APPROACH 1: Domain-Specific Coloring

Strategy

Each physics domain redefines color assignments.
Guarantee: No equation has repeating colors.

Trade-off:

- \+ Every equation is visually distinct
- \+ Maximum clarity per equation
- – Same letter may have different colors across domains
- – No global "velocity is always cyan" consistency

CH1-3: Kinematics

Color Key

d = displacement v = velocity a = acceleration t = time g = constant

Definitions:

$$v = \frac{\Delta d}{\Delta t} \qquad a = \frac{\Delta v}{\Delta t}$$

Kinematic Equations:

$$v = v_0 + at$$

$$d = d_0 + v_0 t + \frac{1}{2} a t^2$$

$$v^2 = {v_0}^2 + 2a(d - d_0)$$

CH4-6: Dynamics & Circular Motion

Color Key

F = force m = mass a = acceleration μ = friction coeff

Newton's Laws:

$$F_{\text{net}} = ma \qquad W = mg \qquad F_f = \mu N$$

Circular Motion:

$$a_c = \frac{v^2}{r} = r\omega^2 \qquad F_c = m\frac{v^2}{r}$$

Color Key

p = momentum m = mass v = velocity F = force t = time

Definitions:

$$p = mv$$

Impulse-Momentum:

$$\Delta p = F_{\text{net}} \Delta t$$

Conservation:

$$m_1 v_1 + m_2 v_2 = m_1 v_1' + m_2 v_2'$$

Color Key

W = work KE = kinetic PE = potential P = power

Definitions:

$$W = Fd \qquad KE = \frac{1}{2}mv^2 \qquad P = \frac{W}{t}$$

Conservation:

$$KE_1 + PE_1 = KE_2 + PE_2$$

Color Key

Q = heat m = mass c = specific heat T = temperature

Heat Transfer:

$$Q = mc\Delta T$$

Phase Change:

$$Q = mL_f \qquad Q = mL_v$$

Density:

$$\rho = \frac{m}{V}$$

Color Key

U = internal energy Q = heat W = work P = pressure

First Law:

$$\Delta U = Q - W \qquad W = P\Delta V$$

Ideal Gas:

$$PV = NkT$$

Entropy & Efficiency:

$$\Delta S = \frac{Q}{T} \qquad \text{Eff} = \frac{W}{Q_h}$$

Color Key

v = wave speed f = frequency λ = wavelength T = period

Wave Equation:

$$v = f\lambda \qquad T = \frac{1}{f}$$

Intensity:

$$I = \frac{P}{A} \qquad \beta = 10 \log_{10}\left(\frac{I}{I_0}\right)$$

Standing Waves:

$$f_n = n\frac{v}{2L} \text{ (open)} \qquad f_n = n\frac{v}{4L} \text{ (closed)}$$

Color Key

F = force q = charge E = electric field V = potential

Coulomb's Law:

$$F = k\frac{q_1 q_2}{r^2} \qquad E = \frac{k|Q|}{r^2}$$

Potential:

$$V = \frac{kQ}{r} \qquad U_E = \frac{kQq}{r}$$

Capacitance:

$$C = \frac{Q}{V} \qquad U_E = \frac{1}{2}CV^2$$

Color Key

I = current V = voltage R = resistance P = power

Definitions:

$$I = \frac{\Delta Q}{\Delta t} \qquad V = IR$$

Power:

$$P = IV = I^2R = \frac{V^2}{R}$$

Combinations:

$$R_{\text{series}} = R_1 + R_2 + \cdots \qquad \frac{1}{R_{\text{parallel}}} = \frac{1}{R_1} + \frac{1}{R_2} + \cdots$$

Approach 1 Summary

Result: Zero Color Collisions

Every equation has unique colors for each variable.

Domain Color Assignments:

- Each chapter defines its own color key
- Same letter can have different colors across domains
- Example: V = voltage (CH19) vs V = volume (CH12)

Best for:

- Formula sheets organized by chapter
- Students studying one topic at a time
- Maximum visual distinction per equation

APPROACH 2: Semantic Global Coloring

Strategy

Colors assigned by physics MEANING across all domains.
Guarantee: Same concept = same color everywhere.

Trade-off:

- \+ Consistent mental model across all physics
- \+ "Cyan always means rate/flow"
- – Some equations may have related concepts with same color
- – Overloaded symbols get one canonical meaning

Semantic Color Categories

SPACE/POSITION
d, x, r, h, L, A, V, λ, s

FLOW/RATE
v, ω, I (current), f

INTENSITY
a, T, E (field), P (pressure)

COUNT/PROGRESS
t, N, n, q (charge)

FORCE/CAUSE
F, p (momentum), τ

TRANSFER
Q (heat), W (work), P (power)

STORED
U, KE, PE, S, C

CONSTANT/PROPERTY
g, k, c, μ, ρ, m, R

Note

Some symbols (P, E) are overloaded. Context determines category.

Definitions:

$$v = \frac{\Delta d}{\Delta t} \qquad a = \frac{\Delta v}{\Delta t}$$

Kinematic Equations:

$$v = v_0 + at$$

$$d = d_0 + v_0 t + \frac{1}{2} a t^2$$

$$v^2 = {v_0}^2 + 2a(d - d_0)$$

Semantic reading: Rate depends on intensity over time, changing position.

Newton's Laws:

$$F_{\text{net}} = ma \qquad W = mg \qquad F_f = \mu N$$

Circular Motion:

$$a_c = \frac{v^2}{r} = r\omega^2 \qquad F_c = m\frac{v^2}{r}$$

Semantic reading: Force causes intensity of change in objects with mass.

Definitions:

$$p = mv$$

Impulse-Momentum:

$$\Delta p = F_{\text{net}} \Delta t$$

Conservation:

$$m_1 v_1 + m_2 v_2 = m_1 v_1' + m_2 v_2'$$

Semantic reading: Momentum combines mass with flow/velocity.

Definitions:

$$W = Fd \qquad KE = \frac{1}{2}mv^2 \qquad P = \frac{W}{t}$$

Conservation:

$$KE_1 + PE_1 = KE_2 + PE_2$$

Semantic reading: Work transfers energy, KE/PE stores it. Power is transfer rate.

Note: Same Color

W and P are both red because both are energy transfer mechanisms.

Heat Transfer:

$$Q = mc\Delta T$$

Phase Change:

$$Q = mL_f \qquad Q = mL_v$$

Density:

$$\rho = \frac{m}{V}$$

Semantic reading: Heat transfers based on mass/properties and temperature intensity.

CH12: Thermodynamics

First Law:

$$\Delta U = Q - W \qquad W = P\Delta V$$

Ideal Gas:

$$PV = NkT$$

Entropy & Efficiency:

$$\Delta S = \frac{Q}{T} \qquad \text{Eff} = \frac{W}{Q_h}$$

Semantic reading: Stored energy U changes via Q and W transfers. Pressure is intensity.

CH13-14: Waves & Sound

Wave Equation:

$$v = f\lambda \qquad T = \frac{1}{f}$$

Intensity:

$$I = \frac{P}{A} \qquad \beta = 10 \log_{10}\left(\frac{I}{I_0}\right)$$

Standing Waves:

$$f_n = n\frac{v}{2L} \text{ (open)} \qquad f_n = n\frac{v}{4L} \text{ (closed)}$$

Note: T (period) is orange/count here, not temperature.

CH18: Electric Fields & Potential

Coulomb's Law:

$$F = k\frac{q_1 q_2}{r^2} \qquad E = \frac{k|Q|}{r^2}$$

Potential:

$$V = \frac{kQ}{r} \qquad U_E = \frac{kQq}{r}$$

Capacitance:

$$C = \frac{Q}{V} \qquad U_E = \frac{1}{2}CV^2$$

Semantic reading: Charges create fields, store potential energy.

Definitions:

$$I = \frac{\Delta Q}{\Delta t} \qquad V = IR$$

Power:

$$P = IV = I^2R = \frac{V^2}{R}$$

Combinations:

$$R_{\text{series}} = R_1 + R_2 + \cdots$$

Semantic reading: Current flows, voltage stores potential, power transfers energy.

Approach 2 Summary

Result: Consistent Meaning

Same color = same physics concept across ALL domains.

Cross-Domain Consistency:

- Cyan = flow/rate: velocity, current, frequency, angular velocity
- Blue = space: displacement, radius, wavelength, volume, area
- Vermillion = intensity: acceleration, temperature, pressure, field
- Red = transfer: heat Q, work W, power P

Best for:

- Building unified physics intuition
- Seeing connections across domains
- Long-term conceptual understanding