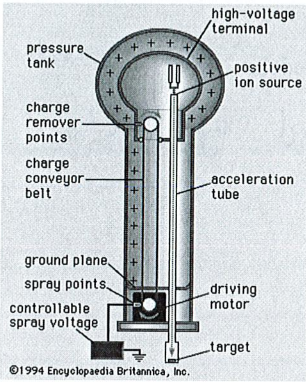
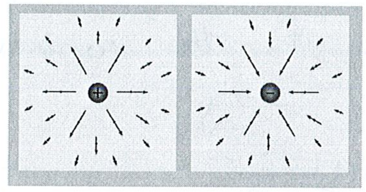
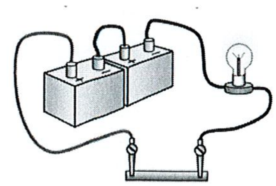


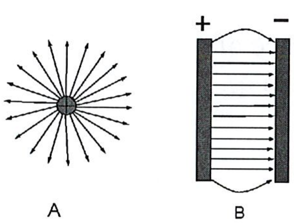




(resourcefulphysics.org)

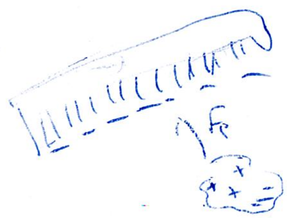
Forces & Fields
Review Assignment

Key!

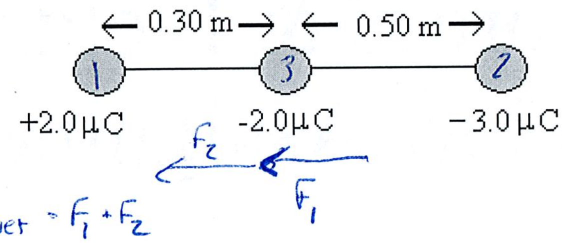


1. After combing your hair the comb will pick up small pieces of paper. Explain how the comb can pick up **neutral** pieces of paper.

Charge in the paper separates as the comb approaches of the comb was charged by friction



2. Three point charges are placed in a line as shown below. Calculate the magnitude of the net electric force on the centre charge due to the other two.



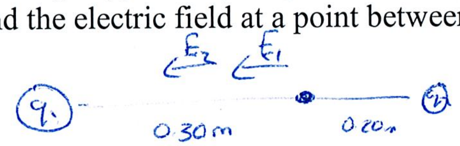
$F_{NET} = F_1 + F_2$

$= \frac{kq_1q_3}{r^2} + \frac{kq_2q_3}{r^2}$

$= 0.40\ N + 0.22\ N$

$= 0.62\ N$ Left

3. Two point charges (q_1= -8.0 μC, q_2 = +4.0 μC) are separated by a distance of 0.50m. Find the electric field at a point between the charges 0.20 m from q_2.

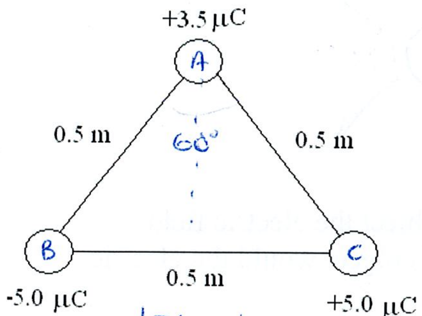


$\vec{E}_{NET} = E_1 + E_2$

$\frac{kq_1}{r^2} - \frac{kq_2}{r^2}$

$8.0 \times 10^5\ \frac{N}{C} + 9.0 \times 10^4\ N/C = 1.70 \times 10^5\ N/C$ Left

4. Three charges are located at the corners of an equilateral triangle as shown below. What is the net electric force acting on the top charge?



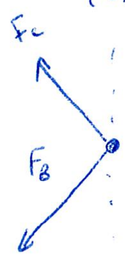
$F_{y_C} = -F_{y_B} \rightarrow 0\ N$

$F_x = \sin 30°(0.63\ N) = 0.315\ N$

$F_{x\,tot} = 2(0.315\ N) = 0.63\ N$

$|F_C| = |F_B| = \frac{kq_1q_2}{r^2}$

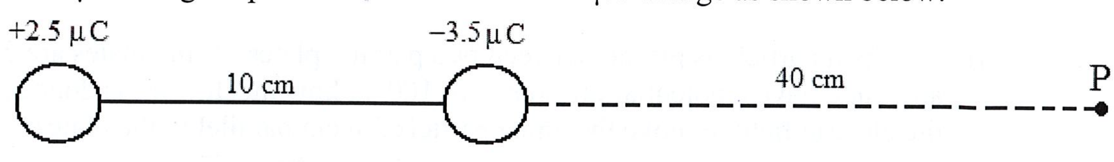
$= 0.63\ N$



5. Find the electric field 30 cm from a +2.5 μC object.

$|\vec{E}| = \frac{kq}{r^2} = 2.5 \times 10^5\ N/C$

6. A +2.5 μC charge is placed +10 cm from a -3.0 μC charge as shown below.



Determine:

a. The electric potential energy of the two charges

b. How much work must be done to the -3.5 μC charge to move it to point P?

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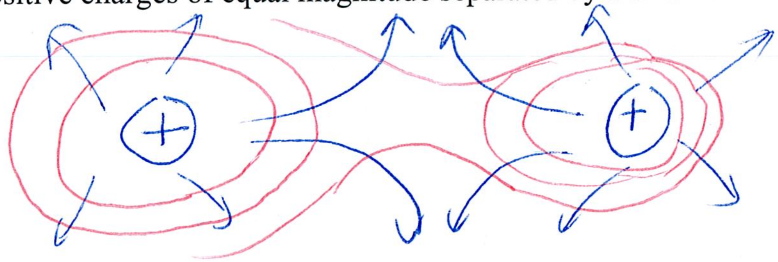
7. Sketch the electric field lines and equipotential surfaces in the region around two positive charges of equal magnitude separated by a small distance.



8. At a distance of 7.50×10^{-1} m from a small charged object the electric field strength is 2.10×10^4 N/C. At what distance from this object would the electric field strength be 1.00×10^3 N/C?

$$\vec{E}_1 = \frac{kq}{r^2} \qquad r = \sqrt{\frac{kq}{E}}$$

$$\frac{\vec{E} r^2}{k} = q \qquad r = \underline{3.45\ m}$$

$$q = 1.32\ \mu C$$

9. A proton is accelerated through a potential difference of 500 V. If it started from rest what is its final velocity?

$$\Delta V q = \frac{1}{2} m v^2$$

$$v = \sqrt{\frac{2Vq}{m}} \qquad v = 3.10 \times 10^5\ m/s.$$

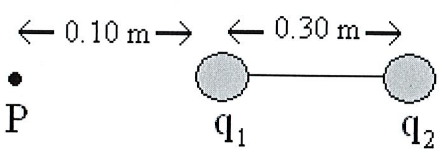
10. An alpha particle is placed between two parallel plates. If the plates are 7.0 cm apart and have a potential difference of 100 V, how much work is done against the electric field to move the alpha particle 5.0 cm parallel to the plates?

0 J

11. What is the electric field strength 2.5 cm from the positive charged plate if the parallel plates in a capacitor are 5.00 cm apart and the potential difference between the plates is 300 V?

$$\vec{E} = \frac{\Delta V}{\Delta d} = \frac{300\ \text{V}}{0.05\ \text{m}} = 6000\ \frac{\text{N}}{\text{C}}$$

12. Two charges are placed 0.30 m apart as shown below.



If the electric field at point P is zero and charge q_1 has a charge of -3.0×10^{-9} C what is the charge of q_2?

$$\vec{E}_1 = \vec{E}_2$$

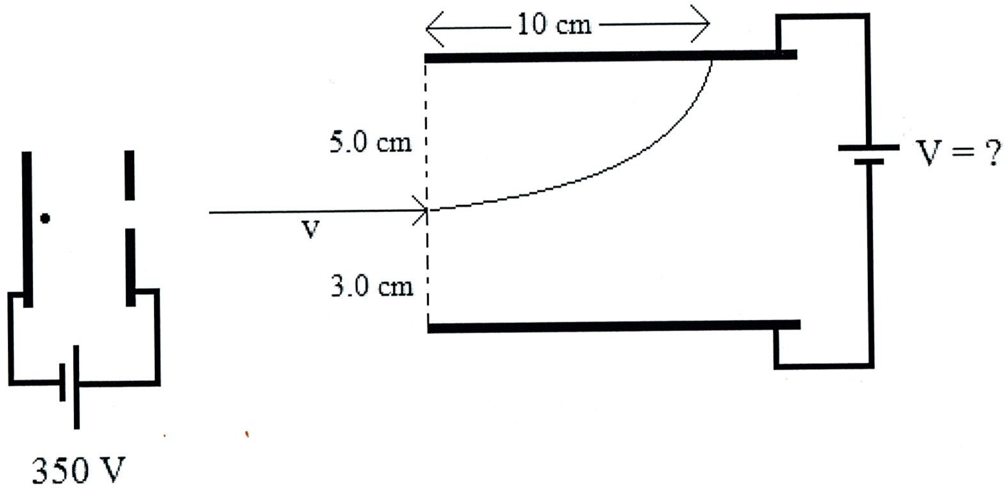
$$\frac{kq_1}{r_1^2} = \frac{kq_2}{r_2^2}$$

$$\frac{q_1 r_2^2}{r_1^2} = q_2$$

$$\frac{(3 \times 10^{-9})(0.40\text{m})^2}{(0.10\text{m})^2} = q_2$$

$$q_2 = 4.8 \times 10^{-8}\ \text{C}$$

13. An electron is accelerated from rest by a potential difference of 350 V as shown in the diagram below. It travels a horizontal distance of 10.0 cm before striking the top plate.



a. What is the shape of the trajectory of the electron while it is in the second set of parallel plates?

parabolic

b. Determine the potential difference between the second set of parallel plates.

$\Delta V q = \frac{1}{2} m v^2$

$v = \sqrt{\frac{2 \Delta V q}{m}}$

$v = 1.11 \times 10^7$ m/s

x	y
$v_x = 1.11\times10^7$	$v_i = 0$ m/s
$d = 0.10$	$d = 0.05$ m
$t = ?$	$a = ?$

$t = 9.01 \times 10^{-9}$ s

$a = \frac{2d}{t^2}$

$a = 1.23 \times 10^{17}$ m/s²

2.46×10^{15} m/s²

$F_e = |\vec{E}| q$

$\frac{ma}{q} = |\vec{E}|$

$|\vec{E}| = 14027 \frac{N}{C}$

$\Delta V = |\vec{E}| \cdot d$

$= 1122$ V

14. An electron travels at 5.5 x 10⁴ m/s through a 0.25 T magnetic field. Determine the magnetic force acting on this particle.

$F_m = qvB$

$= 2.2 \times 10^{-15}$ N

15. An alpha particle is accelerated through a potential difference before entering a 1.7 T magnetic field. In this field the alpha particle experiences a force of 3.30 x 10^{-18} N. Determine the potential difference needed.

$F_M = qvB$

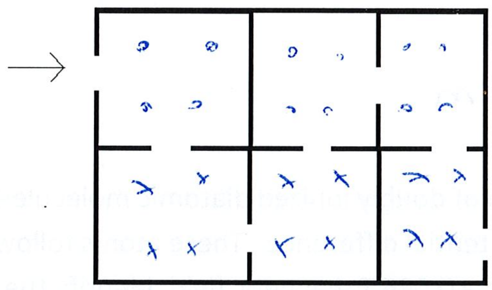
$v = \frac{F_M}{qB}$

$= 6.1$ m/s

$\Delta V = \frac{\frac{1}{2}mv^2}{q}$

$= 7.73 \times 10^{-7}$ V

16. Sketch the magnetic field inside the maze below that would allow a proton to traverse the maze without hitting the walls.



17. A proton travels from the sun with a speed of 7.0 x 10^5 m/s before entering the Earth's magnetic field. If the proton spirals around the field lines in circles with a radius of 75.0 m determine the magnetic field of the Earth at this location.

$F_c = F_M$

$\frac{mv^2}{r} = qvB$

$B = \frac{mv}{qr}$

$= 9.7 \times 10^{-5}$ T

18. A 3.5 x 10^{-18} C charged particle travels in a straight line at 8.0 x 10^6 m/s through mutually perpendicular magnetic and electric fields. Determine the ratio of the magnitude of the electric and magnetic fields.

$F_M = F_e$

$qvB = q|\vec{E}|$

$v = \frac{|\vec{E}|}{B}$

$= 8.0 \times 10^6$

19. An electron is accelerated through a potential difference of 2500 V. The electron then enters a 0.45 T magnetic field. Determine the magnitude of the acceleration the electron will experience while in the magnetic field.

$\Delta V q = \frac{1}{2}mv^2$

$v = \sqrt{\frac{2\Delta V q}{m}} = 2.96\times10^{7}$ m/s

$F_c = F_m$

$ma_c = qvB$

$a_c = 2.34\times10^{18}$ m/s^2

20. A wire with 6.5 A of current flowing through it experiences a force of 0.65 N when placed in a 7.11 x 10^{-2} T magnetic field. Determine the length of the wire.

$F_m = IBl$

$l = \frac{F_m}{IB} = 1.41$ m

21. The mass spectrometer uses a beam of doubly ionized diatomic molecules(X^{2+}) accelerated through a 2.4 x 10^3 V potential difference. These atoms follow a path with a radius of 0.33 m through a 0.086 T magnetic field. Identify the molecule.

$\Delta V q = \frac{1}{2}mv^2$

$2\Delta V q = mv^2$

$F_c = F_m$

$\frac{mv^2}{r} = qvB$

$mv^2 = qvBr$

$2\Delta V q = qvBr$

$v = \frac{2\Delta V}{Br}$

$v = 1.69\times10^{5}$ m/s

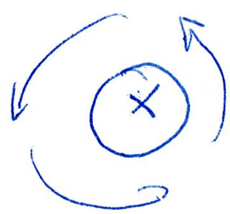
$m = \frac{qBr}{v}$

$= 5.37\times10^{-26}$ kg

≈ 32 protons + neutrons

S_2

22. A 4.0 A current runs through a wire. Draw a cross section diagram of the magnetic field around the wire.



23. A second wire runs parallel to the wire in question 16 and is placed 30 cm from it. The second wire is 30 cm long and carries a current of 2.5 A. Determine the magnetic force acting on the second wire.

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24. Consider the following students' statements about them magnetic force on a positively charged particle placed at rest near a permanent magnet.

Oakley: *A positively charged particle placed near the north pole on a permanent magnet will experience a repulsive force because the north pole acts like a positive charge.*

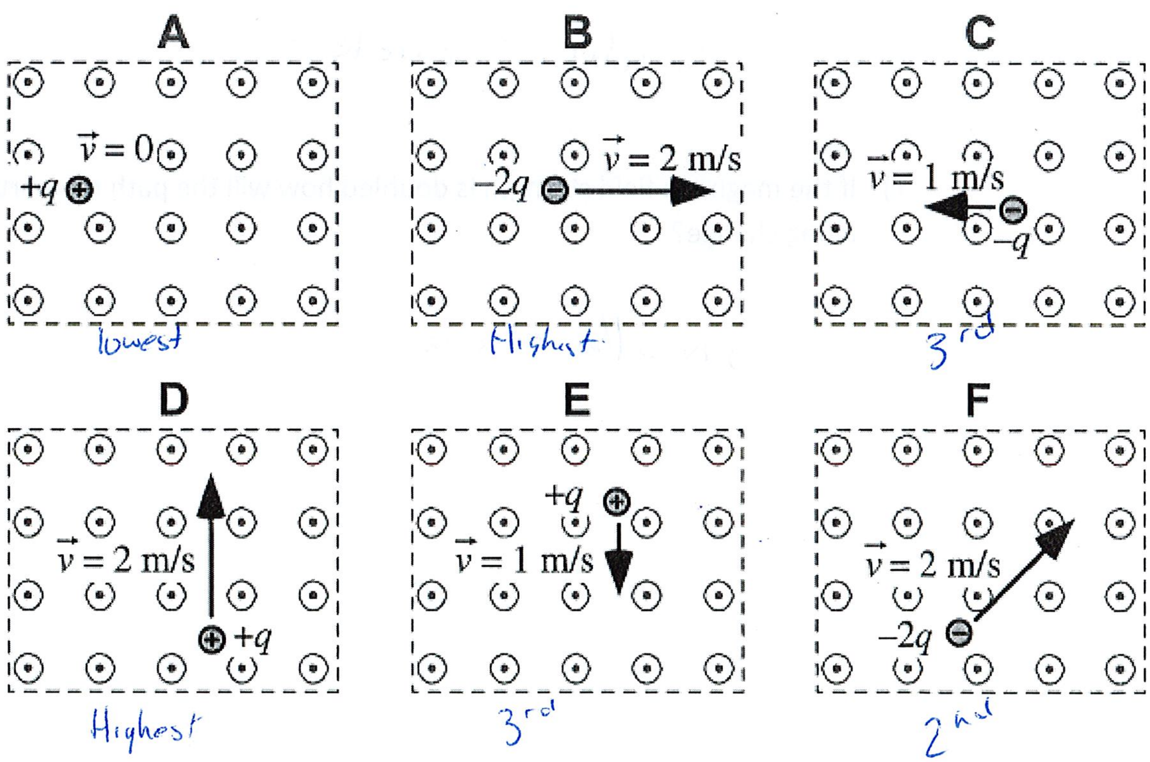
Vova: *I think it will experience an attractive force, but not because of the magnet.*

Nathan: *Since it is not moving, I think it won't experience any electromagnetic force.*

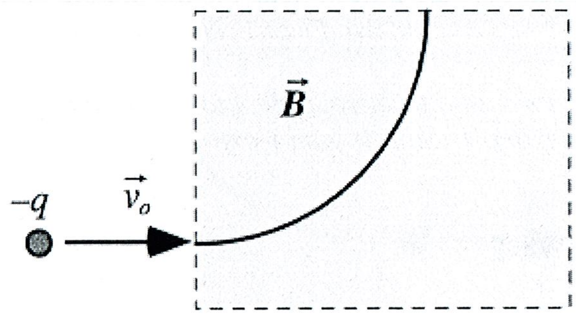
Who do you agree with? Why?

Nathan. Magnetic forces require moving charges.

25. Six diagrams show the motion of a charged particle through a magnetic field. Rank the strength of the magnetic force acting on each of the particles from highest to lowest.



26. A charged particle travels through a region containing a magnetic field as shown in the diagram below.



a) What is the direction of the magnetic field in the diagram?

out of page ⊗

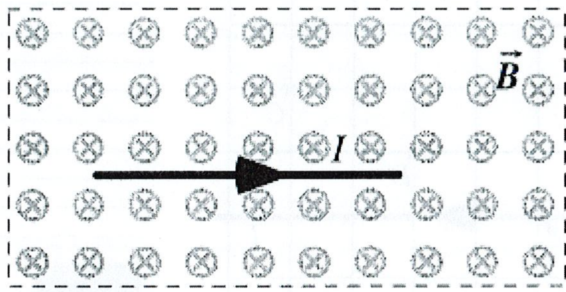
b) If the speed of the particle doubles how will the path it travels along change?

wider circle.

c) If the magnetic field strength is doubled how will the path the particle travels along change?

Smaller circle

27. A current carrying wire segment is in a uniform magnetic field directed into the paper. There are connecting wires running parallel to the magnetic field that are not shown.



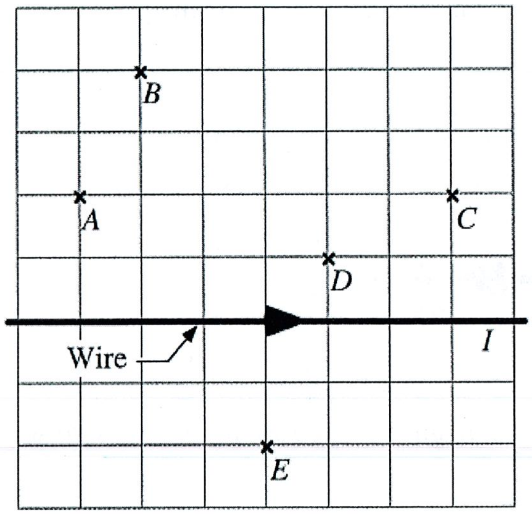
a. What is the direction of the magnetic force acting on the wire segment due to the magnetic field?

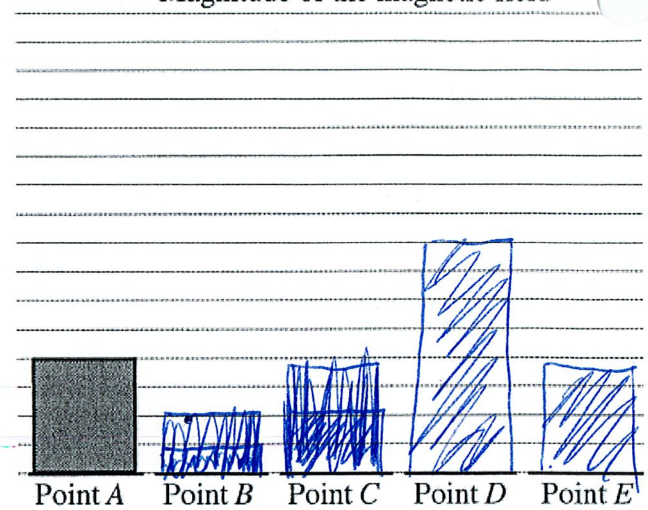
Towards bottom of page

b. If the wire segment in the magnetic field was doubled, what effect would that have on the magnitude of the magnetic force it experiences?

Double the force

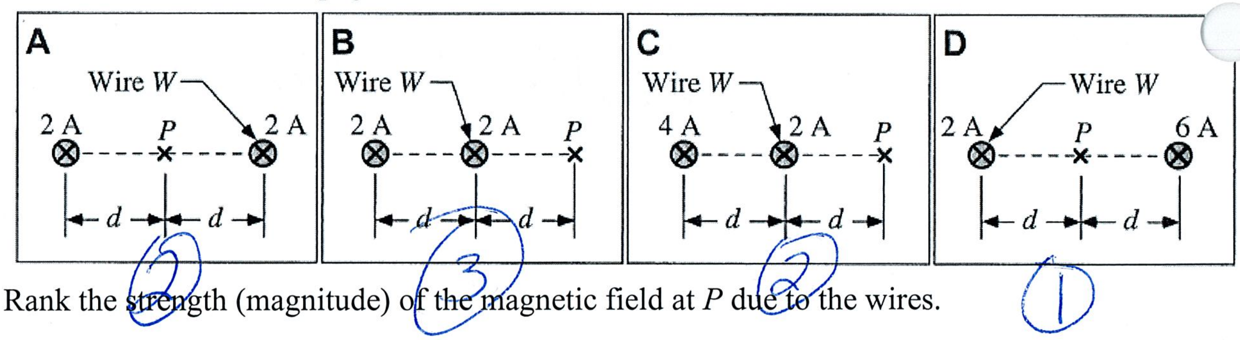
28. A long straight conducting wire has a current in the +x-direction.





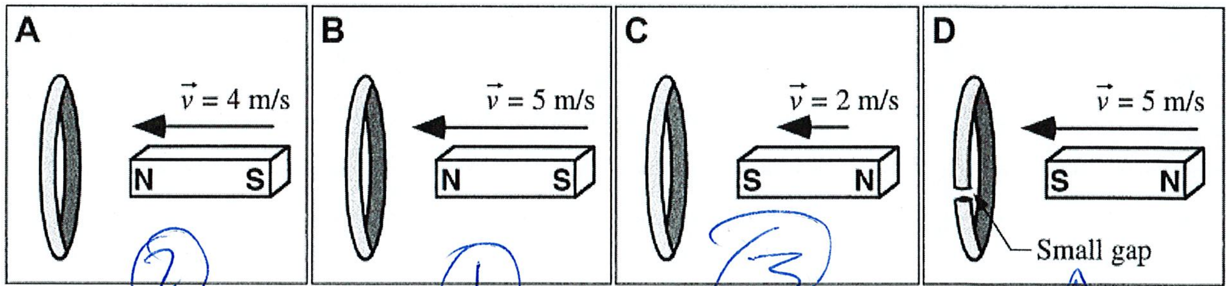
Show the magnitude of the magnetic field at the various points shown in the diagram on the bar chart to the right.

29. In these cases, long, straight wires that are perpendicular to the page are carrying electric currents into the page.



Rank the strength (magnitude) of the magnetic field at P due to the wires.

30. In each case, a permanent magnetic is moving toward a circular wire loop that is fixed in place. All of the wire loops are identical, but the wire in Case D has a small gap. The magnets are identical, but they are approaching the loops at different speeds and with different poles facing the loops. At the instant shown, all of the magnets are the same distance from the wire loops.



Rank the magnitude of the repulsive force on the loop by the approaching magnet at the instance shown.

zero