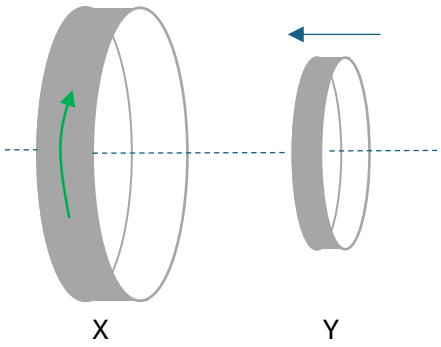
Teacher notes
Topic D

A basic problem in EM induction.

Two rings, X and Y, have a common axis as shown. A current is established in X. Looked at from the right the current is clockwise.

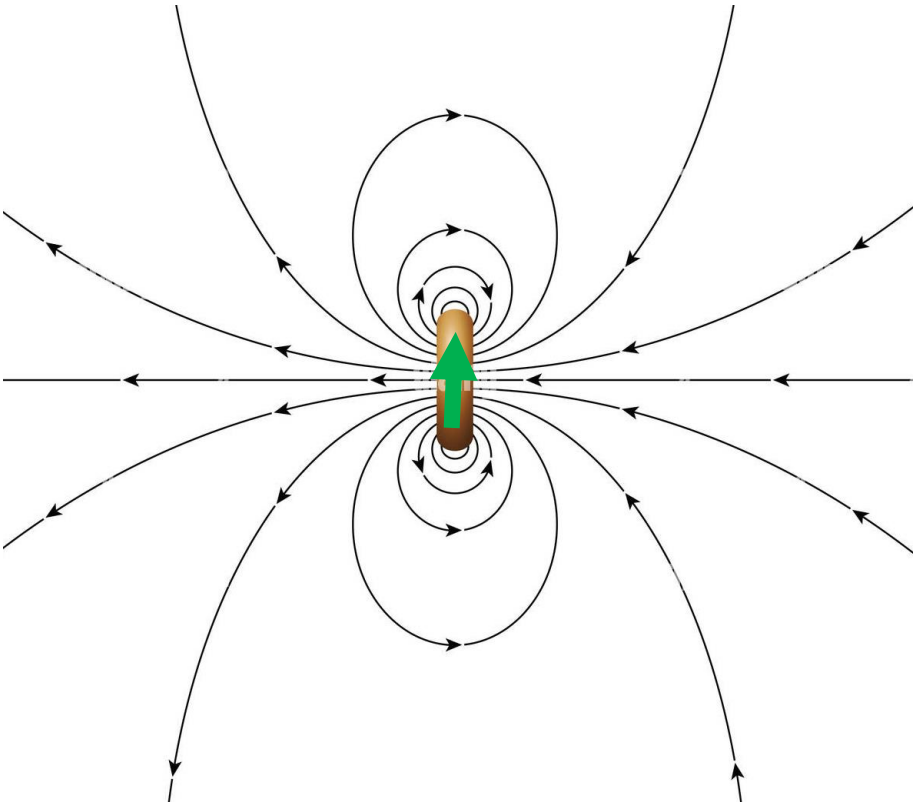
Y approaches X.



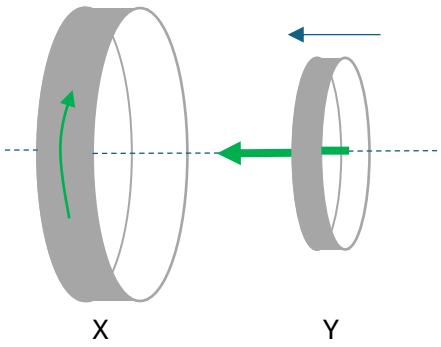
(a) Draw an arrow to show the direction of the magnetic field created by X at the center of Y.
(b) Explain why a current will be established in Y.
(c) Determine the direction of this current.
(d) Describe the force between X and Y as Y approaches.

Answers

(a) The magnetic field lines of a ring when there is a clockwise current (as viewed from the right) are shown below:

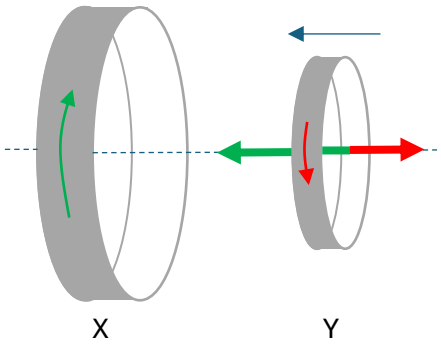


Hence:



(b) The magnetic flux in Y is increasing. By Faraday's law an emf will be induced in Y and so a current will be established.

(c) By Lenz's law, the induced current must oppose the change in flux. The change in flux is an increase and so the magnetic field created by the current in Y (red arrow) will be opposite to the external field created by X (green arrow).



The current in Y must then be counterclockwise (as viewed from the right).

(d) The currents in X and Y are antiparallel so they rings repel.
OR
By Lenz's law, the flux in Y must decrease, this will happen if it is made to go to the right, so the force is to the right.

The force gets stronger as Y gets nearer X because the magnetic field gets stronger.