

# Electromagnetism

## Physics

### 3 “Rules”

1. The “**motor effect**”. This happens when an already moving charged particle enters a magnetic field. A charged particle moving not parallel to (ideally perpendicular to) a magnetic field experiences a force. The force is perpendicular to both the magnetic field and the velocity (this could be current in a wire) of the charged particle. The directions are determined by the “right hand rule” where the right hand thumb points in the direction of the velocity of the positively charged particle, the index finger points in the direction of the magnetic field and the other three fingers point in the direction of the force on the particle.

2. **Magnetic fields** near current carrying wires. The shape of the magnetic field is in concentric circles that are perpendicular to the wire – the field lines are in circles that are in the same plane as the cross section of the wire. The direction is determined by pointing the thumb of the right hand in the direction of conventional (positive) current, the other four fingers curl in the direction of the magnetic field.

3. The “**generator effect**”. This happens when a wire is being made to move through a magnetic field. In concept, when the wire crosses magnetic field lines a current tries to flow. A current (or EMF) is ONLY produced where the magnetic field is changing. A complete circuit is needed for the current to actually flow so instead of discussing the current flow which only happens in a complete circuit we discuss the electromotive force (EMF) that will be present even if a current is not. The maximum EMF (and current) will occur when the direction of the velocity of the wire is perpendicular to the direction of the field. No EMF (or current) will be produced if the velocity and the direction of the field are parallel to each other. When the velocity is perpendicular to the magnetic field the EMF will be produced that is perpendicular to both. The directions are determined by the “right hand rule” where the right hand thumb points in the direction of the velocity of the wire, the index finger points in the direction of the magnetic field and the other three fingers will point in the direction of the EMF (and current if there is a complete circuit).