Force Fields IB Physics Content Guide

Big Ideas

- Opposite charges/poles attract while like charges/poles repel
- The force between charged particles demonstrates the same relationship as the force between bodies with mass
- A force field describes the force at a location per unit mass, charge, or current
- A current flowing through a conductor produces a magnetic field
- The relative directions of current, magnetic field, and electromagnetic force can be found using the right-hand rules

Content Objectives

1 – Static Electricity

I can explain how objects can become charged			
I can qualitatively describe the reactions between charged particles			
I can describe the process of grounding a charged object			

2 – Electrostatic and Gravitational Force

I can use Coulomb's Law to relate electrostatic force to particle charge and separation distance			
I can use the Law of Gravitation to relate gravitation force to object mass and separation distance			
I can determine the units of Coulomb's Constant and the Gravitation Constant using unit analysis			
I can describe how the sign of the calculated electrostatic force indicates attraction or repulsion			
I can compare and contrast electrostatic and gravitation forces			
I can discuss the impact of permittivity on Coulomb's Constant			

3 – Force Fields

I can calculate force between objects with a net charge or mass			
I can draw the vector force field for electric and gravitational fields			
I can describe the role of a test charge or test mass in representing force fields			
I can describe how the magnitude of a force changes with distance from an object			
I can calculate field strength with proper units around a single object			
I can calculate the net field strength based on two or more objects			
I can determine the location where the net field strength is zero			

4 – Magnetism and Right Hand Rule

I can describe the pole conditions required for magnetic attraction and repulsion			
I can explain what happens when a dipole magnet is cut into pieces			
I can describe the role of magnetic domains in magnetizing and de-magnetizing a material			
I can draw in magnetic field lines around a magnet with a north and south pole			
I can describe the layout of the Earth's magnetic poles			
I can use the right-hand rule to draw in a magnetic field around a current carrying wire			
I can use the right-hand rule to predict the current direction through a wire with a surrounding field			
I can indicate a vector that is pointing into or out of the page			
I can describe some applications of electromagnets in use today			
I can describe the design factors that affect the strength of an electromagnet			

5 – Electromagnetic Force

I can use the right-hand rule to predict the force direction on a charge moving through a field			
I can use the right-hand rule to predict the force direction on a current carrying wire placed a field			
I can describe the general functions of electric motors and generators			
I can calculate the magnetic field strength and force on a wire or moving charged particle			
I can predict the trajectory of a charged particle moving through a magnetic field at different speeds			

Force Fields

Shelving Guide

Forces between objects

Coulomb's Law

	Variable Symbol	Unit
Electrostatic Force		
Object 1 Charge		
Object 2 Charge		
Separation Distance		
Coulomb Constant		
Permittivity of Free Space		

Data Booklet Equations:

$$F = k\frac{q_1 q_2}{r^2}$$

$$k = \frac{1}{4\pi\varepsilon_0}$$

k =
ε_0 =

Universal Law of Gravitation

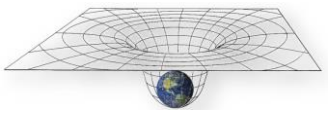
	Variable Symbol	Unit
Gravitational Force		
Object 1 Mass		
Object 2 Mass		
Separation Distance		
Gravitational Constant		

Data Booklet Equation:

$$F = G\frac{m_1 m_2}{r^2}$$

G =

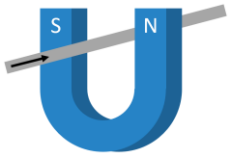
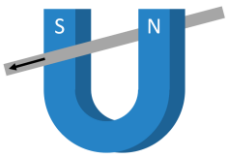
Force Fields

Electric Field			Gravitational Field		
					
Symbol		*Data Booklet Equation:* $E = \frac{F}{q}$	Symbol		*Data Booklet Equation:* $g = \frac{F}{m}$ $g = G\frac{M}{r^2}$
Units			Units		

Magnetic Fields

Right Hand Rule

Right Hand Rule #1			Right Hand Rule #2	
Magnetic field around a current carrying wire			Electromagnetic force direction on a wire or moving particle	
Thumb			Thumb	
Fingers			Fingers	
	 		Palm	
				

Electromagnetic Force

	Variable Symbol	Unit
Magnetic Force		
Magnetic Field Strength		
Current		
Wire Length		
Angle to Field		
Particle Charge		
Particle Velocity		

Data Booklet Equations:

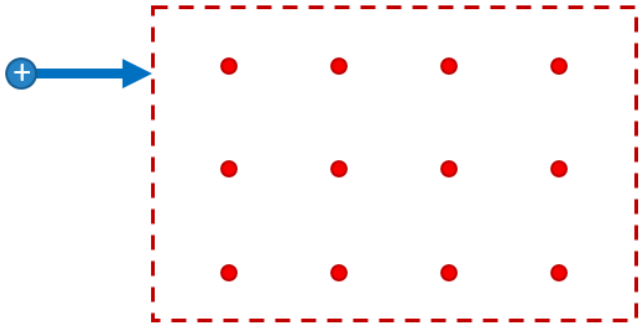
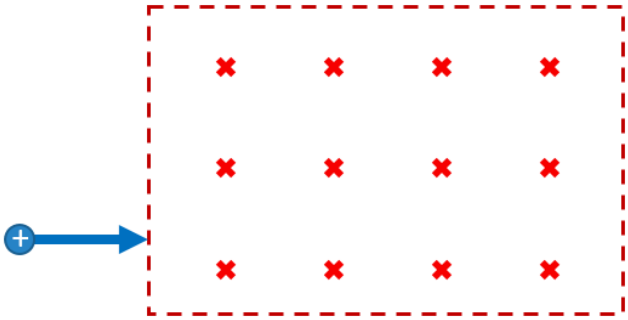
Wire:

$$F = BIL \sin\theta$$

Particle:

$$F = qvB \sin\theta$$

Charged Particles Moving through a Magnetic Field

	Magnetic Field | Out of Screen	Magnetic Field | Into Screen
Positive Particle		
Negative Particle