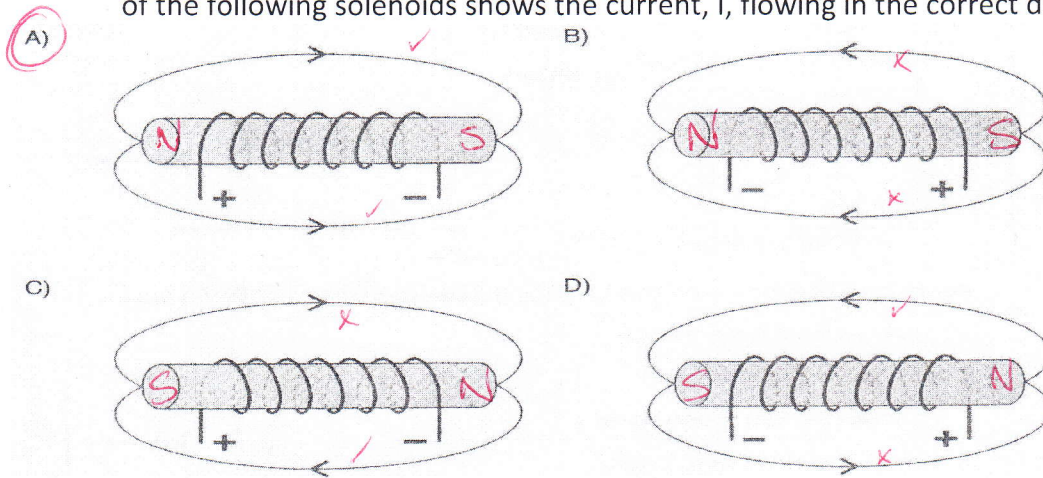$k = 9 \times 10^9\ N \cdot m^2/c^2$
$q_1 = 6.5 \times 10^{-5} C$
$q_2 = ?$
$r = 3.5\,m$

$$q_2 = \frac{r^2 \times Fe}{(k \times q_1)}$$

$$q_2 = \frac{(3.5^2)(9.00 \times 10^3)}{((9 \times 10^9)(6.5 \times 10^{-5}))}$$

$$q_2 = 0.18846 \rightarrow \boxed{0.19\,C}$$

13. When an electric current passes through a solenoid, a magnetic field is created. Which of the following solenoids shows the current, I, flowing in the correct direction?

A) ✓

B)

C)

D)

14. Hotel Ampere uses a key card entry system to secure their hotel rooms. A plastic card is inserted into a slot in the door handle assembly and a solenoid is activated to translate the lock bolt position.

Key-card Entry System
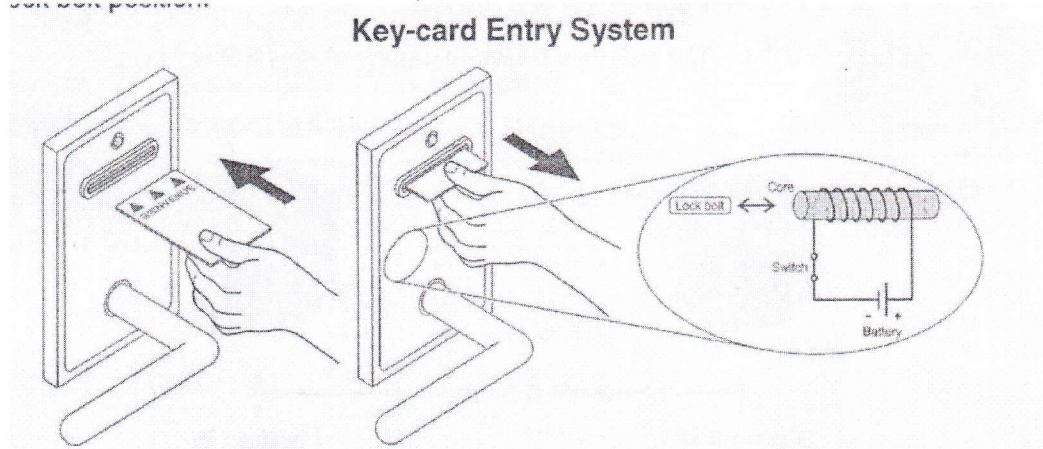
The magnetic field generated by the solenoid attracts the lock bolt when the switch is activated. This causes the lock bolt to move towards the solenoid. The hotel changed to heavier lock bolts in each key card system. As a result, the lock bolts have difficulty completing their translational motion. → *moving horizontally towards the solenoid*

a- On the diagram of the solenoid, draw the shape **and** the direction of magnetic field lines when the circuit is closed.

Core N S
Switch
Battery − +
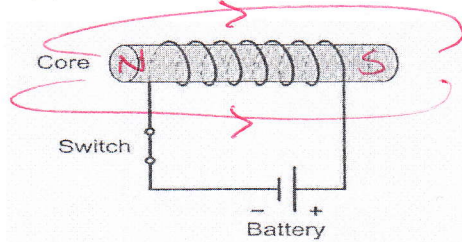
b- Describe two ways to improve the solenoid's function in the key card entry system to ease the movement of the lock bolt.

heavier lock bolts ∴ solenoid must be stronger

① ↑ I (make battery stronger)

② ↑ # loops in solenoid