NANYANG GIRLS' HIGH SCHOOL

2009 Sec 4 Physics Enrichment Worksheet (   )

Magnetism, Electromagnetism & EM Induction

Name: ______________________________ (   )

Class: 4/ ____   **Date: _________**

Objectives

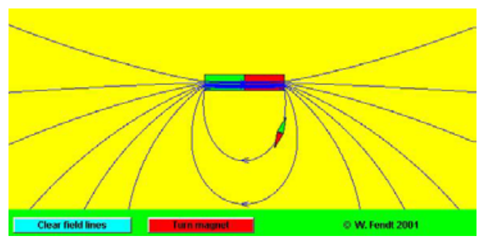
At the end of the lesson, you should be able to

- plot magnetic field lines of a bar magnet with a compass
- draw the pattern of the magnetic field due to currents in straight wires
- understand how a d.c. motor functions
- understand how an a.c. generator functions

Website

Access the Physics wiki at http://johnlittlephysics.pbworks.com/
→ Revise → select the relevant topic in each of the following exercises.

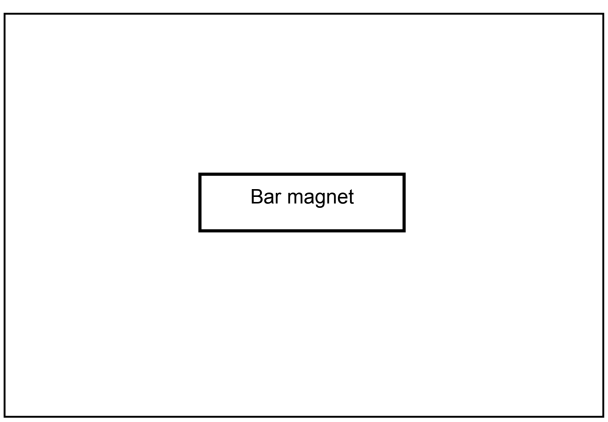
A. **19** **Magnetism, electromagnetism**
→ Magnetic field of a bar magnet simulation



- You may move and stop the compass at intervals to plot the magnetic field around the bar magnet.
- You may clear the field lines to start again or reverse the polarity of the magnet.

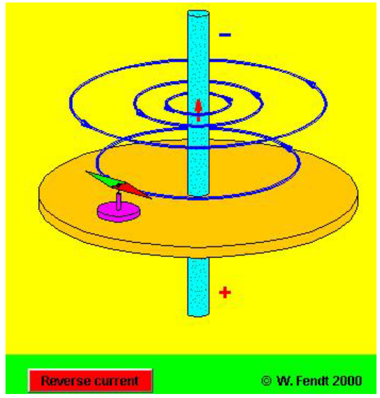
In the space within the box below, **sketch the magnetic field of a bar magnet** with its **North** pole on the **right**.

- Label the polarity of the magnet.
- Indicate the direction of the field lines with arrows.



B. 19 Magnetism, electromagnetism

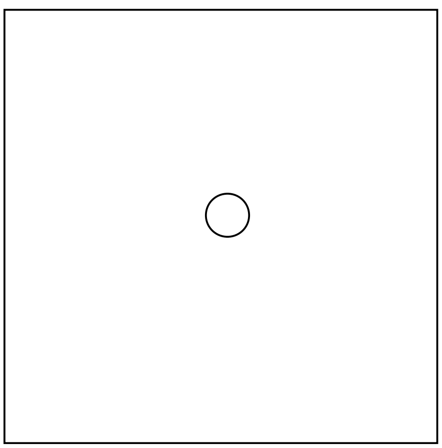
→ Magnetic field of a straight current-carrying wire simulation



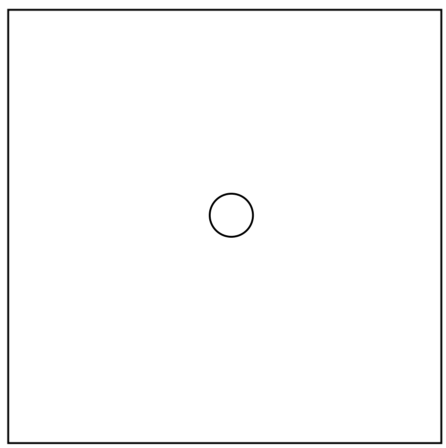
- You may move and stop the compass at intervals to plot the magnetic field around the wire.
- You may reverse the direction of the current.

In the space within each box below, **sketch the magnetic field around each current-carrying wire** (top view).

- Indicate the direction of the current in the central circle.
- Draw 3 concentric circles.
- Indicate the direction of the field lines with arrows



Current flowing **into** paper.



Current flowing **out of** paper.

Q1: Which pole of the compass points in the direction of a magnetic field line at any point?

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Q2: What is the **rule (of thumb)** we can use to remember the direction of the magnetic field around a current-carrying wire?

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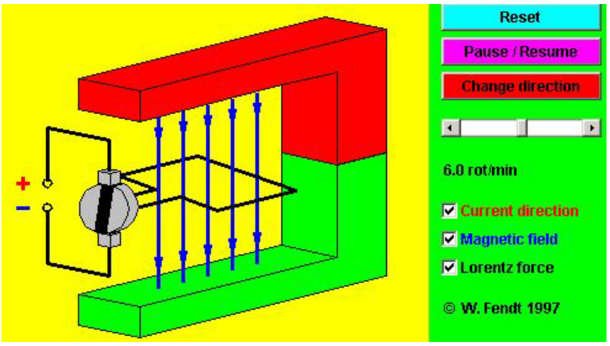
C. **20** **D.C. Motor**

→ d.c. motor simulation



- You may reset, pause/resume, vary the speed of rotation of the coil, change the direction of the current, show/hide the directions of the current, magnetic field and force on the coil.

Q1: What is direction of the magnetic field?

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Q2: When the **current** flowing on one side of the coil is **towards the right (inwards)**, what is the direction of the force on this side: to the left or right?
[Pause the simulation if necessary.]

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Q3: Which **rule** can help us to deduce the **direction of the force** when we have the directions of the **current** and the **magnetic field**?
Verify this rule by applying it for a particular "paused" position of the coil.

____

Q4: In the simulation, the split-ring commutator **changes colour** when the current **stops flowing** for an instant, when the commutator loses contact with the carbon brushes.

(a) At this instant, what is the orientation of the plane of the coil?

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(b) At this position in **(a)**, is the plane of the coil parallel or perpendicular to the magnetic field?

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Q5: By observing carefully the **current flow** on **one side** of the coil
- just before the current stops flowing and
- just after the current flows again,

describe the function of the commutator?

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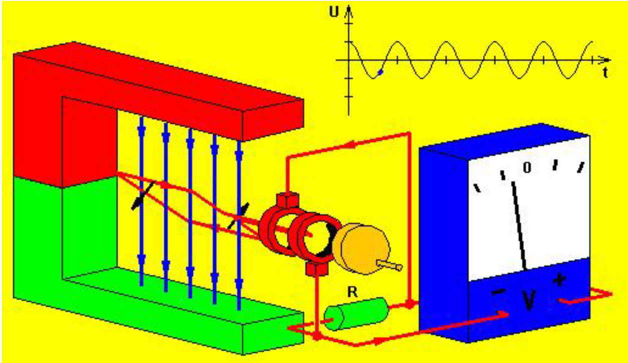
D. **21** **Electromagnetic Induction**

→ A.C. generator simulation



- You may pause/resume, vary the speed of rotation of the coil, show/hide the directions of the rotation (motion), magnetic field and induced current.

Q1: What is direction of the magnetic field?

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Q2: Which **rule** can help us to deduce the **direction of the induced current** when we have the **direction of motion (rotation)** and the **magnetic field**?
Verify this rule by applying it for a particular "paused" position of the coil.

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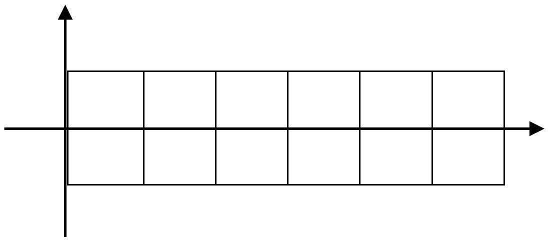
Q3: Sketch **voltage-time** graph to show the shape of the A.C. produced by this electric generator. Label the axes.



Q4: Observe the movement of the "dot" on the **voltage-time** graph. **Pause** the simulation when the "dot" goes to **zero** on the graph, i.e. voltage = 0 V.

(a) At this instant, what is the orientation of the plane of the coil?

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(b) At this position in **(a)**, is the plane of the coil parallel or perpendicular to the magnetic field?

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Q5: What is the function of the two slip rings?

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Q6: What happens to the voltage produced when the slip rings are replaced by the split-ring **commutator**? Observe the **voltage-time** graph.

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E. 21 Electromagnetic Induction
→ generator simulation – "Excellent"

- Click on "Run Now" to start the simulation.
- Check that "Generator" is selected on top.
- Turn on the tap to start the generator.

Q1: What is the purpose of the tap?

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Q2: In the a.c. generator in the previous exercise, the coil rotates within a fixed magnetic field. How does this generator differ from the earlier a.c. generator?

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Q3: **(a)** Besides the lamp, what other indicator is available in the simulation to indicate the magnitude of the induced current?

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(b) What other devices may also be used to indicate the magnitude of the induced current?

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Q4: List all the factors that may affect the magnitude of the induced current in this simulation.

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Q5: Describe all the energy changes shown in this simulation with the lamp.

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- Select and explore the other devices listed at the top (Bar Magnet, Pickup Coil, etc.)

Have nice day!