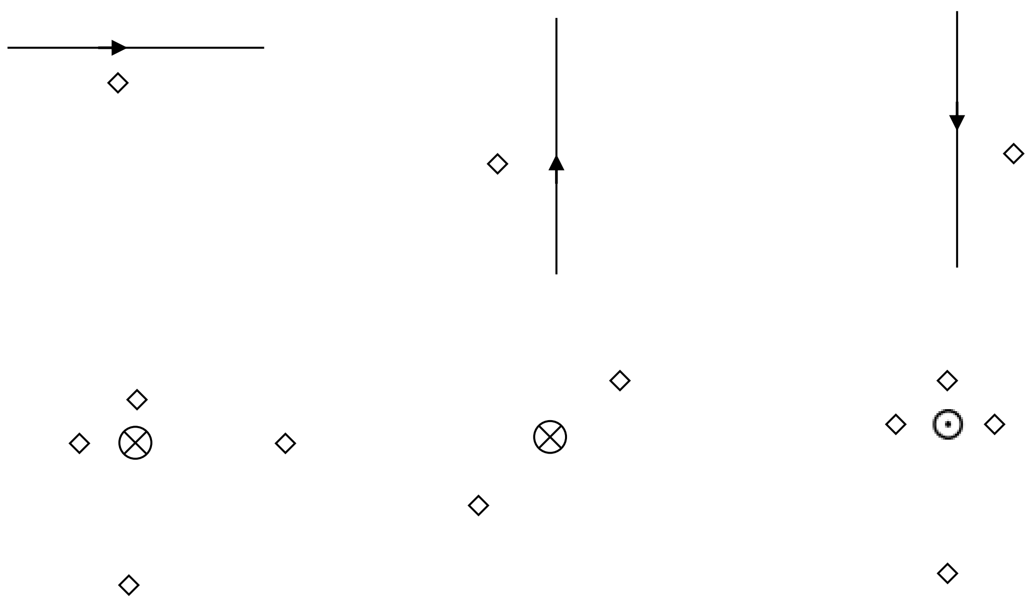
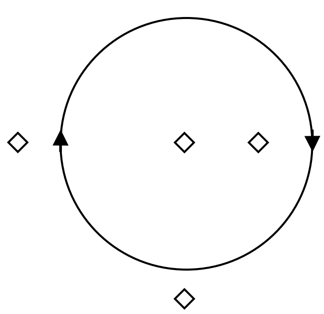
Problem of the week

Magnetic fields

(a) Six long straight wires carry the same current in the directions shown. Indicate the direction of the magnetic field at each of the 13 marked points.

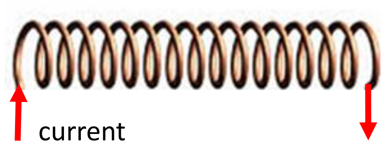


(b) A loop of wire carries current as shown. Indicate the direction of the magnetic field at each of the 4 marked points.

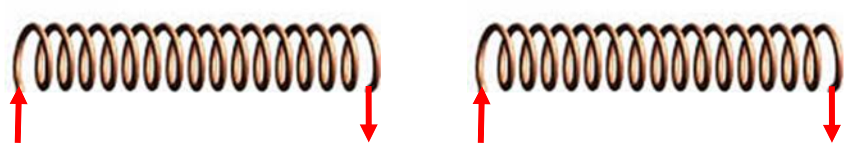


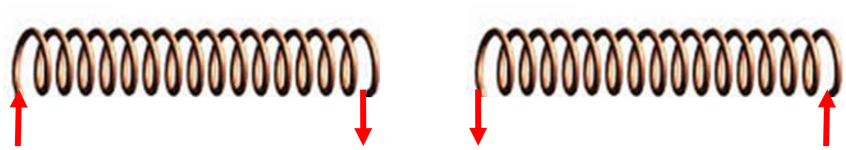
(c)

(i) Indicate the north and south poles of the coil below when current enters the coil in the direction shown.

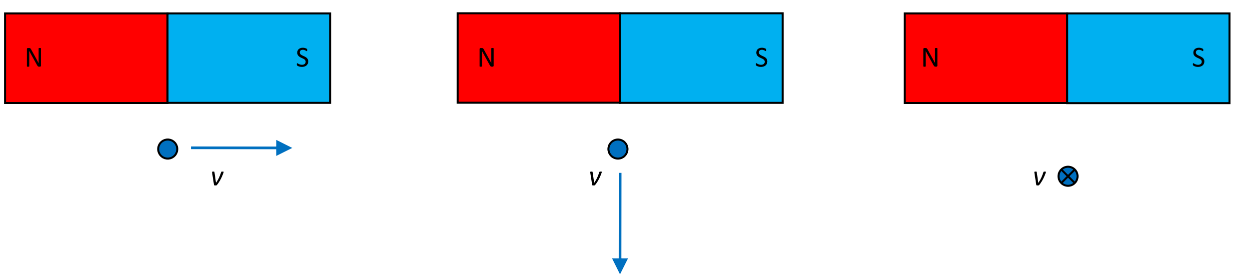


(ii) Show the magnetic forces between the two coils in each of the two cases below.

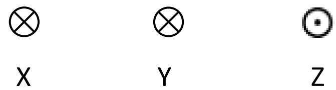


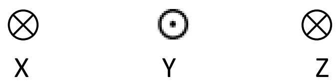


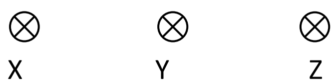
(d) A proton moves past a bar magnet. In each case state the direction of the magnetic force on the proton. (In the third diagram the velocity of the proton is into the plane of the page.)



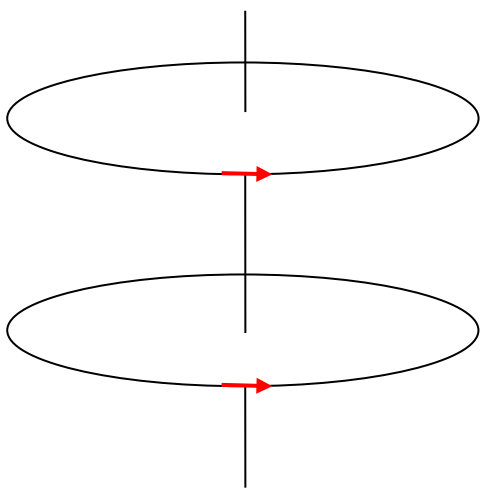
(e) The three wires carry equal currents in the directions shown. The wires are equidistant. X exerts a force *f* per unit length on Y. What is the resultant force per unit length on wire Z in each of the three cases below?







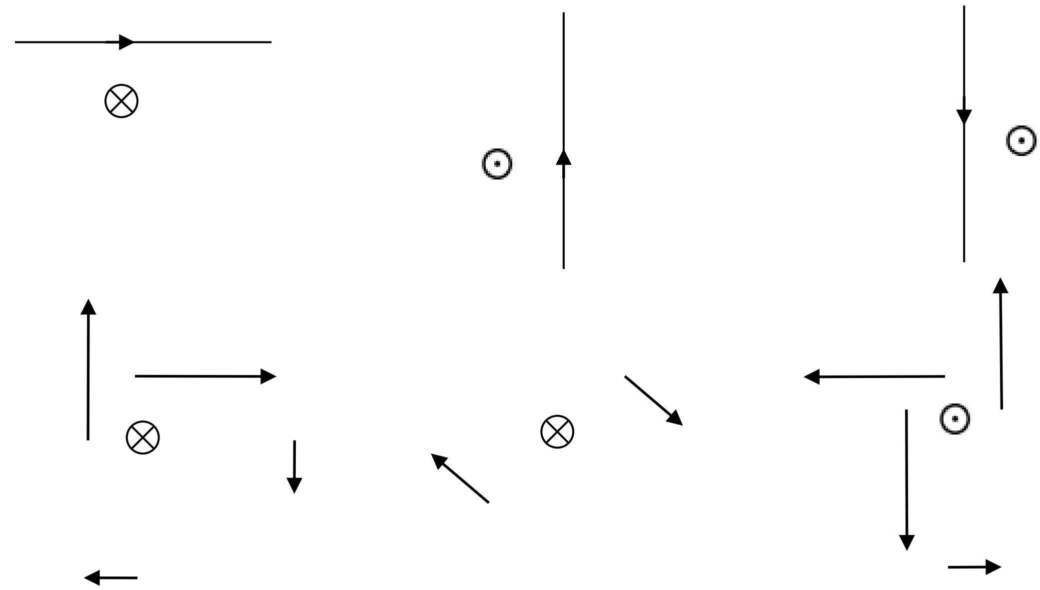
(f) Two identical loops carry counterclockwise current when looked at from above. The loops have a common axis.



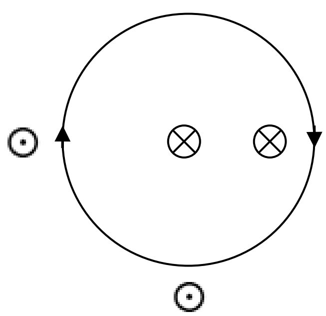
State the magnetic force direction on each loop.

Answers

(a)

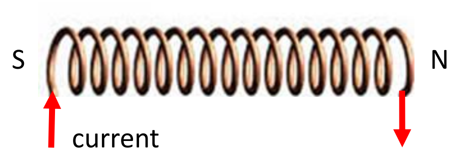


(b)

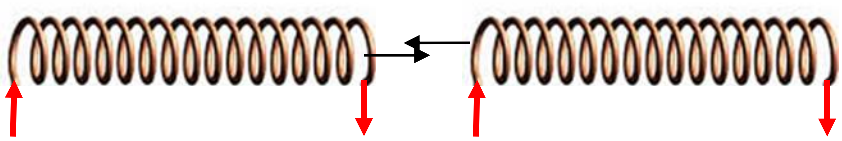


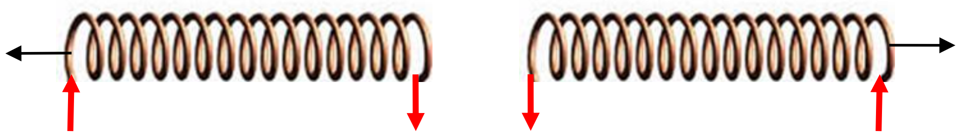
(c)

(i)

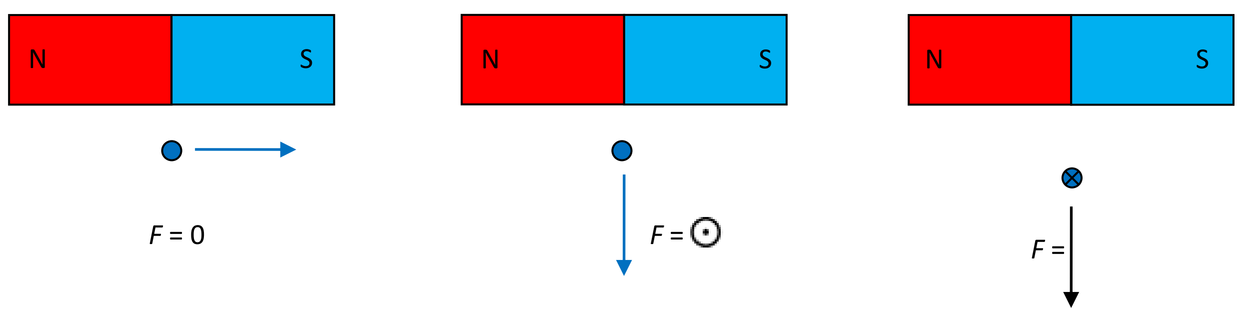


(ii)





(d)



(e) $\frac{3f}{2}$ to the right; $\frac{f}{2}$ to the right; $\frac{3f}{2}$ to the left.

(f) The forces are attractive. The loops behave as two bar magnets as shown (red = N).