# Physics 2 Website Full Developer Content

This document contains introductions, key formulas, calculator logic, simulations, and quiz questions with answers for each chapter. It is designed to provide the IT developer with all necessary content for building the educational Physics 2 website.

## Chapter 23: Electric Fields

Introduction:  
Electric fields are created by electric charges and exert forces on other electric charges. The direction of the electric field is the direction a positive test charge would move. Electric field lines indicate the direction and strength of the field.

Key Formulas:  
- E = F / q  
- F = k \* q1 \* q2 / r^2  
- E = k \* q / r^2  
- E\_total = Σ E\_i

Calculator Implementation:  
Inputs: Charge (q), Distance (r)  
Formula: E = k \* q / r^2 (k = 8.99 x 10^9 N·m²/C²)

Simulation Instructions:  
1. Use HTML canvas or JavaScript library like p5.js.  
2. Place draggable positive/negative charges.  
3. Show field lines using animated arrows.  
4. Color-code directions (blue for +, red for -).

Quiz:  
1. What is the direction of the electric field due to a positive charge?  
 a) Toward the charge  
 b) Away from the charge ✅  
 c) Circular  
 d) None  
  
2. What is the SI unit of electric field?  
 a) Volt  
 b) Newton  
 c) N/C ✅  
 d) J/C  
  
3. Two like charges will:  
 a) Attract each other  
 b) Repel each other ✅  
 c) Stay in place  
 d) Convert energy  
  
4. If the charge increases, what happens to the field strength?  
 a) It decreases  
 b) It remains the same  
 c) It increases ✅  
 d) It becomes zero

## Chapter 24: Gauss’s Law

Introduction:  
Gauss’s Law provides a method to calculate electric fields using symmetry. It states that the total electric flux through a closed surface is equal to the charge enclosed divided by the permittivity of free space.

Key Formulas:  
- Φ = q / ε₀  
- Φ = ∮E·dA

Calculator Implementation:  
Inputs: Charge (q), ε₀ (default 8.85 x 10^-12)  
Formula: Φ = q / ε₀

Simulation Instructions:  
1. Use animated surface (sphere or cube) around point charge.  
2. Add field lines passing through surface.  
3. Show interactive control to change charge value and see flux lines update.

Quiz:  
1. Gauss’s Law relates electric flux to:  
 a) Electric field  
 b) Charge enclosed ✅  
 c) Volume  
 d) Current  
  
2. Electric flux through a closed surface with no charge inside is:  
 a) Maximum  
 b) Equal to charge  
 c) Zero ✅  
 d) Infinite  
  
3. Flux lines go outward if the charge is:  
 a) Negative  
 b) Positive ✅  
 c) Neutral  
 d) Mixed  
  
4. Electric flux units are:  
 a) N·m²/C ✅  
 b) C/m²  
 c) J/C  
 d) V/m

## Chapter 25: Electric Potential

Introduction:  
Electric potential is the energy per unit charge at a point in an electric field. It’s a scalar quantity, unlike electric field. Equipotential surfaces have the same potential at every point.

Key Formulas:  
- V = U / q  
- V = k \* q / r  
- ΔU = q \* ΔV  
- E = -dV / dx

Calculator Implementation:  
Inputs: Charge (q), Distance (r)  
Formula: V = k \* q / r

Simulation Instructions:  
1. Display charges and equipotential lines around them.  
2. Use color gradient to represent potential values.  
3. Allow dragging of test charge and show its potential value dynamically.

Quiz:  
1. The unit of electric potential is:  
 a) Newton  
 b) Joule  
 c) Volt ✅  
 d) Ampere  
  
2. A positive charge in an electric field will:  
 a) Lose potential energy ✅  
 b) Gain energy  
 c) Remain constant  
 d) Stop moving  
  
3. Electric potential is:  
 a) A vector  
 b) A scalar ✅  
 c) Imaginary  
 d) Not defined  
  
4. Equipotential lines are always:  
 a) Random  
 b) Parallel to field lines  
 c) Perpendicular to field lines ✅  
 d) None

## Chapter 26: Capacitance and Dielectrics

Introduction:  
Capacitance is the ability of a system to store charge per unit voltage. Dielectrics are materials placed between capacitor plates that increase capacitance by reducing the effective electric field.

Key Formulas:  
- C = Q / V  
- C = ε \* A / d  
- U = ½ C V²

Calculator Implementation:  
Inputs: ε, Area (A), Distance (d)  
Formula: C = ε \* A / d

Simulation Instructions:  
1. Visualize two plates with user-defined spacing.  
2. Slider for changing dielectric constant (κ).  
3. Show live updates of stored energy and capacitance as values change.

Quiz:  
1. A capacitor stores:  
 a) Current  
 b) Voltage  
 c) Charge ✅  
 d) Resistance  
  
2. Unit of capacitance:  
 a) Ampere  
 b) Farad ✅  
 c) Henry  
 d) Coulomb  
  
3. Capacitance increases when:  
 a) Distance increases  
 b) Dielectric is removed  
 c) Plate area increases ✅  
 d) Temperature rises  
  
4. Dielectrics:  
 a) Reduce capacitance  
 b) Increase resistance  
 c) Increase capacitance ✅  
 d) Decrease voltage